SOIL SURVEY

Madera Area California

OUR SOIL * OUR STRENGTH

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

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of the Madera Area will serve several groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields, aid ranchers in managing their grazing lands, and add to our fund of knowledge about soils.

In making this survey, soil scientists dug holes and examined surface soils and subsoils; measured slopes with a hand level; noticed differences in the growth of crops, grass, trees, and brush; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming and related uses.

The scientists plotted the boundaries of the soils on aerial photographs. Then, cartographers prepared from the photographs the detailed soil map in the back of this report. Fields, woods, roads, and many other landmarks can be seen on the map.

Locating the soils

Use the index to map sheets to locate areas on the large map. The index is a small map of the Area on which numbered rectangles have been drawn to show what part of the Area is represented on each sheet of the large map. On the large map, the boundaries of the soils are outlined, and each kind of soil is identified by a symbol. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map. Suppose, for example, an area located on the map has a symbol HaA. The legend for the detailed map shows that this symbol identifies Hanford fine sandy loam, 0 to 1 percent slopes. This soil and all the other soils in the Area are described in the section "Soil Series and Mapping Units."

Finding information

Particular parts of the report will be of special interest to particular groups of readers.

Farmers and those who work with farmers can identify the soils on a given farm on the soil map. They can learn about the soils in the section "Soil Series and Mapping Units" and about management and probable yields in the section "Use, Management, and Estimated Yields." The soils are grouped by capability units, which are groups of soils that need similar management and respond in about the same way. For example, the description of Hanford fine sandy loam, 0 to 1 percent slopes, shows it to be in capability unit I–1. The management this soil needs is described under the heading "Capability unit I–1" in the section "Use, Management, and Estimated Yields."

Soil scientists will find information about how the soils were formed and how they are classified in the section "Formation and Classification of Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers to the Area can get a general idea of the geography and agriculture by reading the sections "History and General Character of the Area" and "Agriculture."

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Fieldwork for this survey was completed in 1951. Unless otherwise indicated, all statements in the report refer to conditions in the Area at that time. This publication is a cooperative contribution from the Soil Conservation Service and the California Agricultural Experiment Station.

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SOIL SURVEY OF MADERA AREA, CALIFORNIA

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UNITED STATES DEPARTMENT OF AGRICULTURE AND THE CALIFORNIA AGRICULTURAL EXPERIMENT STATION

THE MADERA AREA consists of the western two-thirds of Madera County. The county is in the geographical center of California and occupies part of the eastern side of the San Joaquin Valley and the western slope of the Sierra Nevada (fig. 1). Madera County is bounded on the northwest by the Chowchilla River and Mariposa County; on the west, south, and southeast by the San Joaquin River; and on the east by Mono County. The boundary between Mono and Madera Counties is at the crest of the Sierra Nevada. Madera, the county seat and the largest city, is in the west-central part of the county. It is 140 miles east-southeast of San Francisco, 135 miles southeast of Sacramento, and 21 miles northwest of Fresno.

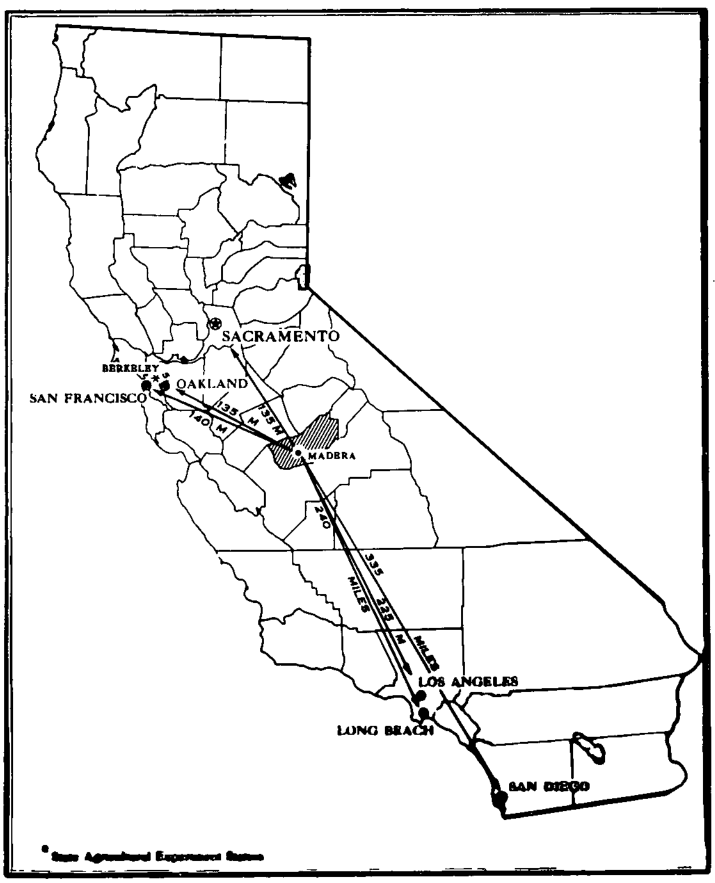

Figure 1.—**Location of Madera Area in California.**

The total area of the county is approximately 2,148 square miles (1,374,720 acres). Of this, 810 square miles is valley land, 540 square miles is foothill land, and 794 square miles is mountainous land. The valley was surveyed in detail, the foothills in semi-detail, and the mountains in reconnaissance. Only the valley and the foothills are shown on the maps in this report, and only the soils in those parts of the county are described in detail.

Soil Associations

The association of two or more soils in a repeating pattern makes it possible to generalize about the soils of an area and to emphasize one or more outstanding things. Thus, important problems may be highlighted, such as restricted drainage, excess salts or alkali, gravelly or stony materials, or shallowness over claypan, hardpan, or bedrock. Many of these problems are difficult for an individual to deal with, and they are frequently a basis for group action, such as the formation of an irrigation, drainage, or soil conservation district.

There are 14 soil associations in the Madera Area. The colored map at the back of this report, just ahead of the detailed soil map, shows the extent and distribution of each of these important patterns of soils. The Area naturally divides into four major parts. From west to east, and generally increasing in elevation, these four parts are (1) the recent alluvial fans and flood plains, (2) the basin area, (3) the older alluvial fans and terraces, and (4) the uplands. In the first of these parts there are three soil associations, in the second, four soil associations, in the third, two soil associations, and in the fourth, five soil associations. Each major part and each association is described in the following pages.

Soils of the Recent Alluvial Fans and Flood Plains

The recent alluvial fans and flood plains form the nearly level and very gently sloping areas along the drainageways. The elevation ranges from 110 to 400 feet.

The alluvial fans are cone-shaped and slope gently upward toward the uplands. The major fans are those of the Chowchilla and Fresno Rivers. Only the northern edge of the San Joaquin River fan is in the Madera Area.

Along most of its course, the flood plain of the San Joaquin River is narrow. Flooding is now well controlled by Friant Dam.

The three soil associations in this part of the Area are the following:

1. Pachappa-Grangeville, composed of slightly calcareous, nonsaline and nonalkali to slightly saline-alkali, well-drained, stratified, moderately coarse textured and medium textured soils.
2. Hanford-Tujunga, composed of noncalcareous, nonsaline and nonalkali, well drained and somewhat excessively drained, moderately coarse textured and coarse textured soils.
3. Columbia-Temple, composed of noncalcareous to strongly calcareous, nonsaline-alkali or slightly saline-alkali, imperfectly drained, moderately coarse textured to moderately fine textured soils.

1. Pachappa-Grangeville soil association

This association dominates the Chowchilla River fan in the northwestern part of the Madera Area. There is much variation in the soils within short distances because of stream deposition and stratification. Thin, recent deposits on top of older soil materials are common. As a result of widespread pump irrigation, the soils are now mostly well drained, but much of the acreage was imperfectly drained in the past.

Pachappa and Grangeville soils dominate the association, but Traver, Chino, Fresno, Hanford, and Tujunga soils are also important. The Pachappa soils are brownish sandy loams overlying slightly finer textured, moderately calcareous subsoils. They are slightly saline-alkali in many places. The Grangeville soils are grayish brown and are moderately coarse textured throughout. The subsoil and substratum contain slight amounts of lime and are somewhat mottled. Slight amounts of salts and alkali, mostly in the subsoil and substratum, are also common.

The Traver, Chino, and Fresno soils are between drainageways. For the most part, these soils contain more lime than the Pachappa and Grangeville soils, are more strongly saline-alkali, and are imperfectly drained. The Hanford and Tujunga soils along the drainageways are moderately coarse to coarse in texture, uniform throughout, noncalcareous, and nonsaline and nonalkali.

Shallow-rooted, lime-, salt-, and alkali-tolerant crops are best for these soils. Cotton, alfalfa, small grain, forage crops, and irrigated pasture are the best suited crops. Deep-rooted, normally long-lived crops and crops sensitive to lime, salts, and alkali are likely to be short-lived and uneven in appearance and are unlikely to produce satisfactory yields.

2. Hanford-Tujunga soil association

This association dominates the Fresno and San Joaquin River fans in the south-central part of the Madera Area. Relatively deep and uniform deposits of alluvium derived largely from granitic rocks characterize the area. Natural drainage is good to somewhat excessive. The water table is now well below its former level, as a result of pump irrigation.

On the Fresno River fan Hanford soils dominate, and winding, narrow stringers of coarse-textured Tujunga soils occupy the old stream channels. The San Joaquin River fan is similar, except that an unrelated substratum high in silt underlies the Hanford soils at moderate depths. Cottonwood Creek marks the approximate boundary between the Fresno River fan and the San Joaquin River fan and between the two major variations in the Hanford soils.

The Hanford soils are pale brown, noncalcareous, and moderately coarse textured. Typically, they are very deep, except where underlain by the unrelated silty substrata. The Tujunga soils are much like the Hanford soils in appearance, but they were derived from coarse-textured materials and are much lower in fertility, water-holding capacity, and organic matter. Typically, moisture moves very rapidly through the Tujunga soils.

The minor soils in this association include the Greenfield, Traver, Chino, Atwater, Grangeville, San Joaquin, and Madera soils. The Greenfield soils are the most important of the included soils. They are similar to the Hanford soils but occupy older and slightly higher terraces, chiefly along the Fresno River, and they have slightly more clay in the subsoil than in the surface soil.

The soils of this association are well suited to a wide range of crops, and they could be intensively used for many crops in addition to those now commonly grown. Deep-rooted, long-lived crops grow well, especially on the Fresno River fan. Somewhat more careful management is required on the San Joaquin River fan, because of the silty substratum. On the Fresno River fan, the most common crops are cotton, alfalfa, small grain, and pasture, and there are small acreages of fruit and nut crops. Grapes are the main crop on the San Joaquin River fan.

Most of the problems of managing the soils in this association result from the contrast in fertility and in water requirements between the Hanford and Tujunga soils.

3. Columbia-Temple soil association

This association occurs along the San Joaquin River flood plain on the western edge of Madera County. The natural drainage was imperfect to poor. Floods occurred almost every year until Friant Dam, further up the San Joaquin River, was built. Pine Flat Dam, on the Kings River in Fresno County, similarly controls floodwaters that enter the San Joaquin River from Fresno Slough at the southwestern corner of the county. Intensive pump irrigation has lowered the water table, and most of this association now has improved surface and subsurface drainage.

Columbia and Temple soils dominate; Foster and Chino soils are also important. The Columbia soils are pale brown, noncalcareous, and moderately coarse textured throughout. They show little change with increasing depth, except for variable mottling in the subsoil and substratum. Generally they are close to the river. The Temple soils are farther from the river, where the movement of water was slower and the finer textured sediments were deposited. The Temple soils are dark colored, mottled, and medium textured to moderately fine textured. They are strongly calcareous in the subsoil. In many places they are slightly saline.

Because of the generally imperfect drainage, the lime content, and excess salts and alkali, the best crops for the soils in this association are shallow-rooted, short-lived forage, pasture, row, and grain crops. Alfalfa, cotton, sugar beets, and small grains are the most common crops. Deep-rooted, long-lived crops, such as orchard crops, are not well suited. Temporary or perched water tables, caused by overirrigation or lateral movement of water from higher areas, present serious management problems. Problems caused by excess salts and alkali are also locally important.

Soils of the Basin Area

The basin includes the older alluvial deposits in the western part of the Madera Area. The relief is nearly level to very gently undulating, and the entire area slopes downward very gently from the east toward the west. The elevation ranges from 125 feet to about 165 feet.

This area was probably at the lower end of older alluvial fans, and it received the finer textured, water-transported sediments. Much water-soluble material in the form of lime and soluble salts was also deposited. Winding, shallow, intermittent streams are common, and the pattern of soils is closely related to them.

The four soil associations in this part of the Area are the following:

4. Fresno-El Peco-Pozo, composed of slightly to strongly calcareous, slightly to strongly saline-alkali soils that have a light-colored or dark-colored surface soil and are shallow to moderately deep over a lime-silica hardpan.
5. Fresno-El Peco, composed of slightly to strongly calcareous, slightly to strongly saline-alkali soils that have a light-colored surface soil and are shallow to moderately deep over a lime-silica hardpan.
6. Dinuba-El Peco, composed of slightly calcareous, nonsaline and nonalkali to strongly saline-alkali soils that have a light-colored surface soil, an unrelated silty substratum, and, in places, a thin lime-silica hardpan at a moderate depth.
7. Traver-Chino, composed of slightly to moderately calcareous, nonsaline and nonalkali to strongly saline-alkali soils that have a light-colored or dark-colored surface soil and a subsoil of slightly higher clay content.

4. Fresno-El Peco-Pozo soil association

This association occurs in the northwestern part of the Madera Area. It extends from just south of the Fresno River to the northwestern corner of the Area. It is generally south and west of the Chowchilla River alluvial fan, which is in the Pachappa-Grangeville association. Surface drainage is slow, and, because of the lime-silica hardpan in the subsoil, internal drainage is very slow. General drainage is imperfect, although the water table is now well below its former level because of widespread pump irrigation.

The distinctive characteristic of this association is the contrast between the dark-colored surface horizon of the Pozo soils and the light-colored surface horizon of the Fresno and El Peco soils. There are also differences in microrelief. The Pozo soils are generally in swales or low places along shallow watercourses, and the Fresno and El Peco soils are on slightly higher areas between waterways. The organic-matter content of the Pozo soils is high, but the Fresno and El Peco soils are low to very low in organic matter. Salts and alkali, especially in the surface soil, are less strong in the Pozo soils than in the Fresno and El Peco soils. The presence of a horizon of moderate clay content in the subsoil of the Fresno soils and in the El Peco soils is the principal difference between these two series.

Range has been the principal use of this association until recently, because of the excess salts and alkali and the hardpan. Flooding with surplus surface water diverted by levees increased forage production somewhat. Limited areas were reclaimed; most of these are where the salt and alkali concentrations are least strong. Reclaimed areas are used for irrigated pasture, forage, and grain crops. Until recently, reclamation was limited mainly to removing the excess salts and alkali from the surface soil and planting salt- and alkali-tolerant crops and pasture plants. Little effort was made to break the hardpan or to remove salts and alkali from the subsoil.

There have been two recent developments. The first has been to locate and improve the dark-colored Pozo soils. Improvement has been mostly a matter of leveling the surface to prepare for pump irrigation and planting cotton, forage crops, and pasture. Little if any effort has been made to remove salts and alkali. The second development has been the improvement of the Fresno and El Peco soils by leveling, deep chiseling, and the application of gypsum and other amendments to reduce the accumulation of salts and alkali, improve permeability, and disrupt the hardpan. After improvement, these soils are used mostly for irrigated pasture and forage crops.

5. Fresno-El Peco soil association

This association occurs in the southwestern part of the Area, south of the Fresno River. It is similar to association 4 except that no Pozo soils are present (fig. 2).

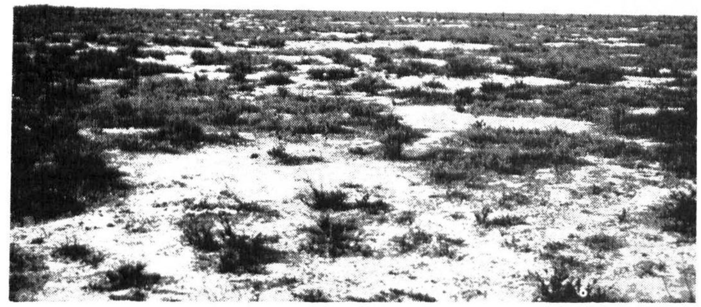

***Figure 2.*—Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes, in the Fresno-El Peco soil association.**

Range is the predominant use. The soils are being improved in the same way as the Fresno and El Peco soils in association 4.

6. Dinuba-El Peco soil association

This association occurs in the southwestern part of the Area. It is bordered on the northwest by the Fresno-

El Peco association, and the two associations have many similarities.

The distinctive feature of association 6 is the presence of unrelated silty sediments in the substratum of the Dinuba and El Peco soils. The principal difference between the two soils is that the upper part of this unrelated substratum is cemented with lime and silica in the El Peco soils but not in the Dinuba soils. The Dinuba soils have slightly more clay in the subsoil than in the surface soil, but the El Peco soils are relatively uniform down to the hardpan. The silty substratum or hardpan is usually at a moderate depth. Slight to moderate amounts of excess salts and alkali are present; local areas are strongly affected. Drainage is moderately good to imperfect; internal drainage is slow to very slow.

Irrigated row, forage, grain, and pasture crops are the common crops; grapes are also important on the nonsaline and nonalkali areas. Range is the principal use for the areas where the concentrations of salts and alkali are strong. Reclamation ordinarily requires the use of gypsum and other amendments, deep leaching, and in places deep chiseling to improve water penetration and to disrupt the hardpan.

7. Traver-Chino soil association

This association occurs in two large tracts, one east of the Fresno-El Peco and Dinuba-El Peco soil associations and the other along the San Joaquin River in the southwestern part of the Area. General drainage is good to imperfect. Pumping for irrigation has lowered the water table.

Traver and Chino soils are dominant, and some Dinuba, Fresno, and Wunjey soils are also included. The Traver soils are light colored and moderately coarse textured to medium textured. They have slightly more clay in the subsoil than in the surface soil. The Chino soils are similar but have a dark-colored surface soil, slightly more clay in the subsoil, and a moderately calcareous lower subsoil. Concentrations of salts and alkali vary from slight to strong; the Traver soils are generally the more strongly affected. Some parts of the association are free of excess salts and alkali.

Irrigated row, forage, pasture, and grain crops are commonly grown on the soils less strongly affected by salts and alkali. Strongly affected areas are mostly in range. Deep-rooted tree crops are poorly suited. Reclamation by periodic deep leaching and the application of gypsum and other amendments is usually feasible.

Soils of the Older Alluvial Fans and Terraces

The older alluvial fans and terraces include gently sloping to rolling and hilly areas that have not received fresh deposits of alluvium for a long time. They generally occupy benches or terraces and are rarely if ever flooded. Some areas are so strongly sloping that they are subject to stream cutting and erosion. The elevation ranges from 180 to about 500 feet.

Many changes have occurred in these older alluvial deposits and in the soils formed from them. The distinguishing differences among the soils depend on how stable the surface has been.

The two associations in this part of the Area are the following:

8. San Joaquin-Madera, composed of brownish to reddish-yellow soils that have a claypan subsoil over an indurated iron-silica hardpan.
9. Cometa-Whitney, composed of brownish to reddish-brown soils that have slight to large amounts of clay in the subsoil and lack an iron-silica hardpan.

8. San Joaquin-Madera soil association

This association occurs in the northern and south-central parts of the Area. It is most extensive on the old Chowchilla River fan, in the north, and dominates in much of the area between Chowchilla and Madera. The San Joaquin River fan, in the south, is somewhat less extensive.

The surface conforms to the slope of the old alluvial fan deposits from which the soils in this association were derived. The areas slope gently upward from west to east, and the relief is undulating or hogwallowed.

The San Joaquin and Madera soils differ mainly in color, reaction, and natural fertility. These differences are not marked, nor are they especially important, because the very slowly permeable claypan-hardpan subsoil, comparatively near the surface, is the striking characteristic of these soils and dominates in determining their use and management.

Except where irrigated, this association is used mainly for dryfarmed small grain or for range. Yields of dryfarmed crops are rather low, primarily because of low rainfall, restricted rooting depth, low fertility, and low water-holding capacity. Some of the lower tracts, mostly in the western part of the Area where the pumping lift is not excessive, have been leveled and are used mostly for irrigated pasture. If properly fertilized, irrigated, and seeded to suitable grasses and legumes, the pastures are productive. Disrupting the hardpan by the use of heavy equipment or by blasting has not been extensively attempted. More intensive use depends largely on obtaining additional water, and the pumping lift makes this a serious problem in much of this association.

9. Cometa-Whitney soil association

This association dominates in the central part of the older alluvial fans. In a general way it centers along the Fresno River. Relief is generally more pronounced than in association 8; slopes are stronger and more irregular, and more stream dissection has taken place (fig. 3).

On the gentler slopes, where soil development has more than kept pace with soil removal, the brown to reddish-brown Cometa soils, which have a claypan subsoil at a moderate depth, occur extensively. On the stronger slopes, where surface dissection has been active, are the brownish Whitney soils, which have only a slight accumulation of clay in the subsoil.

This association, like the San Joaquin-Madera, is used mainly for dryfarmed grain or for range. The Cometa soils are used and managed in much the same way as the San Joaquin and Madera soils; the claypan in the Cometa soils is about as restrictive as the claypan-hardpan combination in the San Joaquin and Madera soils.

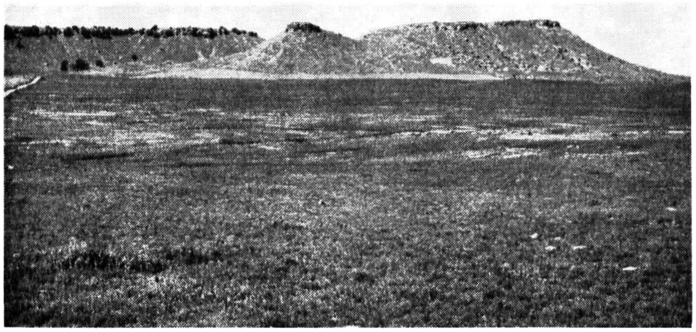

Figure 3.—East side of Little Table Mountain, in the Cometa-Whitney soil association. Remnants of Ione conglomerate cap exposed parts of the underlying Sierran granitic bedrock.

Figure 4.—Typical landscape in the Ahwahnee-Vista soil association.

The Whitney soils tend to be somewhat more productive of small grain, especially in years of favorable rainfall.

Little of this association is irrigated. Irrigation possibilities are limited by the strong, irregular slopes, the variable soil pattern, and the pumping lift.

Soils of the Uplands

The uplands comprise the gently sloping to steep foothills and low mountains of the Sierra Nevada. The elevation ranges from about 500 feet to 3,000 feet or more. Grasses and a few scattered oak trees dominate on the lower lying areas; as elevation and rainfall increase, the grass, tree, and brush cover becomes more abundant. Areas at elevations of more than 3,000 feet, on the eastern edge of the survey Area, are forested. Rainfall increases gradually, with increasing elevation, from about 15 inches to 35 inches.

Largely on the basis of kind of parent rock, amount of rainfall, elevation, and vegetation, the soils of the upland are grouped into the following five soil associations:

10. Daulton-Whiterock, composed of dark-colored to light-colored, shallow soils derived from slate and schist.
11. Ahwahnee-Vista, composed of brown to grayish-brown, moderately deep to deep soils derived from granite.
12. Ahwahnee-Auberry, composed of grayish-brown, deep soils derived from granite.
13. Coarsegold-Trabuco, composed of reddish-brown, moderately deep to deep soils derived from mica schist and basic igneous rocks.
14. Holland-Tollhouse, composed of reddish-brown to grayish-brown, shallow to deep soils derived from granite.

10. Daulton-Whiterock soil association

This association occurs in the lower foothills, mostly in the northern part of the Area near Daulton, but also in smaller tracts extending southeastward toward Friant Dam. Rainfall varies between 15 and 20 inches. The elevation ranges from 500 to 1,000 feet. The vegetation is largely annual grasses and herbs. Slopes range from gentle to steep. Outcrops of vertically tilted, metamorphosed bedrock are common; because of these outcrops, some areas are called tombstone land.

The Daulton and Whiterock soils differ from one another in color and reaction. The Daulton soils are dark grayish brown and slightly acid. The Whiterock soils are light brownish gray and medium to strongly acid. Natural fertility and water-holding capacity are low because the soils are shallow over bedrock.

Range is almost the only use made of this association. Possibilities for range improvement are limited.

11. Ahwahnee-Vista soil association

This association dominates on the lower foothills. It occupies a belt 10 to 15 miles wide extending from the northern border to the southern border of Madera County. Rainfall varies between 16 and 20 inches. The elevation ranges from 500 to 1,500 feet. The vegetation is chiefly annual grasses and herbs, scattered blue oaks and Digger pines, and patches of brush. Slopes range from gentle to steep. Outcrops of granitic bedrock are common (fig. 4).

The Ahwahnee and Vista soils differ from each other chiefly in color of the surface soil and in reaction. The Vista soils have a brown surface soil, and the Ahwahnee soils have a grayish-brown surface soil. In reaction, the Vista soils are neutral and the Ahwahnee soils are slightly acid. The organic-matter content of the Ahwahnee soils is slightly higher than that of the Vista soils, mostly because of the slightly more effective rainfall and denser vegetative cover.

Because of moderately coarse texture, a moderately deep to locally shallow root zone, moderate to low fertility and water-holding capacity, strong slopes, and outcrops of bedrock, the use of this association is limited largely to woodland range. Control of brush is important in range management. Self-reseeding annual legumes, fertilized with phosphorus and sulfur, will help to improve the range.

12. Ahwahnee-Auberry soil association

This association occupies the higher parts of the foothills, near Oakhurst in the northern part of the Area and along Fine Gold and Little Fine Gold Creeks in the east-central part of the Area. Rainfall varies between 20 and 30 inches. The elevation ranges from about 1,500 to 2,800 feet. The vegetation consists of oaks, Digger pines, and brush and an understory of annual grasses and herbs. A few yellow pines and incense-cedars grow at the higher elevations. Slopes range from gentle to steep. Outcrops of granitic bedrock are common.

The Ahwahnee and Auberry soils differ from each other chiefly in the clay content of the subsoil. Ahwahnee soils have only slightly more clay in the subsoil than in the surface soil; the Auberry soils have a moderate accumulation of clay in the subsoil.

Like the Ahwahnee-Vista association, this one is used mostly for range. Forage production is higher because of the higher average rainfall, but the management problems are similar. Brush encroachment, especially in the shallower and more rocky areas, is an important problem.

13. Coarsegold-Trabuco soil association

This association occurs in the same general part of the Area as the Ahwahnee-Auberry association. Rainfall varies between 20 and 35 inches. The elevation ranges from 1,500 to 3,500 feet. The vegetation consists of oaks, Digger pines, and brush and an understory of annual grasses and herbs. A few yellow pines occur at the higher elevations. Slopes range from gentle to very steep (fig. 5). Rock outcrops are common in places.

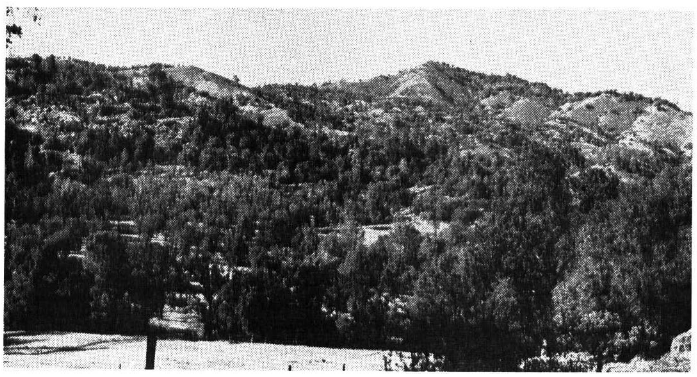

***Figure 5.*—Looking north from the Fresno River, in the Coarsegold-Trabuco soil association. Vista soils in foreground, Coarsegold soils on higher foothills.**

The Coarsegold and Trabuco soils differ chiefly in parent material and in clay content of the subsoil. The Coarsegold soils were derived from mica schist, and the Trabuco soils were derived from basic igneous rocks. The Coarsegold soils have a moderate accumulation of clay in the subsoil, and the Trabuco soils have a strong accumulation of subsoil clay. Because of the iron and other basic materials in the parent rocks, both soils are reddish, the Trabuco more so than the Coarsegold.

Like the other associations in the foothills—the Ahwahnee-Vista and Awahnee-Auberry—this one is used almost exclusively for range. The soils are fertile, and they produce some of the best forage in the foothills. Range management problems are similar to those described for the Ahwahnee-Auberry association.

14. Holland-Tollhouse soil association

This association occurs on the more strongly sloping, higher foothills and the low mountains near the eastern edge of the Area. Rainfall varies between 25 and 35 inches. The elevation ranges from 2,800 to 3,500 feet. The vegetation is variable; brush, oaks, and scattered Digger pines grow on the Tollhouse soils, and the same plants along with ponderosa pines, sugar pines, and incense-cedars on the Holland soils. On both soils the understory consists of annual grasses and herbs. Slopes range from hilly to very steep. Granitic outcrops are common, especially on the Tollhouse soils.

The Holland and Tollhouse soils differ mainly in color and depth. The Holland soils are deep and reddish brown; the Tollhouse soils are shallow and grayish brown. Slopes are typically hilly to steep on the Holland soils and very steep on the Tollhouse soils.

The lower lying areas of Holland soils are used for woodland range; they have a more open type of vegetation and considerable grass in the understory. Irrigated commercial apple and pear orchards are also possible, but few have been planted. The higher lying areas of Holland soils are suited to commercial production of timber; they are more densely wooded with conifers. The Tollhouse soils are shallow; they produce a limited amount of range forage and have little other use.

Soil Series and Mapping Units

This section provides detailed information about the soils. It describes each series recognized in the Area and each of the soils shown on the detailed soil map. The approximate acreage and proportionate extent of the soils are given in table 1. The names of the mapping units and the capability classification of each are listed in the Guide to Mapping Units, which is at the back of the report.

Ahwahnee and Auberry Series

The Ahwahnee series consists of well-drained upland soils derived from coarse-grained granitic rocks. These soils occur at elevations of about 1,000 to 2,800 feet in the foothills of the Sierra Nevada. The Auberry soils were derived from similar parent rocks and are generally at elevations of 2,250 to 2,800 feet. At elevations of 2,250 feet and more, Ahwahnee and Auberry soils are so closely associated that they are mapped together. At elevations of less than 2,250 feet, the Ahwahnee soils are associated with the Vista soils and are mapped with them as an undifferentiated association.

The Ahwahnee soils are deep. They have a grayish-brown surface horizon that is moderate in organic matter. There is only slightly more clay in the subsoil than in the surface soil.

The Auberry soils are similar to the Ahwahnee but have more clay in the subsoil and have a moderately distinct subsoil structure.

The Vista soils are similar to the Ahwahnee but have a brown surface horizon that is low in organic matter. They are also less acid and somewhat shallower to bedrock.

Because of increasing rainfall with increasing elevation, there are gradual changes in the soils, accompanied by increases in the amount of vegetative growth and of organic matter in the surface soil. The vegetation at the lower elevations consists of an open stand of oaks, an understory of annual grasses and herbs, and a scattering of shrubs and Digger pines. At the higher elevations, the soils are more densely wooded and there are

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

Symbol	Soil	Acreage	Percent
AaC	Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes	3, 674	0. 4
AaD	Ahwahnee and Auberry coarse sandy loams, 15 to 30 percent slopes	12, 869	1. 5
AbD	Ahwahnee and Auberry rocky coarse sandy loams, 8 to 30 percent slopes	17, 747	2. 0
AbE	Ahwahnee and Auberry rocky coarse sandy loams, 30 to 45 percent slopes	12, 977	1. 5
AbB	Ahwahnee and Auberry rocky coarse sandy loams, 3 to 8 percent slopes	4	[1]
AcD	Ahwahnee and Auberry very rocky coarse sandy loams, 15 to 30 percent slopes	1, 199	. 1
AcF	Ahwahnee and Auberry very rocky coarse sandy loams, 30 to 75 percent slopes	4, 010	. 5
AdC	Ahwahnee and Vista coarse sandy loams, 8 to 15 percent slopes	9, 030	1. 0
AdD	Ahwahnee and Vista coarse sandy loams, 15 to 30 percent slopes	29, 180	3. 3
AdB	Ahwahnee and Vista coarse sandy loams, 3 to 8 percent slopes	108	[1]
AeB	Ahwahnee and Vista rocky coarse sandy loams, 3 to 8 percent slopes	138	[1]
AeD	Ahwahnee and Vista rocky coarse sandy loams, 8 to 30 percent slopes	101, 864	11. 6
AeE	Ahwahnee and Vista rocky coarse sandy loams, 30 to 45 percent slopes	32, 523	3. 7
ArD	Ahwahnee and Vista very rocky coarse sandy loams, 15 to 30 percent slopes	7, 150	. 8
ArF	Ahwahnee and Vista very rocky coarse sandy loams, 30 to 75 percent slopes	12, 794	1. 5
AsA	Alamo clay, 0 to 1 percent slopes	1, 835	. 2
AtB	Atwater loamy sand, 3 to 8 percent slopes	2, 566	. 3
AtA	Atwater loamy sand, 0 to 3 percent slopes	3, 316	. 4
AwB	Atwater loamy sand, moderately deep and deep over hardpan, 3 to 8 percent slopes	1, 600	. 2
AwA	Atwater loamy sand, moderately deep and deep over hardpan, 0 to 3 percent slopes	4, 331	. 5
BeA	Bear Creek loam, 0 to 3 percent slopes	612	. 1
BfA	Borden fine sandy loam, 0 to 1 percent slopes	1, 216	. 1
BkA	Borden fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	1, 309	. 1
BmA	Borden loam, 0 to 1 percent slopes	287	[1]
BoA	Borden loam, slightly saline-alkali, 0 to 1 percent slopes	362	[1]
BzA	Buchenau loam, 0 to 3 percent slopes	261	[1]
BuA	Buchenau fine sandy loam, 0 to 3 percent slopes	112	[1]
BvA	Buchenau fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes	75	[1]
ByA	Buchenau fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes	22	[1]
CaA	Cajon loamy sand, 0 to 1 percent slopes	1, 906	. 2
CaaA	Cajon loamy sand, slightly saline-alkali, 0 to 1 percent slopes	3, 006	. 3
CabA	Cajon loamy sand, moderately saline-alkali, 0 to 1 percent slopes	205	[1]
CacA	Cajon loamy sand, strongly saline-alkali, 0 to 1 percent slopes	541	. 1
CbaB	Calhi loamy sand, slightly alkali, 0 to 8 percent slopes	1, 011	. 1
CbbB	Calhi loamy sand, moderately alkali, 0 to 8 percent slopes	1, 156	. 1
CcaA	Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 0 to 3 percent slopes	60	[1]
CcaB	Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 3 to 8 percent slopes	90	[1]
CcbA	Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 0 to 3 percent slopes	291	[1]
CcbB	Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 3 to 8 percent slopes	153	[1]
CccA	Calhi loamy sand, moderately deep and deep over silt, strongly saline-alkali, 0 to 3 percent slopes	149	[1]
CdaA	Calhi loamy sand, shallow over hardpan variant, moderately saline-alkali, 0 to 1 percent slopes	664	0. 1
CgA	Chino loam, 0 to 1 percent slopes	518	. 1
CgaA	Chino loam, slightly saline-alkali, 0 to 1 percent slopes	5, 069	. 6
CgbA	Chino loam, moderately saline-alkali, 0 to 1 percent slopes	571	. 1
CgcA	Chino loam, strongly saline-alkali, 0 to 1 percent slopes	49	[1]
CfA	Chino fine sandy loam, 0 to 1 percent slopes	410	[1]
CfaA	Chino fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	5, 580	. 6
CfbA	Chino fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes	56	[1]
CeA	Chino clay loam, 0 to 1 percent slopes	298	[1]
CeaA	Chino clay loam, slightly saline-alkali, 0 to 1 percent slopes	2, 313	. 3
CebA	Chino clay loam, moderately saline-alkali, 0 to 1 percent slopes	380	[1]
ChD	Coarsegold loam, 8 to 30 percent slopes	3, 842	. 4
ChF	Coarsegold loam, 45 to 75 percent slopes	29, 381	3. 4
CkD	Coarsegold rocky loam, 15 to 30 percent slopes	1, 425	. 2
CkF	Coarsegold rocky loam, 30 to 75 percent slopes	2, 712	. 3
CmA	Columbia fine sandy loam, 0 to 1 percent slopes	1, 018	. 1
CmtA	Columbia fine sandy loam, moderately deep and deep over Temple soils, 0 to 1 percent slopes	1, 287	. 1
CmdA	Columbia fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes	552	. 1
CrB	Columbia soils, channeled, 0 to 8 percent slopes	168	[1]
CoA	Columbia loamy sand, 0 to 1 percent slopes	205	[1]
CotA	Columbia loamy sand, over Temple soils, 0 to 1 percent slopes	205	[1]
CpA	Columbia sandy loam, 0 to 1 percent slopes	26	[1]
CpdA	Columbia sandy loam, moderately deep over sand, 0 to 1 percent slopes	78	[1]
CuB	Cometa sandy loams, 3 to 8 percent slopes	37, 414	4. 3
CuC	Cometa sandy loams, 8 to 15 percent slopes	6, 263	. 7
CuA	Cometa sandy loams, 0 to 3 percent slopes	489	. 1
CsB	Cometa gravelly sandy loam, 3 to 8 percent slopes	1, 746	. 2
CtB	Cometa loam, 3 to 8 percent slopes	944	. 1
CwB	Cometa-Whitney sandy loams, 3 to 8 percent slopes	1, 988	. 2
CwC	Cometa-Whitney sandy loams, 8 to 15 percent slopes	1, 182	. 1
CyA	Corning gravelly loam, 0 to 3 percent slopes	142	[1]

[1] Less than 0.1 percent.

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

Symbol	Soil	Acreage	Percent	Symbol	Soil	Acreage	Percent
CyB	Corning gravelly loam, 3 to 8 percent slopes	224	(1)	FgaA	Fresno, El Peco, and Chino soils, slightly saline-alkali, 0 to 1 percent slopes	2, 600	0. 3
DbD	Daulton loam, 8 to 30 percent slopes	11, 287	1. 3	FgbA	Fresno, El Peco, and Chino soils, moderately saline-alkali, 0 to 1 percent slopes	377	(1)
DaD	Daulton fine sandy loam, 8 to 30 percent slopes	12, 872	1. 5	FhbA	Fresno, El Peco, and Lewis soils, moderately saline-alkali, 0 to 1 percent slopes	4, 879	. 6
DaB	Daulton fine sandy loam, 3 to 8 percent slopes	455	. 1	FhcA	Fresno, El Peco, and Lewis soils, strongly saline-alkali, 0 to 1 percent slopes	548	. 1
DaE	Daulton fine sandy loam, 30 to 45 percent slopes	1, 126	. 1	FkaA	Fresno, El Peco, and Pozo soils, slightly saline-alkali, 0 to 1 percent slopes	671	. 1
DcB	Daulton rocky fine sandy loam, 3 to 8 percent slopes	52	(1)	FkbA	Fresno, El Peco, and Pozo soils, moderately saline-alkali, 0 to 1 percent slopes	500	. 1
DcE	Daulton rocky fine sandy loam, 30 to 45 percent slopes	4, 521	. 5	GaA	Grangeville fine sandy loam, 0 to 1 percent slopes	12, 522	1. 4
DeB	Delhi sand, 3 to 8 percent slopes	440	. 1	GbA	Grangeville fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	4, 517	. 5
DeA	Delhi sand, 0 to 3 percent slopes	690	. 1	GmA	Grangeville sandy loam, 0 to 1 percent slopes	1, 003	. 1
DfA	Delhi sand, moderately deep and deep over hardpan, 0 to 3 percent slopes	634	. 1	GnA	Grangeville sandy loam, slightly saline-alkali, 0 to 1 percent slopes	821	. 1
DpA	Dinuba-El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes	7, 400	. 8	GcA	Grangeville fine sandy loam, over Traver soils, 0 to 1 percent slopes	11, 459	1. 3
DsA	Dinuba-El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes	3, 495	. 4	GdA	Grangeville fine sandy loam, over Traver soils, slightly saline-alkali, 0 to 1 percent slopes	1, 917	. 2
DmA	Dinuba fine sandy loam, 0 to 1 percent slopes	1, 884	. 2	GeA	Grangeville fine sandy loam, moderately deep and deep over Temple soils, 0 to 1 percent slopes	526	. 1
DoA	Dinuba loam, 0 to 1 percent slopes	104	(1)	GfA	Grangeville fine sandy loam, deep over hardpan, 0 to 1 percent slopes	877	. 1
DtA	Dinuba-El Peco loams, slightly saline-alkali, 0 to 1 percent slopes	175	(1)	GhA	Grangeville fine sandy loam, deep over alkali hardpan, 0 to 1 percent slopes	1, 257	. 1
DuA	Dinuba-El Peco loams, moderately saline-alkali, 0 to 1 percent slopes	142	(1)	GkA	Grangeville fine sandy loam, deep over alkali hardpan, slightly saline-alkali, 0 to 1 percent slopes	552	. 1
EdA	El Peco-Dinuba fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes	7, 691	. 9	Gp	Gravel pits	168	(1)
FbA	Foster loams, 0 to 1 percent slopes	1, 876	. 2	GrA	Greenfield coarse sandy loam, 0 to 3 percent slopes	3, 510	. 4
FbaA	Foster loams, slightly saline-alkali, 0 to 1 percent slopes	351	(1)	GrB	Greenfield coarse sandy loam, 3 to 8 percent slopes	373	(1)
FbbA	Foster loams, moderately saline-alkali, 0 to 1 percent slopes	392	(1)	GuB	Greenfield sandy loam, 3 to 8 percent slopes	794	. 1
FbcA	Foster loams, strongly saline-alkali, 0 to 1 percent slopes	272	(1)	GuA	Greenfield sandy loam, 0 to 3 percent slopes	772	. 1
FbdA	Foster loams, sandy substratum, 0 to 1 percent slopes	19	(1)	GvA	Greenfield sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes	1, 156	. 1
FbeA	Foster loams, moderately deep and deep over Temple soils, 0 to 1 percent slopes	298	(1)	GvB	Greenfield sandy loam, moderately deep and deep over hardpan, 3 to 8 percent slopes	821	. 1
FcbA	Foster loams, moderately deep and deep over Temple soils, moderately saline-alkali, 0 to 1 percent slopes	34	(1)	GsA	Greenfield fine sandy loam, 0 to 3 percent slopes	3, 167	. 4
FaA	Foster clay loam, 0 to 1 percent slopes	343	(1)	GsB	Greenfield fine sandy loam, 3 to 8 percent slopes	15	(1)
FaaA	Foster clay loam, slightly saline-alkali, 0 to 1 percent slopes	877	. 1	HaA	Hanford fine sandy loam, 0 to 1 percent slopes	7, 613	. 9
FabA	Foster clay loam, moderately saline-alkali, 0 to 1 percent slopes	254	(1)	HbA	Hanford fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes	3, 353	. 4
FacA	Foster clay loam, strongly saline-alkali, 0 to 1 percent slopes	153	(1)	HfA	Hanford sandy loam, 0 to 3 percent slopes	3, 323	. 4
FdcA	Foster-Chino loams, strongly saline-alkali, 0 to 1 percent slopes	533	. 1	HhA	Hanford sandy loam, moderately deep over sand, 0 to 3 percent slopes	407	(1)
FecA	Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes	32, 168	3. 7	HgA	Hanford sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes	2, 316	. 3
FfcA	Fresno and El Peco loams, strongly saline-alkali, 0 to 1 percent slopes	6, 968	. 8	HeB	Hanford gravelly sandy loam, 3 to 8 percent slopes	619	. 1
FebA	Fresno and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes	5, 849	. 7				
FfbA	Fresno and El Peco loams, moderately saline-alkali, 0 to 1 percent slopes	5, 155	. 6				
FeaA	Fresno and El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes	4, 711	. 5				
FfaA	Fresno and El Peco loams, slightly saline-alkali, 0 to 1 percent slopes	3, 853	. 4				

[1] Less than 0.1 percent.

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

Symbol	Soil	Acreage	Percent
HdA	Hanford (Ripperdan) fine sandy loam, moderately deep and deep over silt, 0 to 3 percent slopes	20,825	2.4
HcA	Hanford (Ripperdan) fine sandy loam, shallow variant, 0 to 3 percent slopes	149	(1)
HkB	Hideaway very stony loam, 0 to 8 percent slopes	1,123	.1
HkD	Hideaway very stony loam, 15 to 30 percent slopes	172	(1)
HmA	Hildreth sandy clay, 0 to 3 percent slopes	1,634	.2
HnB	Hildreth-San Joaquin complex, 0 to 8 percent slopes	254	(1)
HoD	Holland sandy loam, 15 to 30 percent slopes	6,531	.7
HoE	Holland sandy loam, 30 to 45 percent slopes	7,247	.8
HrE	Holland rocky sandy loam, 30 to 45 percent slopes	4,204	.5
HsB	Hornitos gravelly sandy loam, 3 to 8 percent slopes	567	.1
HsD	Hornitos gravelly sandy loam, 8 to 30 percent slopes	448	.1
HvD	Hornitos very rocky sandy loam, 8 to 30 percent slopes	1,783	.2
JyA	Jesbel gravelly clay loam, 0 to 3 percent slopes	187	(1)
JeA	Jesbel clay, 0 to 3 percent slopes	78	(1)
JgB	Jesbel gravelly clay, 3 to 8 percent slopes	26	(1)
LeA	Lewis loam, slightly saline-alkali, 0 to 1 percent slopes	940	.1
LwA	Lewis loam, moderately saline-alkali, 0 to 1 percent slopes	783	.1
MaA	Madera fine sandy loam, 0 to 3 percent slopes	14,077	1.6
MdA	Madera-Lewis complex, slightly saline-alkali, 0 to 1 percent slopes	1,406	.2
MbA	Madera loam, 0 to 3 percent slopes	2,689	.3
McA	Madera-Alamo complex, 0 to 1 percent slopes	291	(1)
MoA	Marguerite loam, 0 to 3 percent slopes	653	.1
MrA	Marguerite loam, slightly saline-alkali, 0 to 3 percent slopes	11	(1)
MsA	Marguerite loam, moderately saline-alkali, 0 to 3 percent slopes	86	(1)
MmA	Marguerite clay loam, 0 to 3 percent slopes	280	(1)
MnA	Marguerite clay loam, moderately saline-alkali, 0 to 3 percent slopes	22	(1)
MtB	Montpellier coarse sandy loam, 3 to 8 percent slopes	574	.1
MtC	Montpellier coarse sandy loam, 8 to 15 percent slopes	1,559	.2
PbA	Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	8,508	1.0
PaA	Pachappa fine sandy loam, 0 to 1 percent slopes	7,781	.9
PcA	Pachappa sandy loam, 0 to 1 percent slopes	668	.1
PdA	Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes	4,409	.5
PeA	Pachappa sandy loam, moderately deep and deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes	388	(1)
PfA	Porterville clay, 0 to 3 percent slopes	339	(1)
PfB	Porterville clay, 3 to 8 percent slopes	567	.1
PgB	Porterville rocky clay, 3 to 8 percent slopes	160	(1)
PoA	Pozo loam, 0 to 1 percent slopes	2,458	.3
PsA	Pozo loam, slightly saline, 0 to 1 percent slopes	5,811	.7
PtA	Pozo loam, moderately saline, 0 to 1 percent slopes	2,868	0.3
PvA	Pozo loam, strongly saline, 0 to 1 percent slopes	1,593	.2
PhA	Pozo clay loam, 0 to 1 percent slopes	962	.1
PkA	Pozo clay loam, slightly saline, 0 to 1 percent slopes	1,048	.1
PmA	Pozo clay loam, moderately saline, 0 to 1 percent slopes	216	(1)
PnA	Pozo clay loam, strongly saline, 0 to 1 percent slopes	97	(1)
RaA	Ramona sandy loam, 0 to 3 percent slopes	13,532	1.5
RaB	Ramona sandy loam, 3 to 8 percent slopes	768	.1
RbA	Ramona sandy loam, deep over hardpan, 0 to 3 percent slopes	440	.1
RcA	Raynor clay, 0 to 3 percent slopes	172	(1)
RcB	Raynor clay, 3 to 8 percent slopes	1,097	.1
RdA	Redding gravelly loam, 0 to 3 percent slopes	981	.1
RdC	Redding gravelly loam, 3 to 15 percent slopes	1,783	.2
RfC	Redding gravelly sandy loam, 3 to 15 percent slopes	1,033	.1
RgC	Redding-Raynor complex, 3 to 15 percent slopes	1,828	.2
Rh	Riverwash	3,506	.4
Rk	Rock land, Hornitos soil material	246	(1)
RmB	Rocklin rocky sandy loam, pumiceous variant, 3 to 8 percent slopes	41	(1)
RmD	Rocklin rocky sandy loam, pumiceous variant, 8 to 30 percent slopes	593	.1
RtA	Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes	630	.1
RsA	Rossi silt loam, moderately saline-alkali, 0 to 1 percent slopes	563	.1
RrA	Rossi silt loam, slightly saline-alkali, 0 to 1 percent slopes	407	(1)
RoA	Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes	996	.1
RpA	Rossi clay loam, strongly saline-alkali, 0 to 1 percent slopes	201	(1)
SaA	San Joaquin sandy loams, 0 to 3 percent slopes	63,344	7.2
SbA	San Joaquin-Alamo complex, 0 to 3 percent slopes	1,085	.1
ScB	San Joaquin-Whitney sandy loams, 0 to 8 percent slopes	373	(1)
SyB	Sesame sandy loam, 3 to 8 percent slopes	1,085	.1
SnB	Sesame rocky sandy loam, 3 to 8 percent slopes	41	(1)
SeB	Sesame loam, 3 to 8 percent slopes	295	(1)
SeC	Sesame loam, 8 to 15 percent slopes	71	(1)
SkC	Sesame rocky loam, 8 to 15 percent slopes	101	(1)
TdA	Temple loam, 0 to 1 percent slopes	22	(1)
TbA	Temple clay loam, 0 to 1 percent slopes	936	.1
TaA	Temple clay, 0 to 1 percent slopes	283	(1)
TeA	Temple loam, slightly saline, 0 to 1 percent slopes	116	(1)
TcA	Temple clay loam, slightly saline, 0 to 1 percent slopes	601	.1
Tf	Terrace escarpments	380	(1)
TgF	Tollhouse rocky coarse sandy loam, 30 to 75 percent slopes	3,320	.4
TkC	Trabuco rocky loam, 8 to 15 percent slopes	179	(1)
TkF	Trabuco rocky loam, 45 to 75 percent slopes	1,641	.2
ThE	Trabuco loam, 15 to 45 percent slopes	500	.1

1 Less than 0.1 percent.

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

Symbol	Soil	Acreage	Percent	Symbol	Soil	Acreage	Percent
ToA	Traver loam, strongly saline-alkali, 0 to 1 percent slopes	7,553	0.9	VsB	Vista-Sesame complex, 3 to 8 percent slopes	959	0.1
TmA	Traver loam, slightly saline-alkali, 0 to 1 percent slopes	1,706	.2	WaB	Whiterock rocky fine sandy loam, 3 to 8 percent slopes	56	(1)
TnA	Traver loam, moderately saline-alkali, 0 to 1 percent slopes	8,501	1.0	WaE	Whiterock rocky fine sandy loam, 30 to 45 percent slopes	138	(1)
TpA	Traver-Chino complex, slightly saline-alkali, 0 to 1 percent slopes	1,231	.1	WbD	Whiterock very rocky fine sandy loam, 8 to 30 percent slopes	470	1
TrA	Traver-Chino complex, moderately saline-alkali, 0 to 1 percent slopes	2,309	.3	WfB	Whitney fine sandy loam, 3 to 8 percent slopes	10,466	1.2
TsA	Traver, Fresno, and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes	201	(1)	WfC	Whitney fine sandy loam, 8 to 15 percent slopes	895	.1
				WmA	Whitney loam, 0 to 3 percent slopes	37	(1)
				WmB	Whitney loam, 3 to 8 percent slopes	90	(1)
				WmC	Whitney loam, 8 to 15 percent slopes	19	(1)
TtA	Traver, Fresno, and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes	183	(1)	WnD	Whitney sandy loam, 15 to 30 percent slopes, eroded	757	.1
TuB	Trigo fine sandy loam, 3 to 8 percent slopes	1,779	.2	WtB	Whitney-Trigo fine sandy loams, 3 to 8 percent slopes	2,413	.3
TuC	Trigo fine sandy loam, 8 to 15 percent slopes	560	.1	WrB	Whitney and Rocklin sandy loams, 3 to 8 percent slopes	6,516	.7
TvB	Trigo-Cometa sandy loams, 3 to 8 percent slopes	873	.1	WrC	Whitney and Rocklin sandy loams, 8 to 15 percent slopes	5,427	.6
TwA	Tujunga loamy sand, 0 to 3 percent slopes	20,504	2.3	WoC	Whitney and Rocklin gravelly sandy loams, 3 to 15 percent slopes	477	.1
TwB	Tujunga loamy sand, 3 to 8 percent slopes	257	(1)	WxA	Wunjey very fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes	910	.1
TxA	Tujunga loamy sand, moderately deep and deep over hardpan, 0 to 3 percent slopes	642	.1	WvA	Wunjey very fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes	668	.1
TzB	Tujunga and Hanford soils, channeled, 0 to 8 percent slopes	2,749	.3	WuA	Wunjey very fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	563	.1
TyA	Tujunga loamy sand, moderately deep and deep over silt, 0 to 3 percent slopes	93	(1)	WyB	Wunjey very fine sandy loam, strongly saline-alkali, channeled, 1 to 8 percent slopes	388	(1)
VaA	Visalia fine sandy loam, 0 to 1 percent slopes	4,730	.5	ZaB	Zaca clay, 3 to 8 percent slopes	675	.1
					Water	3,890	.4
					Intermittent water	1,906	.2
VdA	Visalia sandy loam, 0 to 3 percent slopes	2,134	.2		Towns (not surveyed)	1,738	.2
VnA	Visalia sandy loam, moderately deep over sand, 0 to 3 percent slopes	310	(1)		Total	874,880	98.8

[1] Less than 0.1 percent.

scattered individual specimens, as well as clusters, of ponderosa pine and incense-cedar.

The slopes are comparatively gentle to steep. Rock outcrops are common.

Small tracts sufficiently free of rock outcrops and relatively gently sloping have been used for hay and small grain. but the predominant use of these soils is woodland range. Where rock outcrops are numerous, woodland range is essentially the only use.

Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes (AaC).—These soils occur extensively in the upper foothills of the Sierra Nevada.

Representative profile of Ahwahnee coarse sandy loam:

0 to 8 inches, grayish-brown and slightly hard[1] (dark-brown and very friable when moist) coarse sandy loam; slightly acid; moderate, fine, granular structure; moderate in organic matter; in undisturbed areas the surface is covered with a thin layer of litter and partially decomposed grasses, herbs, and woody materials.

8 to 22 inches, light-brown and hard (dark yellowish-brown and very friable when moist) coarse sandy loam; contains slightly more clay than the horizon above; very weak, medium, subangular blocky structure to essentially massive; medium acid.

22 to 36 inches, light-brown and hard (dark yellowish-brown and very friable when moist) coarse sandy loam; contains slightly more clay than the surface horizon and numerous sharp, gritty particles of disintegrated granitic rock; medium acid; essentially massive.

36 to 60 inches, light-brown and hard (dark yellowish-brown and very friable when moist) coarse sandy loam; contains many partially disintegrated fragments of coarse-textured granitic rock; grades into disintegrated, coarse-textured, granitic bedrock.

The depth to the decomposing parent rock may be only 48 inches. There are some rock outcrops. Included are areas in which there is very little or no increase in clay in the subsoil and in which the subsoil is essentially massive.

Representative profile of Auberry coarse sandy loam:

0 to 7 inches, grayish-brown and slightly hard (dark-brown and friable when moist) coarse sandy loam; moderate, fine and medium, granular structure; slightly acid; moderate in organic matter; in undisturbed areas the surface is covered with a thin layer of litter and partially decomposed grasses, herbs, and woody materials.

[1] All terms for soil color and consistence in this report are for dry soil, unless otherwise stated.

7 to 12 inches, pale-brown and hard (dark grayish-brown and friable when moist) heavy sandy loam; weak, medium and fine, subangular blocky structure; medium acid.
12 to 16 inches, brown and hard (dark-brown and friable when moist) gritty loam with colloidal coatings; weak, medium, subangular blocky structure; medium acid.
16 to 35 inches, brown and very hard (dark yellowish-brown and firm when moist) light sandy clay loam with colloidal coatings; moderate, coarse and very coarse, angular blocky structure; strongly acid.
35 to 42 inches, pale-brown and slightly hard (yellowish-brown and friable when moist) gritty loam with some colloidal coatings; weak, medium and fine, subangular blocky structure; medium acid.
42 inches +, very pale brown (variable yellowish-brown to dark-gray when moist) loamy sand derived from weathered parent rock; massive; neutral; unweathered rock occurs at variable depths below this.

The principal variations are in depth to and hardness of the underlying bedrock. The depth may vary from 36 to 60 inches, and, in addition, several feet of weathered parent rock may underlie the profile.

Both soils have good natural drainage. Surface runoff is slow. Internal drainage is rapid in the Ahwahnee soil and medium to moderately slow in the Auberry soil. The effective rooting zone is deep in both soils but deeper in the Auberry soil. The moisture-holding capacity and natural fertility are moderate, and the erosion hazard is slight.

Use and management.—These soils are used mainly for woodland range, but small tracts at the lower elevations have been used for hay and small grain.

A number of range studies have been conducted on these and similar soils at the San Joaquin Experimental Range near O'Neals. These studies indicate that good-quality forage consisting principally of broadleaf filaree, soft chess, and foxtail fescue can be produced only for a limited period each year. This period usually extends from about the first of February to the first of June. During this interval of approximately 4 months, temperature and moisture are most favorable and the forage is sufficiently balanced in crude protein, crude fiber, minerals, and vitamins so that the animals stay in good condition and increase in weight. For the rest of the year, the quality of the forage is poor. During the dry period in summer and early in fall, the forage is deficient in crude protein, in minerals, and probably in vitamin A. It remains relatively high in crude fiber (carbohydrates), but unless a protein supplement is furnished, the animals will lose weight or barely maintain weight.

Although new green growth appears within a few days after the first effective fall rains, studies indicate that, until about the end of January, the forage is insufficient to more than maintain animal weight. Low temperatures restrict new growth, and the rains reduce the value of the old growth by dissolving and removing the minerals and other nutrients. Supplemental feed containing both proteins and carbohydrates is required during this period to maintain or improve animal weight and condition. The amount of supplemental feed can be gradually decreased as the green forage becomes more abundant and more nutritious late in winter. About the first of February, the forage becomes adequate and the feeding of supplements can be discontinued.

Fertility studies have shown that these soils have a nitrogen deficiency for grasses and a sulfur deficiency for legumes. The most economical way to correct these deficiencies and improve the quantity and quality of the forage is to apply fertilizers containing nitrogen and sulfur. The naturally occurring annual legumes—Spanishclover (deervetch), maiden (littlehead) clover, tree (foothill) clover, and tomcat clover—as well as introduced annual legumes—burclover, rose clover, subterranean clover, and crimson clover—respond to sulfur, although not always in the season of application. In turn the legumes supply nitrogen for the grasses. The effect of sulfur is greatest on transition areas between slopes and swales and on north slopes; it is least in the swales, presumably because the soils are higher in organic matter and somewhat finer textured and contains more sulfur naturally. The swale areas also respond to phosphorus. Both sulfur and phosphorus can be supplied by applying superphosphate.

Brush control is important in maintaining forage production on these soils. Trees create less of a problem than brush, but they can reduce forage production if they shade more than one-third of the surface. Carefully controlled burning is becoming a common way of reducing the amount of brush and other undesirable vegetation.

Good sites exist in places for the construction of ponds. Such ponds can be used both to water stock and to irrigate supplemental pastures. Irrigated pastures of grasses and legumes can help to stabilize range operations. (Capability unit IVe–1; natural land type E_1; Storie index rating 57)

Ahwahnee and Auberry coarse sandy loams, 15 to 30 percent slopes (AaD).—These soils are similar to Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes, except for stronger slopes. Runoff is medium, and the erosion hazard is moderate.

Use and management.—These soils are used for woodland range. Because of the strong slopes, cultivation is difficult under most circumstances. Range use and management are about the same as for Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes. (Capability unit VIe–4; natural land type E_1; Storie index rating 47)

Ahwahnee and Auberry rocky coarse sandy loams, 8 to 30 percent slopes (AbD).—These rolling and hilly soils are extensive. Rock outcrops are numerous, but the soils are otherwise similar to Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes. Surface runoff is slow to medium. The depth of the root zone is variable because of the presence of boulders or bedrock. Typically, the root zone is deep in the areas free of rock outcrops. The moisture-holding capacity and the natural fertility are moderate to low, depending on the depth to bedrock. The erosion hazard is slight to moderate.

Use and management.—Because of the boulders and rock outcrops, these soils are all in woodland range. The range management needed is about the same as for Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes. (Capability unit VIe–4; natural land type E_4; Storie index rating 32)

Ahwahnee and Auberry rocky coarse sandy loams, 30 to 45 percent slopes (AbE).—Stronger slopes and slightly shallower profiles are the principal differences between these soils and Ahwahnee and Auberry rocky coarse sandy loams, 8 to 30 percent slopes. Runoff is rapid, and the erosion hazard is severe.

Use and management.—Steep slopes and rock outcrops are the principal reasons why these soils are best suited to and generally used for woodland range. Because of rapid runoff these soils absorb somewhat less moisture than Ahwahnee and Auberry rocky coarse sandy loams, 8 to 30 percent slopes. Brush control is likely to be more difficult on these soils because of the stronger slopes, and fertilizing is not feasible. Otherwise, the two units are used and managed in about the same way. (Capability unit VIIe-4; natural land type E_{12}; Storie index rating 9)

Ahwahnee and Auberry rocky coarse sandy loams, 3 to 8 percent slopes (AbB).—Except for having gentler slopes, these soils are much like Ahwahnee and Auberry rocky coarse sandy loams, 8 to 30 percent slopes. The depth of the profile is the same or slightly greater. Runoff is slow, and the erosion hazard is slight. These soils are inextensive.

Use and management.—In use and management, these soils are similar to Ahwahnee and Auberry rocky coarse sandy loams, 8 to 30 percent slopes. (Capability unit VIe-4; natural land type E_4; Storie index rating 42)

Ahwahnee and Auberry very rocky coarse sandy loams, 15 to 30 percent slopes (AcD).—A large proportion of these soils consists of rock outcrops, and the profiles in general are somewhat shallower than those of Ahwahnee and Auberry rocky coarse sandy loams, 8 to 30 percent slopes. Runoff is medium, and the erosion hazard is severe.

Use and management.—These soils are used exclusively for woodland range. They are used and managed in about the same way as Ahwahnee and Auberry rocky coarse sandy loams, 8 to 30 percent slopes. Brush control is more difficult, and fertilizing is not feasible. Capability unit VIIe-4; natural land type E_{12}; Storie index rating 15)

Ahwahnee and Auberry very rocky coarse sandy loams, 30 to 75 percent slopes (AcF).—Except that they have steeper slopes and slightly shallower profiles, these soils are similar to Ahwahnee and Auberry very rocky coarse sandy loams, 15 to 30 percent slopes. Runoff is rapid, and the erosion hazard is severe.

Use and management.—These soils are all in woodland range. They are used and managed in about the same way as Ahwahnee and Auberry very rocky coarse sandy loams, 15 to 30 percent slopes. (Capability unit VIIe-4; natural land type E_{17}; Storie index rating 9)

Ahwahnee and Vista coarse sandy loams, 8 to 15 percent slopes (AdC).—These soils occur extensively in the lower foothills of the Sierra Nevada. They are at lower elevations and receive less rainfall than the Ahwahnee and Auberry soils. Consequently, the Ahwahnee soil differs in some ways from the Ahwahnee soils mapped with Auberry soils. The surface soil contains somewhat less organic matter, is slightly lighter colored, and tends to be harder and nearly massive when dry. The reaction is slightly less acid, and the depth to the parent rock is slightly less.

The Vista soil is essentially the same as the one described under the heading "Vista Series." It is relatively more extensive in the lower lying areas of this mapping unit.

Use and management.—These soils are used mainly for woodland range, but small tracts have been used for hay and small grain. These soils are used and managed in about the same way as Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes. (Capability unit IVe-1; natural land type E_1; Storie index rating 49)

Ahwahnee and Vista coarse sandy loams, 15 to 30 percent slopes (AdD).—Except for having stronger slopes, these soils are similar to Ahwahnee and Vista coarse sandy loams, 8 to 15 percent slopes. Runoff is medium, and the erosion hazard is moderate.

Use and management.—These soils are used for woodland range. Because of the slopes, cultivation is difficult in most places. In use and management, these soils are similar to Ahwahnee and Auberry coarse sandy loams, 15 to 30 percent slopes. (Capability unit VIe-4; natural land type E_1; Storie index rating 39)

Ahwahnee and Vista coarse sandy loams, 3 to 8 percent slopes (AdB).—These soils are similar to Ahwahnee and Vista coarse sandy loams, 8 to 15 percent slopes, except for having more gentle slopes. Runoff is slow, and the erosion hazard is slight.

Use and management.—Woodland range is the principal use of these soils. Use and management are about the same as for Ahwahnee and Vista coarse sandy loams, 8 to 15 percent slopes.

Small tracts have been planted to small grain for hay or grain. Phosphorus and a little nitrogen are most likely to produce a response from small grain. Care should be taken to minimize erosion if these soils are cultivated. (Capability unit IIIe-1; natural land type E_1; Storie index rating 51)

Ahwahnee and Vista rocky coarse sandy loams, 3 to 8 percent slopes (AeB).—These soils are inextensive. They are like Ahwahnee and Vista rocky coarse sandy loams, 8 to 30 percent slopes, except that they are more gently sloping and have slightly deeper profiles. Runoff is slow, and the erosion hazard is slight.

Use and management.—In use and management these soils are similar to Ahwahnee and Vista rocky coarse sandy loams, 8 to 30 percent slopes. (Capability unit VIe-4; natural land type E_4; Storie index rating 39)

Ahwahnee and Vista rocky coarse sandy loams, 8 to 30 percent slopes (AeD).—These rolling and hilly soils are extensive. Rock outcrops are numerous (fig. 6), but otherwise these soils are similar to Ahwahnee and Vista coarse sandy loams, 8 to 15 percent slopes. Runoff is slow to medium. The effective rooting depth is variable

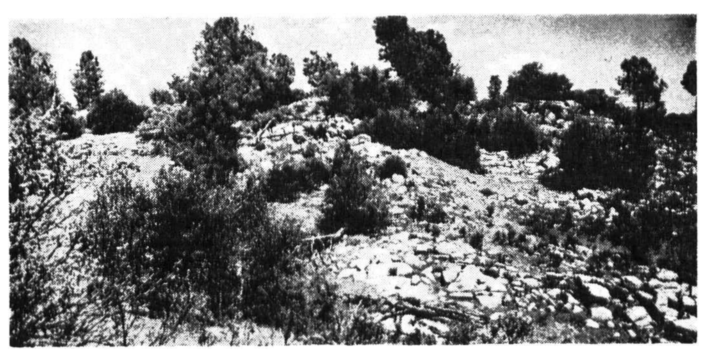

***Figure 6.*—Vista rocky coarse sandy loam in the Ahwahnee and Vista complex.**

because of the presence of boulders and bedrock. Typically, the root zone is moderately deep to deep in areas free of rock outcrops. The moisture-holding capacity and the natural fertility are moderate to low, depending on the depth to bedrock. The erosion hazard is slight to moderate.

Use and management.—Boulders and rock outcrops restrict the use of these soils to woodland range. Range management is about the same as for Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes. (Capability unit VIe-4; natural land type E_4; Storie index rating 25)

Ahwahnee and Vista rocky coarse sandy loams, 30 to 45 percent slopes (AeE).—Stronger slopes and slightly shallower profiles are the principal differences between these soils and Ahwahnee and Vista rocky coarse sandy loams, 8 to 30 percent slopes. Runoff is rapid, and the erosion hazard is severe.

Use and management.—These soils are used only for woodland range. Because of rapid runoff, they absorb somewhat less moisture and produce somewhat less forage than Ahwahnee and Vista rocky coarse sandy loams, 8 to 30 percent slopes. In use and management the two units are similar. Brush control is likely to be more of a problem on these soils because of the stronger slopes, and fertilizing is not feasible. (Capability unit VIIe-4; natural land type E_{12}; Storie index rating 11)

Ahwahnee and Vista very rocky coarse sandy loams, 15 to 30 percent slopes (ArD).—A large proportion of these soils consists of rock outcrops. The profiles are somewhat shallower, on the average, than those of Ahwahnee and Vista rocky coarse sandy loams, 8 to 30 percent slopes. Runoff is medium, and the erosion hazard is severe.

Use and management.—These soils are used exclusively for woodland range. They are used and managed in about the same way as Ahwahnee and Vista rocky coarse sandy loams, 8 to 30 percent slopes, but they produce considerably less forage because of the large proportion of rock outcrops. Brush control is more difficult, and fertilizing is not feasible. (Capability unit VIIe-4; natural land type E_{12}; Storie index rating 13)

Ahwahnee and Vista very rocky coarse sandy loams, 30 to 75 percent slopes (ArF).—Except for steeper slopes and slightly shallower profiles, these soils are similar to Ahwahnee and Vista very rocky coarse sandy loams, 15 to 30 percent slopes. Runoff is rapid, and the erosion hazard is severe.

Use and management.—These soils are all used for woodland range. In use and management they are similar to Ahwahnee and Vista very rocky coarse sandy loams, 15 to 30 percent slopes. They produce somewhat less forage, however, because of greater runoff. Also, brush control is more difficult, and fertilizing is not feasible. (Capability unit VIIe-4; natural land type E_{12}; Storie index rating 8)

Alamo Series

The soils of the Alamo series are dark-colored, poorly drained clays overlying an iron-silica hardpan. They occupy small depressions, chiefly within areas of San Joaquin or Madera soils, which are lighter colored, well drained, sandy, hardpan soils on the low terraces. The parent material of the Alamo soils was derived from a wide variety of rocks; granitic materials predominate. The vegetation consists largely of annual grasses, herbs, and weeds.

A few individual areas of these soils are large enough to be shown separately on the map, but most areas were mapped in complexes with San Joaquin or Madera soils.

Because of the small size of the individual areas and their usually complex occurrences, these soils are used in much the same way as the well-drained adjacent soils, principally for dryfarmed grain or for range. Fine texture, a shallow effective rooting zone, and poor drainage restrict their use.

Alamo clay, 0 to 1 percent slopes (AsA).—This dark-colored soil occurs in depressions on old low terraces in the central part of the Area. It is associated with San Joaquin and Madera soils. Very few areas are more than 10 acres in size.

Representative profile:

0 to 12 inches, gray and extremely hard (very dark gray and extremely firm when moist) clay; slightly acid; strong, very coarse, blocky structure; low in organic matter.

12 to 22 inches, gray and extremely hard (dark-gray and extremely firm when moist) clay with colloidal coatings; strong, very coarse, blocky structure; neutral, becoming distinctly mottled and mildly alkaline in the lower part; a mat of fine, flattened roots may occur at the abrupt lower boundary.

22 to 30 inches, reddish-brown (darker reddish-brown when moist), indurated, iron-silica hardpan; small amount of lime, principally in the seams, and some dark manganese stainings; most strongly indurated in the upper portion.

30 to 60 inches, pale-brown and very hard (brown and firm when moist), massive and softly consolidated, gritty sandy loam to sandy clay loam; a few strong-brown mottlings and stainings; slightly calcareous, the lime being in thin seams; moderately alkaline.

The principal variations are in the depth to and the thickness and hardness of the hardpan layer. In most places the clay just above the hardpan is mottled, probably as a result of periodic waterlogging. Included are a few areas in which the hardpan layer is lacking but the profile is otherwise like the representative profile described.

This soil is poorly drained; internal drainage is very slow, and runoff is ponded. The root zone is shallow, and the available water holding capacity is moderate. The natural fertility is low. Erosion is no problem, and some areas occasionally receive depositions from the higher lying associated soils. This soil is free of excess salts or alkali.

Use and management.—This soil is used mainly for dryfarmed small grain, principally barley. Some areas are in range.

Because of its fine texture, this soil is difficult to cultivate. When dry, it forms large, extremely hard clods, and it sticks to implements when wet. As it is usually cultivated along with the coarser textured adjacent soils, it is usually worked when rather moist, and implements frequently become stuck. In wet years, crops are drowned. In dry years when the surrounding sandy soils produce very little, yields on this soil may be fairly good.

Drainage is not generally feasible but is possible in places. Drained areas are fairly productive. (Capability unit IIIw-5; natural land type C_{14}; Storie index rating 13)

Atwater Series

The soils of the Atwater series are well drained and very deep. They were derived from somewhat older, wind-reworked, granitic alluvium and typically occur on the leeward side of present or abandoned stream courses, principally on low terraces. The slopes are typically undulating to gently sloping. The surface soil is coarse textured, but there is enough clay in the subsoil to increase the water-holding capacity and fertility. In places, a hardpan substratum of an older, unrelated soil underlies the profile. Annual grasses and herbs are the principal vegetation.

The related but more recent Delhi soils have no accumulation of clay in the subsoil. They are more rapidly permeable than the Atwater soils and consequently are droughty.

The Atwater soils are used mainly for dryfarmed grain and for range. Wind erosion of fallow fields is a problem. Small areas have been planted to irrigated crops, including cotton, barley, alfalfa, grain sorghum, grapes, and orchard crops.

Atwater loamy sand, 3 to 8 percent slopes (AtB).—This gently sloping soil is found principally along Berenda Creek, but smaller areas are scattered throughout the low terraces and alluvial fans of the Fresno and Chowchilla River systems.

Representative profile:

0 to 24 inches, pale-brown and soft (dark-brown and very friable when moist) loamy sand; slightly acid; very weak, very fine, granular structure when moist, and essentially massive when dry; very low in organic matter.

24 to 39 inches, pale-brown and hard (dark-brown and friable when moist) heavy sandy loam with colloidal coatings; neutral; weak, medium, subangular blocky structure.

39 to 60 inches +, yellowish-brown and slightly hard (dark yellowish-brown and very friable when moist) sandy loam; neutral; massive.

The principal variations are in the depth to and the clay content of the subsoil. The texture of the subsoil ranges from heavy sandy loam to heavy loam or light sandy clay loam.

This soil is well drained. Runoff is slow, and internal drainage is moderately rapid. The rooting zone is very deep, and the available water holding capacity and the natural fertility are moderate. The hazard of erosion, principally by wind, is severe if the soil is improperly cultivated. The soil is free of excess salts and alkali.

Use and management.—This soil is used mostly for dryfarmed grain, principally barley, and for range. A small area is irrigated and used chiefly for cotton, barley, alfalfa, grain sorghum, grapes, and orchard crops.

If dryfarmed this soil is not subject to water erosion, because of the rapid infiltration, but while the soil is fallow wind erosion is frequently severe, and adjacent roads are sometimes covered with sand. In spite of this, surface mulching is not a general practice, apparently because the soil is commonly used in conjunction with soils less susceptible to wind erosion. Wherever surface mulching to control soil drifting is possible, it should prove beneficial.

Commonly, dryfarmed small grain is not fertilized, but in extensive fertilization trials on Atwater soils it has generally shown a response to phosphorus. Nitrogen alone has not increased yields, but small amounts of nitrogen added to phosphorus have resulted in profitable yield increases. Potash has not increased yields.

Irrigated crops on Atwater soils are most likely to respond to nitrogen. If legumes have been turned under recently, the response to nitrogen is less. Phosphorus has not increased yields of nonleguminous crops, but it and sulfur may benefit legumes. Large heads of water are needed to irrigate this soil; consequently, care is needed to prevent erosion. The contour check method of irrigation is least likely to cause erosion. (Capability unit IIe-4; natural land type A_5; Storie index rating 68)

Atwater loamy sand, 0 to 3 percent slopes (AtA).—This soil is similar to Atwater loamy sand, 3 to 8 percent slopes, except for having more gentle slopes. Runoff is very slow.

Use and management.—This soil is used for the same crops as Atwater loamy sand, 3 to 8 percent slopes, but a larger proportion has been leveled and irrigated. Deep cuts have been made in places. As a result, the surface soil is variable in thickness, and the subsoil and, in places, the parent material are exposed. Because of this, the growth of crops is uneven, and such differences may persist for a considerable period after leveling. (Capability unit IIe-4; natural land type A_5; Storie index rating 76)

Atwater loamy sand, moderately deep and deep over hardpan, 3 to 8 percent slopes (AwB).—This soil is similar to Atwater loamy sand, 3 to 8 percent slopes, except that it is underlain, generally at depths of 40 to 50 inches, by a hardpan, or semiconsolidated substratum, similar to that underlying the San Joaquin and Madera soils. In a few places, the depth to the hardpan is as little as 18 inches, usually as a result of leveling. The root zone is moderately deep to deep. Where the hardpan is at a moderate depth, the water-holding capacity is somewhat reduced.

Use and management.—This soil is used in much the same way as Atwater loamy sand, 3 to 8 percent slopes. It cannot be leveled and irrigated so readily, because of the restricted depth to the hardpan. Yields are more variable. Care must be taken to prevent overirrigation, which can result in waterlogging and the formation of a temporary perched water table. (Capability unit IIIe-4; natural land type A_{11}; Storie index rating 65)

Atwater loamy sand, moderately deep and deep over hardpan, 0 to 3 percent slopes (AwA).—Except for having gentler slopes, this soil is similar to Atwater loamy sand, moderately deep and deep over hardpan, 3 to 8 percent slopes. Runoff is very slow.

Use and management.—This soil is used in about the same way as Atwater loamy sand, moderately deep and deep over hardpan, 3 to 8 percent slopes. Many areas have been leveled and irrigated. This soil is best suited to shallow-rooted row and forage crops. Trees and vines grow somewhat unevenly because of the variable depth to the unrelated substratum. Care must be taken when irrigating to prevent waterlogging. (Capability unit IIIe-4; natural land type A_{11}; Storie index rating 72)

Auberry Series

In the Madera Area, soils of the Auberry series are mapped only in undifferentiated units with the Ahwahnee soils. They are described under the heading "Ahwahnee and Auberry Series."

Bear Creek Series

The soils of the Bear Creek series are dark colored and moderately well drained. They occupy small alluvial fans and narrow flood plains within the older low terraces. The parent material consisted of mixed local alluvium derived from the Redding, Rocklin, Cometa, Whitney, Raynor, and other associated soils.

Although moderately low in organic matter, the surface soil is dark gray. The subsoil typically contains a little more clay than the surface soil and is mottled in the lower part. The profile is variable because of stratification, principally in the subsoil and the parent material. The slopes are very gentle. The vegetation consists of annual grasses and herbs.

In most places these soils are underlain, at depths of 36 to 60 inches, by an unrelated, softly consolidated substratum. In wet years a temporary perched water table may form above this substratum.

Dryland small grain and range are the principal uses.

Bear Creek loam, 0 to 3 percent slopes (BeA).—This dark-colored soil occupies small alluvial fans and narrow flood plains within the older low terraces. It is not extensive and occurs mainly along Little Dry Creek.

Representative profile:

- 0 to 20 inches, dark-gray and hard (very dark gray and friable when moist) loam; some rounded gravel; slightly acid; weak, fine, granular structure when moist, and essentially massive when dry; moderately low in organic matter.
- 20 to 32 inches, grayish-brown and hard (dark grayish-brown and friable when moist) gravelly loam with thin colloidal coatings and common, strong-brown mottles, mostly in the lower part; neutral; moderate, medium, subangular blocky structure.
- 32 to 43 inches, grayish-brown and hard (dark grayish-brown and friable when moist) very gravelly sandy loam with thin colloidal coatings and common, strong-brown mottles; neutral; massive.
- 43 to 58 inches +, light yellowish-brown and hard (dark yellowish-brown and friable when moist) gravelly sandy clay that has some lime seams; massive; softly consolidated; mildly alkaline; this material is unrelated to the soil profile above.

The texture of the surface soil varies from sandy loam to clay loam within short distances, and the gravel content varies considerably throughout the profile. The depth to the unrelated, finer textured substratum is variable; it is typically between 36 and 60 inches but is more than 60 inches in places.

This soil is moderately well drained. Runoff is very slow, and internal drainage is medium down to the substratum, then very slow. The root zone is deep, and the available water holding capacity and natural fertility are moderate. Erosion is no problem. Some areas occasionally receive deposits from higher lying associated soils. The soil is free of excess salts and alkali.

Use and management.—All of this soil is used for dryfarmed small grain or for range. Dryfarmed grain is likely to respond to phosphorus or a mixture of phosphorus and a little nitrogen. Phosphorus and sulfur will probably be beneficial to legumes.

None of this soil is irrigated, and, because of its location and the small size of the areas, it is not likely to be. If irrigated it would probably be best suited to pasture or alfalfa. (Capability unit IIs-3; natural land type A_2; Storie index rating 72)

Borden Series

The Borden series consists of well-drained, brownish soils that developed from granitic alluvium on somewhat older alluvial fans. These soils have a moderate amount of clay in the subsoil, and they contain segregated lime, most of which is in the lower part of the subsoil. Salts and alkali are common in the subsoil, possibly because of restricted drainage in the past. The vegetation is mainly annual grasses and herbs. The slopes are very gentle.

The Pachappa soils are similar, but they have less segregated lime, alkali, and clay in the subsoil.

The Borden soils are used extensively for cultivated row and forage crops. A small acreage is used for dryfarmed grain and for range. Because of the common occurrence of salts and alkali in the subsoil, these soils are not well suited to deep-rooted crops, vine crops, or orchard crops.

Borden fine sandy loam, 0 to 1 percent slopes (BfA).—This soil occurs on the somewhat older alluvial fans of the Chowchilla and Fresno Rivers, in areas that are no longer subject to frequent floods or high water tables.

Representative profile:

- 0 to 17 inches, brown and slightly hard (dark-brown and very friable when moist) fine sandy loam; noncalcareous; slightly acid; very weak, very fine, granular structure when moist, and essentially massive when dry; low in organic matter.
- 17 to 21 inches, light yellowish-brown and hard (dark yellowish-brown and firm when moist) light sandy clay loam with moderate colloidal coatings; slightly calcareous; moderately alkaline; moderate, coarse, subangular blocky structure.
- 21 to 28 inches, light yellowish-brown and slightly hard (dark yellowish-brown and friable when moist) heavy fine sandy loam with thin colloidal coatings; moderately calcareous; moderately alkaline; weak, coarse, subangular blocky structure; lime is mostly segregated and occurs as streaks and nodules.
- 28 to 60 inches +, light yellowish-brown and slightly hard (dark yellowish-brown and friable when moist) sandy loam; massive; slightly calcareous; moderately alkaline; lime is mostly disseminated.

The principal variations are in the color of the subsoil and the reaction of the subsoil and substratum. In some places the subsoil is strong brown, and the lower part of the subsoil and the substratum may be strongly alkaline.

This soil is well drained. Runoff is very slow, and internal drainage is moderately slow. The root zone is deep. The available water holding capacity and the natural fertility are moderate. The erosion hazard is slight. There are some salts and alkali in the lower part of the subsoil and the substratum in places.

Use and management.—This soil is used for a wide variety of irrigated crops, including cotton, alfalfa, grain sorghum, and barley. There are also some vineyards and orchards, but growth is somewhat spotty, possibly because of salts and alkali in the lower part of the subsoil and the substratum. Nitrogen is the only plant nutrient to produce an increase in yields, but phosphorus and sulfur improve the quality of some crops, such as alfalfa and irrigated grass-legume pasture.

One large area is in dryfarmed grain. Fertilizer trials have not been run, but grain would probably respond to phosphorus. Small amounts of nitrogen applied with larger amounts of phosphorus might also prove profitable. See the description of Atwater loamy sand, 3 to 8 percent slopes, for a discussion of the use of fertilizer on dryfarmed grain. (Capability unit IIs-7; natural land type A_2; Storie index rating 85)

Borden fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes (BkA).—This soil is similar to Borden fine sandy loam, 0 to 1 percent slopes, but it has a strongly alkaline reaction in the subsoil and substratum. Tests have shown the subsoil to be high in sodium, which probably accounts for the strong alkalinity.

Up to 25 percent of some areas is saline-alkali to the surface. These areas are either barren or have a poor vegetative cover. Because of the sodium in the lower horizons, internal drainage is somewhat less favorable than in Borden fine sandy loam, 0 to 1 percent slopes.

Use and management.—Because of the presence of salts and alkali, this soil is best suited to shallow-rooted irrigated crops. Otherwise, use and management are about the same as for Borden fine sandy loam, 0 to 1 percent slopes. Alfalfa does fairly well, and irrigated pasture is good. Vines and trees grow unevenly and are adversely affected by the salts and alkali.

Reclamation is difficult and likely to be slowly effective. Periodic deep leaching removes the excess soluble salts. The lime in the subsoil is mostly in nodular form and is not especially helpful in supplying calcium to replace the excess sodium (alkali). Gypsum applied to the surface soil supplies the necessary calcium to replace the excess sodium. (Capability units IIIs-6; natural land type A_{2-2s}; Storie index rating 68)

Borden loam, 0 to 1 percent slopes (BmA).—Except for having a finer textured surface soil that is hard when dry and being slightly higher in available water holding capacity, this soil is similar to Borden fine sandy loam, 0 to 1 percent slopes. In a few places, the entire profile is slightly finer textured.

Use and management.—This soil is used and managed in the same way as Borden fine sandy loam, 0 to 1 percent slopes. (Capability unit IIs-7; natural land type A_2; Storie index rating 85)

Borden loam, slightly saline-alkali, 0 to 1 percent slopes (BoA).—This soil is similar to Borden fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes, except that it has a finer textured surface soil.

Use and management.—This soil is used in much the same way as Borden fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes. (Capability unit IIIs-6; natural land type A_{2-2s}; Storie index rating 68)

Buchenau Series

The soils of the Buchenau series occur on old terraces. They developed from old alluvium derived principally from Mariposa slate and schist. These soils are calcareous throughout. They have a strongly lime-cemented hardpan and contain variable amounts of salts and alkali. There is slightly more clay in the subsoil than in the surface soil. Drainage is moderately good. There may have been a high water table at one time. The vegetation consists of saltgrass, annual grasses, and herbs. Areas that are strongly saline-alkali are nearly devoid of vegetation. The slopes are nearly level to slightly undulating.

The hardpan and the salts and alkali limit the use of these soils to range and dryfarmed grain.

Buchenau loam, 0 to 3 percent slopes (BzA).—This inextensive soil occurs in the Berenda Creek and Daulton Creek drainages. It is near soils derived from the Mariposa rock formation, principally Daulton soils.

Representative profile:

0 to 8 inches, gray and hard (very dark gray and friable when moist) loam; strongly calcareous; moderately alkaline; very weak, very fine, granular structure when moist, and essentially massive when dry; moderately low in organic matter.

8 to 16 inches, grayish-brown and hard (very dark grayish-brown and friable when moist) heavy loam to light clay loam with thin colloidal coatings; strongly calcareous; moderately alkaline; weak, fine, subangular blocky structure; both disseminated and segregated lime.

16 to 30 inches, light brownish-gray and hard (dark grayish-brown and friable when moist) heavy loam to light clay loam with thin colloidal coatings; strongly calcareous; moderately alkaline; weak, fine, subangular blocky structure; soft streaks and hard nodules of lime.

30 to 38 inches, very pale brown (pale brown when moist), strongly lime-cemented hardpan.

38 to 60 inches, light yellowish-brown and slightly hard (olive-brown and very friable when moist) sandy clay loam stratified with thin lenses of lime hardpan; massive; moderately calcareous; moderately alkaline.

In a few places the surface soil is lime-free. The depth to and thickness of the hardpan vary. Included are a few areas that have a clay loam surface texture.

This soil is moderately well drained. Runoff is very slow. Internal drainage is moderately slow to the hardpan, then very slow. The root zone is moderately deep. The available water holding capacity and natural fertility are moderate. The erosion hazard is slight. There are salts and alkali in the subsoil in a few places.

Use and management.—This soil is mostly in range; a little of it is in dryfarmed grain. Fertilizer trials have not been run, but small grain would most likely respond to phosphorus or a mixture of phosphorus and small amounts of nitrogen. The fertilization suggested for Atwater loamy sand, 3 to 8 percent slopes, would probably be suitable.

Because this soil has a lime hardpan and occurs in small, isolated, elevated areas, the irrigation possibilities are limited. Under irrigation, the more shallow-rooted forage crops and pasture would be best suited. Nitrogen would be needed, and phosphorus and sulfur would also benefit grass-legume pastures. (Capability unit IIIs-3; natural land type C_{13}; Storie index rating 28)

Buchenau fine sandy loam, 0 to 3 percent slopes (BuA).—Except for having a coarser textured surface soil and a slightly lower moisture-holding capacity, this soil is similar to Buchenau loam, 0 to 3 percent slopes.

Use and management.—This soil is used in much the same way as Buchenau loam, 0 to 3 percent slopes. (Capability unit IIIs-3; natural land type C_{13}; Storie index rating 28)

Buchenau fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes (BvA).—This soil is similar to Buchenau fine sandy loam, 0 to 3 percent slopes, but the subsoil and up to 25 percent of the surface soil are affected by salts and alkali.

Use and management.—This soil is used almost entirely for range. There is very sparse vegetation or none at all on the saline-alkali areas. Reclaiming the saline-alkali spots by applying gypsum or sulfur is possible but may not be economically practical. (Capability unit IIIs–8; natural land type $C_{13\text{-}2s}$; Storie index rating 21)

Buchenau fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes (ByA).—More than 70 percent of the surface of this soil is affected by salts and alkali. The surface soil is slightly lighter colored and more calcareous than that of Buchenau fine sandy loam, 0 to 3 percent slopes.

Use and management.—The agricultural value of this soil is low. Meager range is the only present use. Reclamation would require heavy applications of gysum or sulfur and may not be economically practical. (Capability unit VIs–8; natural land type $C_{13\text{-}2a}$; Storie index rating 6)

Cajon Series

The Cajon series consists of pale-brown, slightly calcareous, coarse-textured, somewhat excessively drained soils derived from granitic sediments. These soils occupy nearly level, recent alluvial fans and flood plains. Salts and alkali are common throughout the subsoil and in much of the surface soil. The vegetation is mainly annual grasses and herbs. Saltgrass and alkali sacaton grow in the areas most affected by salts and alkali.

The Cajon soils are similar to the Grangeville soils but are coarser in texture, lighter in color, and lower in organic matter. They also are similar to the Wunjey soils, from which they differ mainly in being coarse textured. They resemble the Tujunga soils, but the Tujunga are noncalcareous throughout and nonsaline-alkali.

Range is the principal use. Irrigated row and forage crops, chiefly cotton, alfalfa, and pasture, are grown in places.

Cajon loamy sand, 0 to 1 percent slopes (CaA).—This soil occupies narrow, abandoned stream courses, chiefly on the lower part of the recent alluvial fans.

Representative profile:

0 to 12 inches, pale-brown loamy sand; dark brown when moist; single grained; loose when dry or moist; low in organic matter; moderately alkaline; slightly calcareous.

12 to 24 inches, yellowish-brown loamy sand; dark yellowish brown when moist; single grained; loose when dry or moist; very low in organic matter; moderately alkaline; slightly calcareous.

24 to 60 inches, yellowish-brown stratified sand and fine sand; dark yellowish brown when moist; single grained; loose when dry or moist; moderately alkaline; slightly calcareous; usually many feet thick.

Some areas are brown (nearly dark brown) and slightly higher in organic matter. The lime content is variable, especially in the upper part of the profile.

Drainage is somewhat excessive; internal drainage is very rapid, and runoff is very slow. The root zone is very deep. The moisture-holding capacity and natural fertility are low. The erosion hazard is severe.

Use and management.—Most of this soil is in range. A small part is planted to row and forage crops. This soil is difficult to irrigate because it occurs in narrow bands and has a low moisture-holding capacity. It responds well to fertilizer if enough water is applied. Nitrogen is most likely to be needed for nonleguminous crops. Phosphorus and sulfur are most beneficial to legumes. Zinc may be needed for some crops. Precautions should be taken to control wind erosion. (Capability unit IIIe–4; natural land type A_5; Storie index rating 64)

Cajon loamy sand, slightly saline-alkali, 0 to 1 percent slopes (CaaA).—This soil is similar to Cajon loamy sand, 0 to 1 percent slopes, but the subsoil is slightly saline-alkali, and, in addition, up to 25 percent of the acreage is saline-alkali to the surface.

Use and management.—This soil is used in much the same way as Cajon loamy sand, 0 to 1 percent slopes. It is best suited to shallow-rooted crops. If the excess salts and alkali were eliminated, it should be comparable to Cajon loamy sand, 0 to 1 percent slopes. Because of the very rapid internal drainage, deep leaching alone should be sufficient to reclaim this soil, but small amounts of gypsum or sulfur might speed the process. (Capability unit IIIe–4; natural land type $A_{5\text{-}2s}$; Storie index rating 54)

Cajon loamy sand, moderately saline-alkali, 0 to 1 percent slopes (CabA).—This soil consists of coarse-textured streaks that cross the lower part of the alluvial fans and the basin. Except that it is coarser textured, loose, and single grained, it is similar to Wunjey very fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes. Between 25 and 70 percent of the soil is saline-alkali to the surface. The water-holding capacity and natural fertility are low, and the erosion hazard is severe.

Use and management.—This soil is mostly in range. Because of the coarse texture and very rapid internal moisture movement, deep leaching would readily remove the excess soluble salts. Excess alkali could be removed by the same method, but somewhat more slowly; applying a little gypsum or sulfur might help. If reclaimed, this soil could be used and managed in about the same way as Cajon loamy sand, 0 to 1 percent slopes. (Capability unit IVs–4; natural land type $A_{5\text{-}2m}$; Storie index rating 32)

Cajon loamy sand, strongly saline-alkali, 0 to 1 percent slopes (CacA).—More than 70 percent of this soil is saline-alkali to the surface. Otherwise, it is similar to Cajon loamy sand, moderately saline-alkali, 0 to 1 percent slopes.

Use and management.—This soil is mostly in range. Larger amounts of irrigation water would be required to leach the excess salts and alkali. Otherwise it is similar in use and management to Cajon loamy sand, moderately saline-alkali, 0 to 1 percent slopes. (Capability unit VIs–6; natural land type $A_{5\text{-}2a}$; Storie index rating 16)

Calhi Series

The soils of the Calhi series developed from granitic alluvium that had been reworked by wind. They occur in the basin and on the somewhat older alluvial fans, occupying undulating ridges and large mounds within larger areas of Fresno, El Peco, Dinuba, and other saline-alkali soils.

The Calhi soils are coarse textured and somewhat excessively drained. They are slightly calcareous. They contain variable amounts of salts and alkali. The vegetation is jackass clover, annual grasses, saltgrass, and herbs.

These soils are similar to the Delhi soils. The principal difference is the presence of lime, salts, and alkali in the Calhi soils.

Range is the principal use.

Calhi loamy sand, slightly alkali, 0 to 8 percent slopes (CbaB).—This coarse-textured soil occurs principally in association with Fresno and similar soils in the western part of the Area. The subsoil and up to 25 percent of the surface soil are alkali affected.

Representative profile:

0 to 14 inches, pale-brown and loose (brown and loose when moist) loamy sand; single grained; moderately alkaline; very slightly calcareous; very low in organic matter.

14 to 22 inches, pale-brown and loose (brown and loose when moist) loamy sand; single grained; strongly alkaline; slightly calcareous; very low in organic matter.

22 to 60 inches +, pale-brown and loose (brown and loose when moist) loamy sand; single grained; slightly more calcareous than layer above; very strongly alkaline.

The principal variation is in the depth to alkali, which ranges up to 30 inches or more. It may also be different in the wet seasons than in the dry seasons, because the soil is coarse textured and very rapidly permeable. In places the surface soil is noncalcareous.

This soil is somewhat excessively drained. Runoff is very slow, and internal drainage is very rapid. The root zone is very deep, but the available water holding capacity and natural fertility are low. The erosion hazard is severe.

Use and management.—This soil is almost all in range. A few small areas have been leveled and used for irrigated pasture. Deep leveling is likely to obliterate this soil without appreciably improving the associated and more strongly saline-alkali Fresno, El Peco, and similar soils. Because of the coarse texture and very rapid permeability, deep leaching alone is generally sufficient to remove the excess alkali. If reclaimed, irrigated, and planted to crops, this soil would require fertilizer. For nonleguminous crops it would be particularly deficient in nitrogen, and for legumes and legume-grass mixtures, in phosphorus and sulfur. (Capability unit IIIe–4; natural land type $A_{5\text{-}2s}$; Storie index rating 45)

Calhi loamy sand, moderately alkali, 0 to 8 percent slopes (CbbB).—This soil is similar to Calhi loamy sand, slightly alkali, 0 to 8 percent slopes, except that 25 to 70 percent of the area is affected to the surface by alkali. Included are small areas of strongly saline-alkali soils that have a surface layer of fine sandy loam.

Use and management.—This soil is used in the same way as Calhi loamy sand, slightly alkali, 0 to 8 percent slopes. Because it is moderately alkali, its use for range is more limited, however, and it would be somewhat more difficult to reclaim. (Capability unit IVs–4; natural land type $A_{5\text{-}2m}$; Storie index rating 26)

Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 0 to 3 percent slopes (CcaA).—This soil has been modified by wind, and in its natural state it occupies low mounds and is somewhat hummocky or undulating. It is similar to other Calhi soils, but it has a softly consolidated, silty substratum like that of the Dinuba soils. It is similar to Dinuba fine sandy loam, but consists of loose, single-grained loamy sand down to the unrelated silty substratum. The surface soil is noncalcareous to a depth of about 18 inches, but the subsoil is slightly calcareous. The depth to the silty substratum is typically about 40 inches but ranges from 24 to 50 inches. Up to 25 percent of the area is affected to the surface by salts and alkali. The vegetation consists of annual grasses, saltgrass, herbs, and jackass clover. The spots most strongly affected by salts and alkali are almost devoid of vegetation. The wind erosion hazard is severe, and the water-holding capacity and fertility are low. Internal drainage is very rapid down to the substratum, then slow to very slow.

Use and management.—This soil is used for range. In other localities it has been used in a limited way for irrigated pasture, alfalfa, and a few row crops. Because of its low moisture-holding capacity and coarse texture, wind erosion sometimes makes it difficult to establish seedlings. Stripcropping and windbreaks help to control wind erosion. Irrigation is not difficult, especially if sprinklers are used. Short runs and large heads are necessary to prevent overirrigation if the furrow method is used. Nonleguminous crops are likely to respond to nitrogen, and legumes to phosphate and sulfur. Salts and alkali could readily be removed by deep leaching and by applying manure and small amounts of gypsum or sulfur. (Capability unit IIIe–4; natural land type $A_{11\text{-}2s}$; Storie index rating 50)

Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 3 to 8 percent slopes (CcaB).—Except for having steeper slopes, this soil is similar to Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 0 to 3 percent slopes. It occupies the more strongly sloping mounds. The depth to the silty substratum is more variable; on top of the mounds, it may be more than 60 inches.

Use and management.—This soil is all in range. It has much the same use and management problems as Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 0 to 3 percent slopes. Because of the slopes, sprinkler irrigation is more economical than furrow irrigation. (Capability unit IIIe–4; natural land type $A_{11\text{-}2s}$; Storie index rating 45)

Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 0 to 3 percent slopes (CcbA).—Except for being moderately saline-alkali, this soil is similar to Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 0 to 3 percent slopes. From 25 to 70 percent of the soil is affected by salts and alkali to the surface.

Use and management.—This soil is all in range. It has much the same use and management problems as Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 0 to 3 percent slopes. It needs similar but more intensive reclamation practices to make it suitable for irrigated crops. (Capability unit IVs-4; natural land type A_{11-2m}; Storie index rating 29)

Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 3 to 8 percent slopes (CcbB).—Except for having stronger slopes, this soil is much like Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 0 to 3 percent slopes. Except that it is moderately saline-alkali, it is similar to Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 3 to 8 percent slopes.

Use and management.—This soil is all in range. It has much the same use and management problems as Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 3 to 8 percent slopes. It needs similar but more intensive reclamation practices to make it suitable for irrigated crops. (Capability unit IVs-4; natural land type A_{11-2m}; Storie index rating 26)

Calhi loamy sand, moderately deep and deep over silt, strongly saline-alkali, 0 to 3 percent slopes (CccA).—Except for being strongly saline-alkali, this soil is similar to Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 0 to 3 percent slopes. More than 70 percent of this soil is affected by salts and alkali to the surface.

Use and management.—This soil is all in range. It has much the same use and management problems as Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 0 to 3 percent slopes. It needs similar but more intensive reclamation practices to make it suitable for irrigated crops. (Capability unit VIs-6; natural land type A_{11-2a}; Storie index rating 14)

Calhi loamy sand, shallow over hardpan variant, moderately saline-alkali, 0 to 1 percent slopes (CdaA).—This coarse-textured soil consists of 10 to 25 inches of pale-brown, loose, single-grained, moderately calcareous loamy sand deposited over a lime-silica hardpan similar to that underlying the Fresno soils. The microrelief is hummocky, but the general topography is nearly level. From 25 to 70 percent of this soil is saline-alkali to the surface. The vegetation is annual grasses, jackass clover, saltgrass, and alkali sacaton. Drainage is imperfect. Runoff is very slow, and internal drainage is very rapid to the hardpan, then very slow.

A few small, strongly saline-alkali areas are included.

Use and management.—This soil is used only for range. Because it is in such small bodies, it is managed like the surrounding soils. Reclamation of this soil would require measures similar to those suggested for Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes. Because of the hardpan, reclamation may not be economically practical. (Capability unit IVs-8; natural land type B_{15-2m}; Storie index rating 9)

Chino Series

The soils of the Chino series occupy nearly level, swalelike positions in the basin and on old alluvial fans. Locally, they are subject to light deposition of recent alluvium. The parent material was granitic alluvium.

These soils are dark colored and moderately high in organic matter. There is slightly more clay in the subsoil than in the surface soil, and there is a zone of lime concentration in the lower part of the subsoil.

Drainage was poor while these soils were developing. Before large amounts of water were pumped for irrigation, there was probably an intermittent high water table. A high water table is uncommon now. Nevertheless, drainage is imperfect.

The Chino soils are associated principally with the Pachappa, Traver, Temple, Rossi, and Foster soils. They resemble the Pachappa soils but in most places are darker colored and have more lime in the subsoil. Where associated with the Temple and Rossi soils, in the lower part of the basin, the Chino soils contain more lime and may be saline-alkali. On the alluvial fans, salts and alkali are common in the subsoil and locally affect the surface soil. Annual grasses, herbs, and lippia are the principal vegetation, but the more strongly saline and alkali areas also support saltgrass, alkali sacaton, alkali heath, and greasewood.

Areas free or nearly free of salts and alkali are well suited to irrigated row and forage crops and pasture. Cotton, alfalfa, sugar beets, and grain sorghum are the principal field crops. Areas affected by salts and alkali are probably best suited to irrigated pasture and are generally unsuited to vines and trees. The more strongly salt- and alkali-affected areas are used only for range.

Chino loam, 0 to 1 percent slopes (CgA).—This dark-colored soil occurs principally on the older, low alluvial fans in the western portion of the Area, in association with the Pachappa soils.

Representative profile:

0 to 4 inches, gray and very hard (very dark gray and friable when moist) loam; weak, fine, granular structure when moist, and essentially massive when dry; noncalcareous; neutral; moderately high in organic matter.

4 to 11 inches, light-gray and very hard (dark-gray and firm when moist) light clay loam with colloidal coatings; weak, medium, subangular blocky structure; noncalcareous; neutral.

11 to 22 inches, grayish-brown and very hard (dark grayish-brown and firm when moist) loam with some colloidal coatings; moderately calcareous; moderately alkaline; weak, medium, subangular blocky structure; white splotches and soft nodules of lime.

22 to 64 inches +, grayish-brown grading to light olive-brown and hard (dark grayish-brown grading to olive-brown and friable to firm when moist) loam; slightly calcareous; moderately alkaline; massive.

In places the surface soil is somewhat thicker. The subsoil varies in texture from heavy loam to light clay loam, and lime in the subsoil may be greater in amount and closer to the surface. The substratum is usually somewhat stratified. Mottling is found in the lower subsoil of Chino soils elsewhere, but is uncommon in this Area.

Included are several areas that have a silt loam surface soil.

Although the natural drainage was probably poor, this soil is now imperfectly drained as a result of heavy pumping for irrigation. The water table is well below the soil almost everywhere. Runoff is very slow, and internal drainage is moderately slow. The root zone is deep. The available water holding capacity and natural fertility are moderate. The erosion hazard is slight. There are no excess salts or alkali.

Use and management.—This soil is well suited to and is used for irrigated row and forage crops and pasture. The principal crops are cotton, alfalfa, sugar beets, and grain sorghum. Nitrogen is the nutrient most likely to be needed for irrigated crops other than legumes. Alfalfa and the legumes in irrigated pastures may benefit from phosphorus and sulfur, but the benefit may be mostly in quality rather than in quantity. If drainage were improved these soils would be fairly good for vines and trees, but, because the closely associated soils are much less suitable, it is not advisable to set out vines and trees. (Capability unit IIw–2; natural land type B_1; Storie index rating 95)

Chino loam, slightly saline-alkali, 0 to 1 percent slopes (CgaA).—This soil is similar to Chino loam, 0 to 1 percent slopes, except that up to 25 percent of the acreage is saline-alkali to the surface and slightly calcareous. The saline-alkali spots are either barren or very poorly vegetated.

Small areas that have a silt loam surface soil are included.

Use and management.—This soil is used in much the same way as Chino loam, 0 to 1 percent slopes. It is best suited to shallow-rooted crops, but even these do not grow well on the saline-alkali areas. Periodic deep leaching is probably the most effective measure for improving this soil.

In addition to leaching, applying gypsum is advisable for reclaiming areas that are saline-alkali to the surface. Irrigated pasture is probably the best use for the soil during the period of reclamation. (Capability unit IIs–6; natural land type B_{1-2s}; Storie index rating 76)

Chino loam, moderately saline-alkali, 0 to 1 percent slopes (CgbA).—This soil is similar to Chino loam, slightly saline-alkali, 0 to 1 percent slopes, except that 25 to 70 percent of the surface is affected by salts and alkali.

This soil is in the western part of the Area, in the basin, and is associated with the Temple and Rossi soils. The vegetation consists mainly of saltgrass, alkali sacaton, alkali heath, and greasewood. The saline-alkali spots are nearly barren.

Use and management.—This soil is used mostly for range. Improvement would be costly and would require considerable time. If reclamation is attempted, the measures required would be the same as for Chino loam, slightly saline-alkali, 0 to 1 percent slopes. (Capability unit IIIs–6; natural land type B_{1-2m}; Storie index rating 57)

Chino loam, strongly saline-alkali, 0 to 1 percent slopes (CgcA).—This soil is similar to Chino loam, moderately saline-alkali, 0 to 1 percent slopes, except that more than 70 percent of the area is saline-alkali to the surface. Only the most salt-tolerant and alkali-tolerant plants survive.

Use and management.—This soil is all in range. It could be reclaimed by measures similar to those suggested for Chino loam, slightly saline-alkali, 0 to 1 percent slopes, but more slowly and at greater expense. (Capability unit IVw–6; natural land type B_{1-2a}; Storie index rating 28)

Chino fine sandy loam, 0 to 1 percent slopes (CfA).—This soil is similar to Chino loam, 0 to 1 percent slopes, except for having a coarser textured surface soil. It occurs principally on the old alluvial fans in association with Chino and Pachappa soils. Included are small areas that have a surface soil of sandy loam.

Use and management.—This soil has much the same use and management problems as Chino loam, 0 to 1 percent slopes. (Capability unit IIw–2; natural land type B_1; Storie index rating 95)

Chino fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes (CfaA).—Except for having a coarser surface texture, this soil is similar to Chino loam, slightly saline-alkali, 0 to 1 percent slopes.

Use and management.—This soil has much the same use and management problems as Chino loam, slightly saline-alkali, 0 to 1 percent slopes. (Capability unit IIs–6; natural land type B_{1-2s}; Storie index rating 76)

Chino fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes (CfbA).—Except for having a coarser surface texture, this soil is similar to Chino loam, moderately saline-alkali, 0 to 1 percent slopes.

Use and management.—This soil has much the same use and management problems as Chino loam, moderately saline-alkali, 0 to 1 percent slopes. (Capability unit IIIs–6; natural land type B_{1-2m}; Storie index rating 38)

Chino clay loam, 0 to 1 percent slopes (CeA).—The soil occurs at a slightly lower elevation than either the Chino loams or the Chino fine sandy loams. It is slightly finer textured throughout the profile, and the subsoil structure is more distinct. The available water holding capacity and natural fertility are high.

Use and management.—This soil has much the same use and management problems as Chino loam, 0 to 1 percent slopes. (Capability unit IIw–2; natural land type B_1; Storie index rating 77)

Chino clay loam, slightly saline-alkali, 0 to 1 percent slopes (CeaA).—Except for being finer textured, this soil is similar to Chino loam, slightly saline-alkali, 0 to 1 percent slopes. The natural fertility is moderate.

Use and management.—This soil has much the same use and management problems as Chino loam, slightly saline-alkali, 0 to 1 percent slopes. Because of moderately slow internal drainage, the salts and alkali are less readily removable than from the Chino loams or fine sandy loams; consequently, improvement would be slower. (Capability unit IIs–6; natural land type B_{1-2s}; Storie index rating 54)

Chino clay loam, moderately saline-alkali, 0 to 1 percent slopes (CebA).—This soil is similar to Chino loam, moderately saline-alkali, 0 to 1 percent slopes, except for being finer textured throughout.

Use and management.—This soil is used mostly for range. It has much the same management problems as Chino loam, moderately saline-alkali, 0 to 1 percent slopes. Because of moderate internal drainage, the salts and alkali are less readily removed than from the Chino loams and fine sandy loams, and improvement will be slower. (Capability unit IIIs–6; natural land type B_{1-2m}; Storie index rating 32)

Coarsegold Series

The soils of the Coarsegold series are reddish brown. They developed from material weathered from metamorphosed sedimentary rocks and intrusive basic igneous rocks. This mica schist bedrock, locally known as "slate," occurs in the foothills and lower mountains in the central part of Madera County. Normally there are but few rock outcrops. The topography is gently rolling to steep. The vegetation consists of annual grasses and herbs, blue oak, Digger pine, and brush. A little widely scattered yellow pine grows at the higher elevations and on north-facing slopes.

The principal associated soils are of the Vista, Ahwahnee, Auberry, and Trabuco series. The Trabuco soils are similar to the Coarsegold soils, but they developed from metamorphosed, coarse-grained, intrusive igneous rocks high in dark-colored basic minerals.

Range is the principal use. Some of the best foothill forage is produced on these soils. A few small areas have been planted to grain or grain hay.

Coarsegold loam, 8 to 30 percent slopes (ChD).—This reddish-brown soil developed from material weathered from mixed metamorphosed rocks in the foothills and lower mountains. It has almost no bedrock outcrops.

Representative profile:

0 to 5 inches, brown and slightly hard (dark-brown and friable when moist) loam containing some gravel; weak, fine, granular structure when moist, and nearly massive when dry; slightly acid; moderate in organic matter.

5 to 17 inches, reddish-brown and hard (dark reddish-brown and friable when moist) heavy loam with colloidal coatings; weak, medium, subangular blocky structure; neutral; some fine gravel.

17 to 27 inches, reddish-brown and hard (dark reddish-brown and firm when moist) gravelly clay loam with colloidal coatings; weak, coarse, subangular blocky structure; neutral.

27 to 38 inches, reddish-brown and very hard (dark reddish-brown and very firm when moist) heavy clay loam with colloidal coatings; moderate, coarse, blocky structure; slightly acid; some fine gravel.

38 to 50 inches, disintegrating schist bedrock; some reddish-brown soil material in cracks and fissures.

50 inches +, slightly decomposed schist bedrock; less altered with increasing depth.

In places, the surface soil is strong brown. The amount of clay in the subsoil varies. In most places the depth to bedrock is more than 34 inches.

Included are small areas of Trabuco soils and of soils that have a clay loam surface. At the lower elevations are small areas of soils that are similar to the Coarsegold soils but receive only about half as much rainfall.

This soil is well drained. Runoff is slow to medium, and internal drainage is moderately slow. The root zone is moderately deep to deep. The available water holding capacity and natural fertility are moderate. The erosion hazard is slight to moderate.

Use and management.—This soil is used mainly for range, although a few small areas have been in grain or grain hay. This soil produces some of the best forage of any of the soils of the foothills. No studies have been conducted specifically on this soil, but it is probable that many of the findings obtained at the San Joaquin Experimental Range in studies of the Vista and Ahwahnee soils also apply to this soil. These findings are summarized in the description of Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes. (Capability unit IVe-1; natural land type E_1; Storie index rating 54)

Coarsegold loam, 45 to 75 percent slopes (ChF).—Except for having stronger slopes, this soil is similar to Coarsegold loam, 8 to 30 percent slopes. In spite of the very steep slopes, soil depths of as much as 4 feet are common. Runoff is very rapid. Drainage is somewhat excessive, and the erosion hazard is severe.

Use and management.—This soil is all in range. Because of very steep slopes, range will probably always be the best use for this soil. The forage is of good quality. Range use and management problems are about the same as for Coarsegold loam, 8 to 30 percent slopes. Brush control is difficult on these slopes, and fertilizing is not feasible. (Capability unit VIIe-1; natural land type E_9; Storie index rating 19)

Coarsegold rocky loam, 15 to 30 percent slopes (CkD).—Except for having scattered outcrops of bedrock, this soil is similar to Coarsegold loam, 8 to 30 percent slopes. Runoff is medium, and the erosion hazard is moderate.

Use and management.—This soil is all in range. Although forage production is reduced somewhat by the rock outcrops, this soil is nearly as productive as Coarsegold loam, 8 to 30 percent slopes, and it has similar use and management problems. (Capability unit VIe-1; natural land type E_{12}; Storie index rating 33)

Coarsegold rocky loam, 30 to 75 percent slopes (CkF).—Except for having steeper slopes, this soil is similar to Coarsegold rocky loam, 15 to 30 percent slopes. Runoff is rapid to very rapid, drainage is good to somewhat excessive, and the erosion hazard is moderate to severe.

Use and management.—This soil is all in range. Steepness and rock outcrops limit its use to range. It has about the same use and management problems as Coarsegold rocky loam, 15 to 30 percent slopes. Brush control is more difficult, and fertilizing is not feasible. (Capability unit VIIe-1; natural land type E_{12}; Storie index rating 11)

Columbia Series

In the Madera Area, soils of the Columbia series occur on recent alluvium derived chiefly from granitic rocks. They occupy the flood plain of the San Joaquin River downstream from Mendota Dam. They are imperfectly drained, noncalcareous, brownish, and mottled with strong brown, principally in the subsoils. In their natural condition they were flooded or had a high water table nearly every year. Friant Dam on the San Joaquin River and Pine Flat Dam on the Kings River have greatly reduced the flood hazard, but a high water table still occurs in some years. In stream-channeled areas the topography is nearly level to undulating. The vegetation includes willow, cottonwood, wild rose, annual grasses, and herbs.

These soils occur in small, irregular tracts and are typically stratified and variable in texture.

These soils are used for a variety of row and forage crops but chiefly for alfalfa and cotton. Now that flooding is controlled, some vineyards and orchards could be planted in the better drained areas where a high water table is not likely. Dikes protect most areas from floods.

Columbia fine sandy loam, 0 to 1 percent slopes (CmA).—This recent alluvial soil occurs along the San Joaquin River. Although the flood hazard has been greatly reduced, an intermittent high water table still occurs in wet winters and in spring when runoff from the Sierra Nevada is heavy.

Representative profile:

0 to 14 inches, pale-brown and slightly hard (dark-brown to brown and very friable when moist) fine sandy loam containing fine flakes of mica; slightly acid; very weak, very fine, granular structure; variable strong-brown mottling in lower part; moderate in organic matter.

14 to 36 inches, light yellowish-brown and slightly hard (dark yellowish-brown to yellowish-brown and friable when moist) fine sandy loam; common, strong-brown mottles; neutral; very weak, very fine, granular structure.

36 to 60 inches +, light yellowish-brown and slightly hard (dark yellowish-brown to yellowish-brown and friable when moist) fine sandy loam; common, strong-brown mottles; strata of loam and loamy fine sand, and thin lenses of silt; neutral; massive.

The degree of strong-brown mottling is variable within short distances. The finer textured lenses in particular are more mottled, and in places mottling extends nearly to the surface. Textural variation and stratification are common.

Natural drainage is imperfect; runoff is very slow, and internal drainage is moderately rapid. The root zone is deep. The available moisture holding capacity and natural fertility are moderate. The erosion hazard is slight. The soil is free of excess salts or alkali.

Use and management.—This soil is used for irrigated row and forage crops, principally alfalfa and cotton, and for pasture. Now that flood control has been established, some orchards and vineyards could be planted in areas not subject to an intermittent high water table. No fertilizer trials have been conducted, but nonleguminous crops are most likely to respond to nitrogen, except when they follow legumes. If alfalfa is grown continuously, some increase in yields may be obtained by applying phosphorus and sulfur. In irrigated pastures, legume-grass combinations should be productive. (Capability unit IIw–2; natural land type A_1; Storie index rating 90)

Columbia fine sandy loam, moderately deep and deep over Temple soils, 0 to 1 percent slopes (CmtA).—This soil is similar to Columbia fine sandy loam, 0 to 1 percent slopes, except that it overlies dark-colored, moderately fine textured Temple soils at depths of 19 to 48 inches. Internal drainage is slow in the underlying Temple soils, and intermittent high water tables occur frequently.

Use and management.—This soil is used for the same crops as Columbia fine sandy loam, 0 to 1 percent slopes. Because of the slow internal drainage and intermittent high water table, irrigated pasture is probably its best use. (Capability unit IIw–7; natural land type A_2; Storie index rating 80)

Columbia fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes (CmdA).—This soil is similar to Columbia fine sandy loam, 0 to 1 percent slopes, except that it overlies a strongly cemented lime-silica hardpan of the Pozo series. In places there is a complete Pozo profile beneath the more recent Columbia soil. The thickness of the Columbia soil varies from 18 to 48 inches. Internal drainage is moderately rapid above the hardpan, then very slow. An intermittent high water table occurs frequently.

Use and management.—This soil is used in much the same way as Columbia fine sandy loam, moderately deep and deep over Temple soils, 0 to 1 percent slopes, and has much the same problems. (Capability unit IIs–3; natural land type A_9; Storie index rating 81)

Columbia soils, channeled, 0 to 8 percent slopes (CrB).—These soils occupy the areas nearest to the San Joaquin River. In most places the surface soil is fine sandy loam, but the subsoil and substratum are highly stratified with sand as a result of recent stream action and deposition. Because of stream channeling, the topography is broken or undulating, and an intermittent high water table occurs. Internal drainage is moderately rapid to rapid. The water-holding capacity and natural fertility are moderate to low, depending on the texture of the soil.

Use and management.—These soils are mostly in range. A few areas have been leveled, but the resulting soil is variable in texture within short distances; loamy sand predominates following leveling. If leveled this soil has about the same use and management problems as Columbia fine sandy loam, 0 to 1 percent slopes, but yields are more variable because of variations in texture and other soil characteristics. (Capability unit IIIe–4; natural land type A_{5-5ch}; Storie index rating 32)

Columbia loamy sand, 0 to 1 percent slopes (CoA).—Except for being coarser and more variable in texture, this soil is similar to Columbia fine sandy loam, 0 to 1 percent slopes. It occurs in a few small, irregular tracts that were once channeled but have been leveled and are now farmed. Internal drainage is rapid. The moisture-holding capacity and natural fertility are low. The erosion hazard is moderate.

Use and management.—This soil is used for the same crops as Columbia fine sandy loam, 0 to 1 percent slopes. Because it occurs in small, irregular areas, it is difficult to manage properly. Capability unit IIIs–3; natural land type A_5; Storie index rating 72)

Columbia loamy sand, over Temple soils, 0 to 1 percent slopes (CotA).—This soil is similar to Columbia loamy sand, 0 to 1 percent slopes, except that it overlies dark-colored, finer textured basin soils, mostly of the Temple series, at depths of 12 to 48 inches. Internal drainage is slow in the underlying soils, and an intermittent high water table occurs frequently.

Use and management.—Because it occurs in small bodies, this soil is generally used for row and forage crops in conjunction with adjacent soils. Irrigated alfalfa, cotton, and pasture are the most common crops. (Capability unit IIw–7; natural land type A_6; Storie index rating 72)

Columbia sandy loam, 0 to 1 percent slopes (CpA).—Except for being coarser textured throughout the profile, this soil is similar to Columbia fine sandy loam, 0 to 1 percent slopes. It occupies long, narrow bodies. Internal drainage is rapid, and the erosion hazard is moderate.

Use and management.—This soil is used for the same crops as Columbia fine sandy loam, 0 to 1 percent slopes. (Capability unit IIw–2; natural land type A_1; Storie index rating 95)

Columbia sandy loam, moderately deep over sand, 0 to 1 percent slopes (CpdA).—This soil is similar to Columbia sandy loam, 0 to 1 percent slopes, except that it overlies stratified sand at depths of 18 to 30 inches. The moisture-holding capacity and natural fertility are low.

Use and management.—This soil is used in much the same way as Columbia sandy loam, 0 to 1 percent slopes. (Capability unit IIw–2; natural land type A_1; Storie index rating 86)

Cometa Series

The soils of the Cometa series occupy undulating to rolling, dissected, old, low terraces. They formed from softly consolidated, moderately coarse textured, granitic sediments and have a brown, sandy surface soil and a reddish-brown, dense claypan in the subsoil. The vegetation consists chiefly of annual grasses and herbs.

The topographic position of the Cometa soils is like that of the Whitney and Rocklin soils. The Cometa soils are more reddish in color than the Whitney soils and have more clay in the subsoil. They have more clay in the subsoil than the Rocklin soils but do not have a cemented hardpan. The Montpellier soils are similar to the Cometa soils but have a thicker subsoil and contain less clay. In places the Cometa soils are associated with the San Joaquin soils, which cap some of the rolling knolls.

These soils are used mostly for range and dryfarmed grain. In the northern side of the Area, some attempts have been made to use them for irrigated row and forage crops.

Cometa sandy loams, 3 to 8 percent slopes (CuB).—These soils occupy gently rolling parts of the old, low terraces and are associated chiefly with the Whitney soils.

Representative profile:

0 to 7 inches, brown and hard (dark-brown and friable when moist) heavy sandy loam; slightly acid; very weak, very fine, granular structure when moist, and essentially massive when dry; low in organic matter.

7 to 17 inches, brown and hard (dark-brown and friable when moist) heavy sandy loam; slightly acid; very weak, fine, granular structure when moist, and essentially massive when dry; very low in organic matter.

17 to 27 inches, reddish-brown and extremely hard (dark reddish-brown and firm when moist) sandy clay with colloidal coatings; slightly acid; strong, coarse, blocky structure.

27 to 40 inches +, light yellowish-brown and hard (dark yellowish-brown and firm when moist) heavy sandy loam; weakly stratified; neutral; massive.

The texture of the surface soil varies but is predominantly fine sandy loam, heavy sandy loam, or coarse sandy loam. The texture of the subsoil varies from sandy clay loam to sandy clay. Thin seams of lime are present in the substratum in places.

These soils are well drained. Internal drainage and runoff are slow. The root zone is moderately deep, because of the dense claypan, and the available water holding capacity and natural fertility are low. The erosion hazard is moderate.

Use and management.—These soils are used mainly for dryfarmed small grain, principally barley, and for range.

If used for small grain, the soils have much the same fertility problems as Atwater loamy sand, 3 to 8 percent slopes. Having been weathered for a longer period of time and having a restricted effective rooting depth, they should respond to fertilizer more than the Atwater soil. Water-soluble forms of phosphorus should be used to minimize fixation. Range that is seeded to legumes is most likely to benefit from phosphorus and sulfur.

Because of the variable slopes and elevated, gently rolling topography, these soils are not well suited to irrigation. If irrigated, they should be seeded to a legume-grass combination. Because of the restricted effective depth, a shallow-rooted legume like ladino clover should be used. Nitrogen, phosphate, and sulfur are most likely to bring a response in irrigated pasture. Irrigated row and forage crops have been tried in a few places but are poorly suited and have met with little success. They require large amounts of nitrogen and smaller amounts of phosphorus, or even a complete fertilizer containing potash. It is questionable whether they can be grown profitably at the present time. (Capability unit IVe–3; natural land type D_9; Storie index rating 43)

Cometa sandy loams, 8 to 15 percent slopes (CuC).—These soils are similar to Cometa sandy loams, 3 to 8 percent slopes, but the profile is more variable and the average depth to the claypan subsoil is slightly less. Some erosion has occurred in places; it may, in part, be responsible for the shallower profile. Runoff is medium, and the erosion hazard is severe.

Use and management.—These soils are used mostly for range and dryfarmed small grain. Management is similar to that of Cometa sandy loams, 3 to 8 percent slopes. Because of the severe erosion hazard and the difficulty of applying adequate protective practices, it is probably best to use these soils for range and only an occasional small-grain crop. Legume-grass pasture would be the best use for irrigated areas. Irrigated row and forage crops are poorly suited. (Capability unit IVe–3; natural land type D_9; Storie index rating 40)

Cometa sandy loams, 0 to 3 percent slopes (CuA).—These soils are similar to Cometa sandy loams, 3 to 8 percent slopes, except for having gentler slopes. The total area is small. Runoff is slow. The erosion hazard is slight.

Use and management.—These soils are used mainly for dryfarmed small grain and for range. They have use and management problems similar to those of Cometa sandy loams, 3 to 8 percent slopes, but do not require such intensive erosion control measures. (Capability unit IVs–3; natural land type D_9; Storie index rating 48)

Cometa gravelly sandy loam, 3 to 8 percent slopes (CsB).—This soil, which is in the southern part of the Area, formed from sediments that had a high proportion of well-rounded gravel. Except for having a gravelly surface soil and gravel throughout the profile, it is similar to Cometa sandy loams, 3 to 8 percent slopes. The erosion hazard is moderate.

Use and management.—This soil is used for the same crops as Cometa sandy loams, 3 to 8 percent slopes. It is more difficult to cultivate because of the gravel. The available water holding capacity is a little less. (Capability unit IVe–3; natural land type D_{12}; Storie index rating 32)

Cometa loam, 3 to 8 percent slopes (CtB).—This soil differs from Cometa sandy loams, 3 to 8 percent slopes, in having a darker colored and finer textured surface soil, a finer textured substratum, and slightly greater available water holding capacity. Runoff is slow. The erosion hazard is moderate.

Use and management.—This soil is somewhat better suited to dryfarmed grain and range, the principal uses, than Cometa sandy loams, 3 to 8 percent slopes. (Capability unit IVe–3; natural land type D_9; Storie index rating 45)

Cometa-Whitney sandy loams, 3 to 8 percent slopes (CwB).—This complex is composed of Cometa sandy loam and Whitney fine sandy loam, which occur in such close association that separation is impractical at the field mapping scale. Runoff is slow.

Use and management.—This complex is used mostly for dryfarmed grain and range. Use and management are about the same as for Cometa sandy loams, 3 to 8 percent slopes. Yields are slightly greater, chiefly because the associated Whitney soils are deeper, have a moderate water-holding capacity, and lack the abrupt claypan in the subsoil. (Capability unit IVe–3; natural land type D_9; Storie index rating 51)

Cometa-Whitney sandy loams, 8 to 15 percent slopes (CwC).—Except for steeper slopes, this complex is similar to Cometa-Whitney sandy loams, 3 to 8 percent slopes. Runoff is slow to medium.

Use and management.—This complex is used in about the same way as Cometa-Whitney sandy loams, 3 to 8 percent slopes. (Capability unit IVe–3; natural land type D_9; Storie index rating 43)

Corning Series

The soils of the Corning series developed from gravelly or cobbly sediments derived mostly from metamorphosed sedimentary rock and igneous rock. They occur chiefly on old high terraces. They are reddish and gravelly throughout the profile and have a loam surface soil and a claypan subsoil. The slopes are relatively gentle, and the undisturbed soils typically have a hummocky or "hogwallow" microrelief. The vegetation consists mostly of annual grasses and herbs.

The Corning soils are similar to and are associated with the Redding soils. The principal difference is that the Redding soils have a hardpan below the claypan.

Range and dryfarmed grain are the principal uses of the Corning soils.

Corning gravelly loam, 0 to 3 percent slopes (CyA).—This reddish, gravelly, claypan soil occupies only a small area on the old, high terraces. It may be a remnant of a much more extensive old terrace.

Representative profile:

0 to 5 inches, reddish-yellow and hard (reddish-brown to yellowish-red and friable when moist) gravelly loam; strongly acid; very weak, very fine, granular structure when moist, and essentially massive when dry; the gravel is very hard and mainly quartzitic; moderately low in organic matter.

5 to 10 inches, reddish-brown and very hard (dark reddish-brown and very firm when moist) gravelly clay loam with colloidal coatings; medium acid; weak, fine, blocky structure.

10 to 18 inches, red and extremely hard (dark reddish-brown and very firm when moist) gravelly clay with colloidal coatings; strongly acid; strong, fine, blocky structure.

18 to 25 inches, red and extremely hard (dark reddish-brown and very firm when moist) gravelly clay with colloidal coatings and some dark manganese stains; very strongly acid; strong, coarse, blocky structure.

25 to 38 inches +, reddish-yellow and hard (yellowish-red and firm when moist) gravelly sandy clay loam; strongly acid; massive; dark manganese stains; some pebbles are partially weathered and give a variegated color to the soil.

In places the surface soil is brown. Variations in the depth to and thickness of the claypan subsoil are associated with the hogwallow microrelief. The substratum is typically more gravelly than the soil material above it.

This soil is well drained. Runoff is slow, and internal drainage is very slow. The root zone is shallow and the available water holding capacity is low because of the claypan subsoil. The natural fertility is low. The erosion hazard is slight.

Use and management.—This soil is used mainly for range and dryfarmed grain. It has about the same fertility problems as the Cometa soils and responds to fertilization as well or better. It is likely to be deficient in phosphorus and nitrogen, particularly for dryfarmed grain.

Because of its elevated position and shallow root zone, this soil is not well suited to irrigation. If irrigated, it would be best suited to a combination of shallow-rooted legumes and grasses and would be most likely to respond to phosphate, alone or in combination with a little nitrogen, and lime. Irrigated row and forage crops are poorly suited. They would require large amounts of nitrogen and a little phosphorus or even a complete fertilizer containing potash. It is questionable whether they could be grown profitably. (Capability unit IVs–3; natural land type D_{12}; Storie index rating 42)

Corning gravelly loam, 3 to 8 percent slopes (CyB).—This soil has steeper slopes than Corning gravelly loam, 0 to 3 percent slopes, but is otherwise similar. It occupies short fans near Little Table Mountain. Runoff is slow to medium. The erosion hazard is moderate.

Use and management.—This soil is used in much the same way and, except for the need to control erosion, has about the same management problems as Corning gravelly loam, 0 to 3 percent slopes. (Capability unit IVe–3; natural land type D_{12}; Storie index rating 36)

Daulton Series

The Daulton series consists of shallow soils developed from metamorphosed sedimentary rocks, principally slate of the Mariposa formation. The slate is fairly dark colored because it contains graphite, and the soils are dark grayish brown. These soils occur along the western foothills of the Sierra Nevada. The topography is undulating to hilly. Drainage is good to somewhat excessive. Outcrops of nearly vertically tilted bedrock, tombstonelike in appearance, are numerous in places (fig. 7). The vegetation is annual grasses and herbs and, on north slopes, a little blue oak.

The Daulton soils are associated with the Vista soils and the Whiterock soils. The Vista soils developed from granitic rocks and are pale brown. The shallow Whiterock soils developed from the same kind of parent material as the Daulton soils but are medium acid to strongly acid and light brownish gray.

Almost all of the acreage is used for range. A few areas are used for dryfarmed grain.

Figure 7.—**Tombstonelike outcrops on Daulton rocky fine sandy loam, 30 to 45 percent slopes, in the lower foothills of the Sierra Nevada.**

Daulton loam, 8 to 30 percent slopes (DbD).—This soil occurs in the lower foothills north of the Fresno River. In places there are outcrops of nearly vertically tilted parent rock, locally called "tombstone" rock. Another distinctive identifying feature in places is the presence of chiastolite (andalusite) crystals in the soil and parent rock.

Representative profile:

0 to 5 inches, dark grayish-brown and hard (very dark grayish-brown and friable when moist) loam; slightly acid; weak, fine, granular structure when moist, and essentially massive when dry; numerous small slate fragments and chiastolite crystals; moderate in organic matter.

5 to 17 inches, grayish brown and very hard (dark grayish brown and firm when moist) loam; slightly acid; weak, fine, granular structure when moist, and essentially massive when dry; slate fragments more numerous than in layer above; numerous chiastolite crystals; moderately low in organic matter.

17 inches +, light olive-brown (olive-brown when moist) partly shattered slate bedrock with some soil material in cracks in the upper part; less shattered and more massive with increasing depth; chiastolite crystals numerous in places.

The principal variations are in color, and there is some variation in depth to bedrock. Besides the nearly vertical outcrops of parent rock, there are quartz dikes.

Included are small areas of soils that have a slight accumulation of clay in the subsoil and a weak, subangular, blocky structure. These soils typically occupy the tops of small knolls or ridges and are somewhat deeper to bedrock.

This soil is well drained to somewhat excessively drained. Runoff is slow to medium, and internal drainage is medium. The root zone is shallow, and the erosion hazard is moderate to severe. The available water holding capacity and natural fertility are low, chiefly because of the shallowness of the profile.

Use and management.—This soil is used exclusively for range. It produces some of the best foothill forage, but the amount is limited by the shallowness of the root zone and the shortage of available water. The possibilities for more intensive use of this soil are limited. (Capability unit VIIe–3; natural land type E_5; Storie index rating 32)

Daulton fine sandy loam, 8 to 30 percent slopes (DaD).—This is the most extensive of the Daulton soils. It is similar to Daulton loam, 8 to 30 percent slopes, but has a coarser textured surface soil, is more brownish in color, has a slightly lower water-holding capacity, and contains less organic matter. Internal drainage is moderately rapid.

Use and management.—This soil is used almost exclusively for range. It is used and managed in about the same way as Daulton loam, 8 to 30 percent slopes. The variable slopes, shallowness, and low water-holding capacity restrict the possibilities for more intensive use. (Capability unit VIIe–3; natural land type E_5; Storie index rating 32)

Daulton fine sandy loam, 3 to 8 percent slopes (DaB).—This soil is not extensive. It is similar to Daulton fine sandy loam, 8 to 30 percent slopes, but is slightly deeper and in places has a few inches of weakly developed subsoil that is slightly finer textured than the surface soil. Drainage is good. Runoff is slow, and the erosion hazard is slight.

Use and management.—This soil is used mostly for range, but a few areas are in dryfarmed grain. Because of the more gentle slopes, the slightly deeper root zone, and better water-holding capacity, the forage production should be slightly greater than on Daulton fine sandy loam, 8 to 30 percent slopes, but the management problems are similar. (Capability unit VIIe–3; natural land type E_5; Storie index rating 36)

Daulton fine sandy loam, 30 to 45 percent slopes (DaE).—This soil is similar to Daulton fine sandy loam, 8 to 30 percent slopes, but is slightly shallower to bedrock and has more rock outcrops. Drainage is somewhat excessive. Runoff is rapid, and the erosion hazard is severe.

Use and management.—This soil is used only for range. It has about the same management problems as Daulton fine sandy loam, 8 to 30 percent slopes. (Capability unit VIIe–3; natural land type E_{13}; Storie index rating 18)

Daulton rocky fine sandy loam, 3 to 8 percent slopes (DcB).—Except for having numerous outcrops of bedrock (fig. 8), this soil is similar to Daulton fine sandy loam, 3 to 8 percent slopes.

Use and management.—This soil is used exclusively for range, which is the only feasible use because of the rock outcrops. It is managed in about the same way as

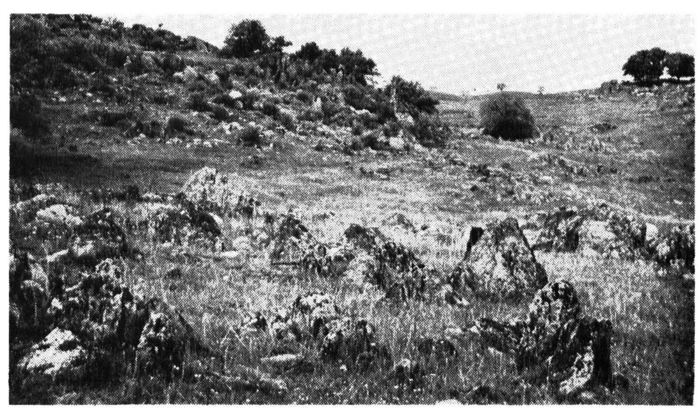

Figure 8.—**Daulton rocky fine sandy loam, 3 to 8 percent slopes, in foreground; Daulton rocky fine sandy loam, 30 to 45 percent slopes, in background.**

Daulton fine sandy loam, 3 to 8 percent slopes. (Capability unit VIIe-3; natural land type E_8; Storie index rating 25)

Daulton rocky fine sandy loam, 30 to 45 percent slopes (DcE).—This soil is slightly shallower to bedrock than Daulton rocky fine sandy loam, 3 to 8 percent slopes. Except for having rock outcrops, it is similar to Daulton fine sandy loam, 30 to 45 percent slopes.

Use and management.—This soil is used exclusively for range, which is the only feasible use because of the steep slopes, rock outcrops, shallowness, and low water-holding capacity. Range management is about the same as for Daulton fine sandy loam, 30 to 45 percent slopes. (Capability unit VIIe-3; natural land type E_{16}; Storie index rating 12)

Delhi Series

The soils of the Delhi series consist of pale-brown, coarse-textured granitic material deposited on alluvial fans and modified by wind action. Drainage is excessive or somewhat excessive. Most areas are gently undulating, but a few have a dunelike topography. The profile is nearly uniform and shows little modification, except for wind or water stratification, throughout its depth. The vegetation is annual grasses and herbs.

These soils are associated principally with Atwater soils, which are of similar origin but are somewhat older and have a slight accumulation of clay in the subsoil.

The Delhi soils are used for dryfarmed grain, for range, and for irrigated alfalfa, cotton, and corn.

Delhi sand, 3 to 8 percent slopes (DeB).—This uniform, coarse-textured soil occurs principally on small, isolated mounds adjacent to streams in the older, low terraces.

Representative profile:

0 to 12 inches, pale-brown (brown when moist), loose sand; neutral; micaceous; single grained; very low in organic matter.

12 to 24 inches, pale-brown (brown when moist), loose sand; neutral; micaceous; single grained; extremely low in organic matter.

24 to 60 inches, light yellowish-brown (yellowish-brown when moist), loose sand; neutral; micaceous; single grained.

The principal variations are slight differences in color, which becomes somewhat more yellowish with increasing depth. The reaction varies from slightly acid to mildly alkaline, usually becoming more alkaline with increasing depth. Included are some areas that have a loamy sand texture.

This soil is excessively drained. Runoff is very slow, and internal drainage is very rapid. The hazard of wind erosion is severe. The available water holding capacity and natural fertility are low because of the coarse texture. The root zone is very deep.

Use and management.—Most of this soil is used for dryfarmed grain and for range. Dryfarmed small grain generally responds to phosphorus, alone or with smaller amounts of nitrogen, but it is questionable whether fertilizing this coarse-textured and droughty soil is economical. Control of wind erosion is needed if this soil is cultivated. (Capability unit IVe-4; natural land type A_5; Storie index rating 65)

Delhi sand, 0 to 3 percent slopes (DeA).—This soil consists mostly of areas of Delhi sand, 3 to 8 percent slopes, that have been leveled.

Use and management.—This soil is used for irrigated alfalfa, cotton, and corn. Under irrigation, it is deficient in nitrogen. Phosphorus and sulfur are beneficial to alfalfa and other legumes. Precautions to minimize wind erosion should be taken.

In other areas, this soil has been used for grapes, small fruits, and nuts. It is deficient in zinc for grapes, peaches, and almonds, but the deficiency can usually be corrected by using zinc sprays. (Capability unit IVe-4; natural land type A_5; Storie index rating 72)

Delhi sand, moderately deep and deep over hardpan, 0 to 3 percent slopes (DfA).—This soil consists of Delhi sand overlying a hardpan substratum of some older, unrelated soil. The depth to the hardpan ranges from 18 to 50 inches. Many areas have been leveled, and this may account in part for the variable depth to the hardpan. Drainage is somewhat excessive.

Some areas of loamy sand are included.

Use and management.—This soil is used in much the same way as Delhi sand, 0 to 3 percent slopes. Because of the variable depth to the unrelated substratum, the growth of crops is usually spotty, and more care must be taken in irrigation and other management. (Capability unit IVe-4; natural land type A_{11}; Storie index rating 72)

Dinuba Series

The Dinuba series consists of pale-brown, moderately coarse textured or medium textured soils. The materials were derived mainly from granitic rocks. The subsoil contains slightly more clay than the surface soil. Beneath the subsoil is a weakly calcareous, unrelated, silty substratum. The vegetation in nonsaline and nonalkali areas consists of annual grasses and herbs. In salt- and alkali-affected areas, it consists of saltgrass, alkali sacaton, jackass clover, and other salt-tolerant and alkali-tolerant plants.

These nearly level soils are located on the lower margins of the San Joaquin River alluvial fan. They have many properties intermediate between those of the Hanford soils on the alluvial fan to the east and those of the Fresno and El Peco soils in the basin, chiefly to the west. They differ from the Hanford soils in having lime in the subsoil and silty substratum, mottling in the substratum, and, in many places, salts and alkali. The Fresno soils contain more salts and alkali than the Dinuba soils; they have an impermeable, indurated hardpan, a moderate amount of clay in the subsoil, and moderately well developed structure in the subsoil. The El Peco soils typically contain more lime than the Dinuba soils, and they have a strongly cemented lime-silica hardpan in the lower part of the subsoil. The Traver soils also resemble the Dinuba soils but lack the unrelated silty substratum.

Areas free or nearly free of salts and alkali are used for irrigated grapes, row and forage crops, and pasture. Those more strongly affected are used mainly for range. Recently, large areas affected by salts and alkali have been leveled and successfully planted to irrigated pasture. It is expected that more areas will be reclaimed.

Dinuba-El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes (DpA).—These pale-colored soils occur extensively on the lower margins of the San Joaquin River alluvial fans. The component soils are too complexly associated to be mapped separately. Up to 25 percent of the area is affected by salts and alkali to the surface. The saline-alkali spots have a poor vegetative cover.

Representative profile of Dinuba fine sandy loam in an area relatively free of salts and alkali:

0 to 10 inches, pale-brown and slightly hard (brown and very friable when moist) fine sandy loam; weak, very fine, granular structure when moist, and essentially massive when dry; noncalcareous; mildly alkaline; very low in organic matter.

10 to 13 inches, pale-yellow to light yellowish-brown and hard (grayish-brown and friable when moist) heavy fine sandy loam; slightly calcareous; very weak, fine and medium, blocky structure; moderately alkaline; lime mostly disseminated.

13 to 24 inches, pale-yellow to light yellowish-brown and hard (grayish-brown and friable when moist) fine sandy loam; massive; moderately alkaline; slightly calcareous; some of the lime may be segregated in small, soft nodules.

24 to 35 inches, light-gray and very hard (light brownish-gray and very firm when moist), massive silt loam; whitish, hard, segregated and disseminated lime and strong-brown mottles; moderately alkaline; slightly calcareous; very few roots enter this material, and a root mat may occur above it.

35 to 50 inches +, light-gray and slightly hard to hard (light brownish-gray and firm to very firm when moist) stratified silt loam and fine sand; moderately alkaline, slightly calcareous; lime decreases in amount somewhat with depth and is mainly disseminated.

The principal variations are in the depth to and hardness of the upper part of the silty substratum. The depth is typically 24 to 36 inches, but it ranges from 18 to 50 inches, and considerable variation occurs within short distances. In places the surface soil is somewhat darker colored than in the profile described, and the areas affected by salts and alkali are strongly alkaline and slightly calcareous to the surface. Variable amounts of strong-brown mottles occur in the subsoil and substratum.

The El Peco soil in this complex is substantially like that described under the heading "El Peco Series," but is typically less alkaline in reaction and less affected by salts and alkali.

The Dinuba soil is moderately well drained, and the El Peco soil is imperfectly drained. Surface runoff is very slow, and internal drainage is moderately rapid down to the silty substratum or lime-silica hardpan, then slow to very slow. The natural fertility is moderate, the erosion hazard is slight, and the available water holding capacity is moderate. The root zone is shallow to moderately deep.

Use and management.—These soils are used for range and for irrigated row and forage crops and pasture. The field crops include alfalfa, cotton, sorghum, corn, sugar beets, and small grain. Vineyards have been planted in some reclaimed areas. The amount of salts and alkali varies greatly in short distances. Deep leaching and applying gypsum or sulfur would benefit most areas. Nonleguminous irrigated row and forage crops respond to nitrogen but generally not to phosphorus. Phosphorus and sulfur, however, may benefit alfalfa and other legumes, especially at the higher levels of production.

Some areas have been plowed to depths of 3 feet to break up the lime-silica hardpan so that grapes or other high-value crops could be planted. Plowing to depths of more than 3 feet is of doubtful value unless fruit trees or some other deep-rooted crop is to be planted. Experience in similar areas indicates that these soils are not well suited to fruit trees. Grapes are not benefited greatly by deep plowing if the depth to the cemented layer is more than 3 feet.

These soils require careful management to prevent overirrigation and a temporary perched water table. Excessive use of water could create problems but has not in this area, heretofore, because of the scarcity and the high cost of water. Waterlogging, even for short periods, adversely affects the deeper rooted crops. Excessive concentrations of soluble salts, frequently associated with overirrigation, are especially damaging to tree and vine crops. Common results of the excessive use of water on these soils in other localities include marginal leaf burn; stunted, missing, and dying trees and vines; reduced yields; and fewer years of full production. (Capability unit IIIs-8; natural land type $A_{2\text{-}2s}$; Storie index rating 63)

Dinuba-El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes (DsA).—These soils are similar to Dinuba-El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes, except that 25 to 70 percent of the area is affected by salts and alkali. In the saline-alkali areas, the vegetation consists of saltgrass and other salt- and alkali-tolerant plants.

Use and management.—These soils are used in much the same way as Dinuba-El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes, but their agricultural value is more limited. Deep leaching and applying gypsum or sulfur will help reclaim the saline-alkali areas, improve the soils, increase yields, and broaden crop suitability. If not reclaimed, these soils are probably best suited to irrigated grass-legume pasture. Using them for irrigated pasture is probably the quickest and cheapest way to begin reclamation. Narrowleaf (or prostrate) trefoil is more tolerant of salts and alkali than either alfalfa or ladino clover and has given excellent results in irrigated pastures during reclamation. (Capability unit IVs-8; natural land type $A_{2\text{-}2m}$; Storie index rating 36)

Dinuba fine sandy loam, 0 to 1 percent slopes (DmA).—This soil is similar to the Dinuba soil in the complex, Dinuba-El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes, except that it is free of excess salts and alkali and is, in most places, less alkaline in reaction.

Use and management.—This soil is used for irrigated grapes, alfalfa, cotton, sugar beets, corn, and pasture. Except that there is no need to remove salts and alkali, the use and management problems are the same as those of Dinuba-El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes. (Capability unit IIIs-3; natural land type A_2; Storie index rating 90)

Dinuba loam, 0 to 1 percent slopes (DoA).—This soil is similar to Dinuba fine sandy loam, 0 to 1 percent slopes, but the texture is somewhat finer throughout and the color is slightly darker. This soil may have been more poorly drained at one time, and this may partly account for the somewhat darker color. At the present time, however, drainage is about the same as for the other Dinuba soils. Internal drainage is medium to the silty substratum, then slow to very slow.

Use and management.—This soil is used and managed in much the same way as Dinuba fine sandy loam, 0 to 1 percent slopes. (Capability unit IIIs–3; natural land type A_2; Storie index rating 90)

Dinuba-El Peco loams, slightly saline-alkali, 0 to 1 percent slopes (DtA).—These soils are similar to the Dinuba-El Peco fine sandy loams except for being finer textured throughout. Internal drainage is medium to the silty substratum or hardpan, then slow to very slow.

Use and management.—These soils are used for range and for irrigated grapes, alfalfa, cotton, sugar beets, corn, and pasture. They have much the same use and management problems as Dinuba-El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes, especially as relates to reclamation of the salt and alkali-affected areas. (Capability unit IIIs–8; natural land type $A_{2\text{-}2s}$; Storie index rating 63)

Dinuba-El Peco loams, moderately saline-alkali, 0 to 1 percent slopes (DuA).—These soils are similar to Dinuba-El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes, except for being finer textured throughout. Internal drainage is medium to the silty substratum or hardpan, then slow to very slow.

Use and management.—These soils are used in much the same way as Dinuba-El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes. (Capability unit IVs–8; natural land type $A_{2\text{-}2m}$; Storie index rating 36)

El Peco Series

The soils of the El Peco series consist of very pale brown, moderately coarse textured to medium textured material derived mainly from granitic rocks. These soils have little or no accumulation of clay in the subsoil. They have a thin, strongly cemented, lime-silica hardpan in the lower part of the subsoil.

Unless reclaimed, these soils are at least slightly affected by salts and alkali. Typically, they are moderately to strongly affected. In the areas least affected, the vegetation consists of annual grasses and herbs; in the areas more strongly affected, it consists of saltgrass, alkali sacaton, jackass clover, and other salt- and alkali-tolerant plants.

These nearly level soils occur mostly on the lower margin of the San Joaquin River alluvial fan. They are associated with the Dinuba and Fresno soils. The Dinuba soils have a slight increase in clay content of the subsoil, and they contain less lime than the El Peco soils, and they lack the strongly cemented hardpan. The Fresno soils have a moderate amount of clay and moderately well developed structural aggregates in the subsoil.

The areas least affected by salts and alkali are used mainly for row and forage crops and pasture. Those more strongly affected are used for range. Considerable areas that are associated with Dinuba soils have been reclaimed, and more probably will be. The hardpan is more of a problem than the excess salts and alkali, but it is being broken by deep plowing, and in places some of it is being removed and piled in fence rows.

El Peco-Dinuba fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes (EdA).—More than 70 percent of this complex is affected by salts and alkali to the surface. The vegetation is mainly saltgrass, alkali sacaton, and jackass clover.

Representative profile of El Peco fine sandy loam strongly affected by salts and alkali:

0 to 4 inches, very pale brown and hard (dark grayish-brown and friable when moist) fine sandy loam; strongly alkaline; slightly calcareous; very weak, medium to fine, granular structure when moist, and essentially massive when dry; very low in organic matter.

4 to 15 inches, very pale brown and hard (dark grayish-brown and friable when moist) fine sandy loam; strongly alkaline; moderately calcareous; lime mostly disseminated; very weak, medium to fine, granular structure when moist, and essentially massive when dry; extremely low in organic matter.

15 to 24 inches, very pale brown and hard (dark grayish-brown and friable when moist) fine sandy loam interstratified with material that is very hard (very firm when moist) and in places somewhat finer textured; massive; strongly alkaline; moderately calcareous.

24 to 30 inches, light-gray (grayish-brown when moist) strongly cemented lime-silica hardpan with a very thin, indurated crust on the upper surface.

30 inches +, light-gray and hard to very hard (light olive-brown and very firm when moist) silt loam interstratified with softer, coarser textured materials of variable thickness and continuing to considerable depth; strongly alkaline; slightly calcareous; weak, platy structure to massive.

The depth to the hardpan ranges from 6 to 40 inches. This may result from leveling in some places and surface deposition in others. The shallowest spots are usually the most strongly saline-alkali. There may be several hardpan layers, separated by softer, coarser textured, calcareous material. Variable faint mottling may occur above as well as below the hardpan.

The Dinuba soil is similar to that described under the heading "Dinuba Series," but is more alkaline in reaction and more affected by excess salts and alkali. It is, however, typically somewhat less strongly saline-alkali than the complexly associated El Peco soils.

The Dinuba soils are moderately well drained and the El Peco soils are imperfectly drained. Surface runoff is very slow, and internal drainage is medium down to the hardpan or silty substratum, then very slow. The root zone is moderately deep but may be shallow locally, depending on the depth to the hardpan. The natural fertility and available water holding capacity are moderate, and the erosion hazard is slight.

Use and management.—These soils are mainly in dryland range. If reclaimed, they would have much the same use suitability and management problems as Dinuba-El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes. Deep leaching and applying gypsum or sulfur should greatly improve these soils. During reclamation, they can best be used for irrigated grass-legume pasture. (Capability unit VIs–8; natural land type $A_{9\text{-}2a}$; Storie index rating 18)

Foster Series

The Foster series consists of imperfectly to poorly drained, dark-colored, nearly level soils developed from recent alluvium derived mainly from granitic and other rocks containing considerable mica. These soils occupy part of the flood plain of the San Joaquin River. They are similar to the well-drained Hanford soils but are poorly drained, dark colored, and moderately high in organic matter. The imperfectly drained Grangeville soils were derived from similar materials but are grayish brown in color and contain much less lime and much less organic matter.

Most nonirrigated areas of Foster soils are saline-alkali, but under irrigation the salt content generally decreases. Except in local spots, the water table is well below the root zone in summer but may be much higher in winter and spring. The vegetation is dominantly sedges, clovers, lippia, annual grasses, and, in saline-alkali areas, saltgrass and alkali sacaton.

These soils are used mostly for irrigated cotton, alfalfa, barley, sorghum, and pasture. Some areas are still used for range.

Foster loams, 0 to 1 percent slopes (FbA).—This mapping unit includes fine sandy loams and loams, so closely associated they could not be separated in mapping.

Representative profile:

0 to 20 inches, gray and slightly hard (very dark gray and friable when moist) loam; highly micaceous; weak, very fine, granular structure; mildly alkaline; moderately calcareous; moderately high in organic matter; lime is disseminated.

20 to 32 inches, gray and slightly hard (dark-gray and friable when moist) stratified loam, fine sandy loam, and fine sand; massive; highly micaceous; strongly calcareous; mildly alkaline; faintly mottled with yellowish brown and strong brown; moderate in organic matter; lime is disseminated.

32 to 60 inches, light brownish-gray and slightly hard (dark grayish-brown and friable when moist) stratified material similar to horizon above; massive; faintly mottled; lime content more variable; almost no lime in many places; normally low in organic matter; mildly alkaline.

The principal variations are due to stratification in the subsoil and substratum. Textural variations are common within short distances. The lime content is variable, particularly in the lower subsoil and the substratum; it ranges from strong to none. Included are a few small areas that are slightly saline-alkali.

These soils are naturally poorly drained but are now imperfectly or, locally, poorly drained, depending on the degree of artificial drainage. Runoff is very slow, and internal drainage is medium. The root zone is deep, the natural fertility is high, and the available water holding capacity is moderate. There is no erosion hazard. Excess salts and alkali are not a problem.

Use and management.—These soils are well suited to a wide variety of crops and are used for irrigated cotton, alfalfa, corn, sorghum, small grain, and pasture. Nitrogen is the only nutrient to which nonleguminous crops are likely to respond; phosphorus and sulfur benefit legumes. Response is most likely at the higher levels of production. If reasonable care is taken in irrigation, no drainage problem should develop, because the water table is now well below the surface during the growing season. Nevertheless, drainage precautions will always be required. (Capability unit IIw–2; natural land type A_1; Storie index rating 100)

Foster loams, slightly saline-alkali, 0 to 1 percent slopes (FbaA).—These soils are similar to Foster loams, 0 to 1 percent slopes, except for having slight concentrations of salts and alkali, particularly in the upper part of the profile.

Use and management.—These soils are used in much the same way as Foster loams, 0 to 1 percent slopes, but yields are somewhat lower, particularly yields of crops sensitive to salts and alkali. Where drainage is adequate, deep leaching alone should greatly improve this soil. Irrigated grass-legume pasture is probably the best use during reclamation. For the legume in such a mixture, narrowleaf (or prostrate) trefoil is a better choice than alfalfa or ladino clover. (Capability unit IIs–6; natural land type A_{1-2s}; Storie index rating 81)

Foster loams, moderately saline-alkali, 0 to 1 percent slopes (FbbA).—These soils are similar to Foster loams, 0 to 1 percent slopes, except for being moderately saline-alkali.

Use and management.—In unreclaimed areas of these soils, no crop does well. Provided adequate drainage is possible, deep leaching greatly improves these soils. Irrigated grass-legume pasture is probably the best use during the reclamation process. Following reclamation, these soils are suitable for the same crops and have the same management problems as Foster loams, 0 to 1 percent slopes. (Capability unit IIIs–6; natural land type A_{1-2m}; Storie index rating 60)

Foster loams, strongly saline-alkali, 0 to 1 percent slopes (FbcA).—These soils are similar to Foster loams, 0 to 1 percent slopes, except for being strongly saline-alkali. Only the most salt-tolerant plants are present.

Use and management.—These soils are used mainly for range. Provided adequate drainage is possible, they can be reclaimed and used for cultivated crops. Deep leaching is probably the most important reclamation measure. Irrigated legume-grass pasture is probably the best use during the reclamation process and immediately following. If successfully reclaimed, these soils are suited to most of the crops generally grown on the Foster soils. (Capability unit IVw–6; natural land type A_{1-2a}; Storie index rating 30)

Foster loams, sandy substratum, 0 to 1 percent slopes (FbdA).—These soils are similar to the deeper Foster loams, except that they are underlain by stratified sand at depths of 12 to 40 inches. They occur in long, narrow bodies on the flood plain of the San Joaquin River in places probably once occupied by stream channels. The total acreage is very small. The root zone is moderately deep to deep, and the available water holding capacity is low to moderate, depending on the depth to sand. The natural fertility is moderate to high.

Use and management.—These soils are used in much the same way as the deeper Foster loams. Stands are somewhat more variable, however, and yields are lower, especially in the places where the sandy substratum is relatively close to the surface. (Capability unit IIw–2; natural land type A_1; Storie index rating 90)

Foster loams, moderately deep and deep over Temple soils, 0 to 1 percent slopes (FbeA).—These soils consist of a 20- to 48-inch layer of Foster loam over a slowly permeable clay or clay loam soil of the Temple or, in a few places, the Rossi series. Internal drainage is medium to the substratum, then slow. Included are small areas that have a surface layer of silt loam. The water-holding capacity and natural fertility are moderate to high, depending on the depth to the unrelated underlying soil.

Use and management.—These soils are used for many of the same crops as the deeper Foster loams. More care must be used in irrigating, however, because of the fine texture and slow permeability of the underlying materials. Waterlogging and a temporary perched water table are possible if excess quantities of water are applied. (Capability unit IIw–7; natural land type A_2; Storie index rating 90)

Foster loams, moderately deep and deep over Temple soils, moderately saline-alkali, 0 to 1 percent slopes (FcbA).—Except for the presence of moderate concentrations of salts and alkali, these soils are similar to Foster loams, moderately deep and deep over Temple soils, 0 to 1 percent slopes.

Use and management.—These soils are used for much the same crops as Foster loams, moderately deep and deep over Temple soils, 0 to 1 percent slopes, but the salts and alkali inhibit the growth of crops. Deep leaching is the most effective reclamation measure. Irrigated grass-legume pasture is probably the best use during and immediately following the reclamation period. (Capability unit IIIs–6; natural land type A_{2-2m}; Storie index rating 54)

Foster clay loam, 0 to 1 percent slopes (FaA).—This soil occupies small basins in the flood plains. It is similar in most respects to Foster loams, 0 to 1 percent slopes, except for having a clay loam texture to depths of 12 to 30 inches. The underlying material is stratified fine sandy loam and loam. The water-holding capacity is moderate to high, depending on the thickness of the clay loam surface soil. The natural fertility is high. Internal drainage is moderately slow.

Use and management.—This soil is used in much the same way as Foster loams, 0 to 1 percent slopes. Some rice is grown in places. (Capability unit IIw–2; natural land type A_1; Storie index rating 85)

Foster clay loam, slightly saline-alkali, 0 to 1 percent slopes (FaaA).—Except for having slight concentrations of salts and alkali, this soil is similar to Foster clay loam, 0 to 1 percent slopes.

Use and management.—This soil is used in much the same way as Foster clay loam, 0 to 1 percent slopes, but the yields of saline-alkali sensitive crops are less. Deep leaching should greatly improve this soil, and, after the elimination of the excess salts and alkali, it should be essentially the same as Foster clay loam, 0 to 1 percent slopes. Irrigated grass-legume pasture is probably the best crop to grow during and immediately following the reclamation process. (Capability unit IIs–6; natural land type A_{1-2s}; Storie index rating 72)

Foster clay loam, moderately saline-alkali, 0 to 1 percent slopes (FabA).—Except for having moderate concentrations of salts and alkali, this soil is similar to Foster clay loam, 0 to 1 percent slopes.

Use and management.—This soil is used mainly for range. Unless the excess salts and alkali are removed, sensitive crops cannot be grown, and yields of the more tolerant crops are reduced. Reclamation through deep leaching has been successful. Irrigated grass-legume pasture is probably the best crop to grow during and immediately following the reclamation period. After removal of the excess salts and alkali, this soil will be essentially the same as Foster clay loam, 0 to 1 percent slopes, and can be used and managed in about the same way. (Capability unit IIIs–6; natural land type A_{1-2m}; Storie index rating 51)

Foster clay loam, strongly saline-alkali, 0 to 1 percent slopes (FacA).—This soil is similar to Foster clay loam, 0 to 1 percent slopes, except that it contains strong concentrations of salts and alkali. In places the salt concentration is more than 3 percent.

Use and management.—This soil is used mainly for range. Reclamation is likely to be difficult and expensive. If drainage is possible, prolonged deep leaching should greatly decrease the strong salt concentrations. Irrigated rice or grass-legume pasture are probably the best crops to grow during, and possibly for a considerable time after, reclamation. If the excess salts and alkali can be removed, this soil will have the same uses and management problems as Foster clay loam, 0 to 1 percent slopes. (Capability unit IVw–6; natural land type A_{1-2a}; Storie index rating 26)

Foster-Chino loams, strongly saline-alkali, 0 to 1 percent slopes (FdcA).—Except for having strong concentrations of salts and alkali, the soils in this complex are similar to Foster loam, 0 to 1 percent slopes, and Chino loam, 0 to 1 percent slopes.

Use and management.—These soils are mainly in range. Deep leaching would be necessary to make them fit for most irrigated crops. Irrigated grass-legume pasture would probably be the best crop to grow during and immediately following reclamation. If reclamation measures were successful, these soils would be suited to the crops generally grown on the Foster and Chino soils. (Capability unit IVw–6; natural land type A_{1-2a}; Storie index rating 29)

Fresno Series

The Fresno series consists of light-colored, imperfectly drained, lime-silica hardpan soils that have developed from older alluvium derived mainly from granitic rocks. They occur in nearly level areas in the basin, generally west of the Dinuba soils and east of the darker colored, more recent Columbia, Temple, and other alluvial soils of the San Joaquin River flood plain. The vegetation consists mostly of saltgrass, alkali sacaton, salt- and alkali-tolerant shrubs, and annual grasses.

The Fresno soils differ from the Traver soils chiefly in having a moderate amount of clay in the subsoil and a strongly cemented hardpan. They are associated chiefly with the El Peco soils, from which they differ in having a moderate accumulation of clay in the subsoil just above the strongly cemented hardpan. They are also associated with the Pozo soils, which have a dark-colored surface soil, lack an accumulation of clay in the subsoil, and usually contain more lime in the hardpan.

These soils are used mainly for range. A few areas have been leveled and cultivated. Irrigated pasture, small grain, cotton, and some alfalfa have been planted.

Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes (FecA).—These soils cover a wide area in the basin. More than 70 percent of the acreage is saline-alkali to the surface. Some areas have practically no vegetation. The proportions of the Fresno and El Peco soils vary from area to area. In the aggregate, there is probably more El Peco soil than Fresno soil.

Representative profile of Fresno fine sandy loam:

0 to 4 inches, light-gray to light brownish-gray and hard (grayish-brown and friable when moist) fine sandy loam; slightly calcareous; strongly alkaline; very weak, very fine,

granular structure when moist, and essentially massive when dry; low in organic matter.
4 to 12 inches, light-gray to light brownish-gray and hard (grayish-brown and friable when moist) fine sandy loam; strongly calcareous; strongly alkaline; very weak, very fine, granular structure when moist, and essentially massive when dry; very low in organic matter.
12 to 18 inches, light brownish-gray and very hard (brownish-gray and firm when moist) sandy clay loam with colloidal coatings; strongly alkaline; strongly calcareous; weak, coarse, prismatic and moderate, medium, blocky structure.
18 to 24 inches, light-gray (grayish-brown when moist), strongly cemented lime-silica hardpan; cementation varies from strong to weak; generally, hardpan is indurated at the top for a fraction of an inch or more.
24 to 60 inches +, light-gray and hard (light brownish-gray and firm to friable when moist), stratified loam and fine sandy loam; massive; slightly calcareous and strongly alkaline but becoming less calcareous and less alkaline with depth; few yellowish-brown and strong-brown mottles.

The depth to the hardpan varies from 14 to 30 inches. In places a succession of hardpanlike layers, alternating with softer material, occur. The kinds and amounts of salts and alkali also vary. In places the surface soil is moderately alkaline.

The El Peco soil is essentially as described under the heading "El Peco Series."

These soils are imperfectly drained. Surface runoff is very slow, and internal drainage is slow to very slow. The root zone is shallow to moderately deep. The natural fertility and the available water holding capacity are moderate to low. The erosion hazard is slight.

Use and management.—These soils are mostly in range. Trying to reclaim soils as strongly saline-alkali as these is economically questionable. Large quantities of gypsum or sulfur would be required, also deep leaching. The hardpan restricts the development of roots and the movement of moisture. Breaking up the hardpan is costly but is being attempted in many places (fig. 9).

If reclamation were attempted, regardless of the cost, and were reasonably successful, these soils would require large amounts of nitrogen for nonleguminous crops and phosphorus and sulfur for legumes. Irrigated grass-legume pasture would probably be the best use, and narrowleaf (prostrate) trefoil the most suitable legume. (Capability unit VIs–8; natural land type $B_{13\text{-}2a}$; Storie index rating 5)

Fresno and El Peco loams, strongly saline-alkali, 0 to 1 percent slopes (FfcA).—These soils differ from Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes, principally in having somewhat finer texture above the hardpan.

Use and management.—These soils are almost all in range. They have about the same uses and management problems as Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes. (Capability unit VIs–8; natural land type $B_{13\text{-}2a}$; Storie index rating 5)

Fresno and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes (FebA).—These soils are similar to Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes, but only 25 to 70 percent of the soil is saline-alkali to the surface. The areas least affected by salts and alkali have a moderately alkaline surface soil.

Use and management.—These soils are almost all in range. They produce more forage than Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes. Reclamation measures are the same as for Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes, except that the requirements for gypsum, sulfur, manure, and other amendments are somewhat less. (Capability unit IVs–8; natural land type $B_{13\text{-}2m}$; Storie index rating 11)

Figure 9.—**Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes. These soils have been ripped, and pieces of the hardpan are scattered on the surface.**

Fresno and El Peco loams, moderately saline-alkali, 0 to 1 percent slopes (FfbA).—These soils are similar to Fresno and El Peco loams, strongly saline-alkali, 0 to 1 percent slopes, but only 25 to 70 percent of the acreage is saline-alkali to the surface.

Use and management.—These soils are mostly in range and have about the same use, management, and reclamation problems as Fresno and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes. (Capability unit IVs–8; natural land type $B_{13\text{-}2m}$; Storie index rating 11)

Fresno and El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes (FeaA).—These soils are similar to Fresno and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes, but less than 25 percent of the acreage is saline-alkali to the surface. The less strongly saline-alkali areas are moderately alkaline in the surface soil but strongly alkaline in the subsoil.

Use and management.—Many areas of these soils have been partially reclaimed. Some areas have been leveled and irrigated, and others lie between dikes built to divert floodwater. Some areas subject to flooding for many years are nearly free of excess salts and alkali in the surface soil. Irrigated pasture is fair in many areas, but stands of irrigated row and forage crops are spotty and generally poor. By using gypsum or sulfur it should be possible to improve most areas enough to grow fair to good irrigated pasture. (Capability unit IIIs–8; natural land type $B_{13\text{-}2s}$; Storie index rating 19)

Fresno and El Peco loams, slightly saline-alkali, 0 to 1 percent slopes (FfaA).—Except for having a finer surface texture, these soils are similar to Fresno and El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are used for irrigated pasture and a few row and forage crops. They have about the same management problems as Fresno and El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes. (Capability unit IIIs–8; natural land type B_{13-2s}; Storie index rating 19)

Fresno, El Peco, and Chino soils, slightly saline-alkali, 0 to 1 percent slopes (FgaA).—This undifferentiated unit consists of Fresno, El Peco, and Chino fine sandy loams and loams in a variety of associations. Also included are some areas of Chino soils that have a clay loam surface soil. The Chino soils occupy narrow, intermittent drainageways that flow around small "islands" of the Fresno and El Peco soils. Less than 25 percent of the area is saline-alkali to the surface. The vegetation is largely annual grasses and herbs. Some saltgrass, alkali sacaton, and salt- and alkali-tolerant shrubs grow in the saline-alkali areas.

Use and management.—These soils are used mostly for range, but some areas have been leveled and irrigated. Irrigated pasture is fairly good, but the growth of row and forage crops is spotty and irregular. Treating the saline-alkali areas with gypsum or sulfur should be beneficial. (Capability unit IIIs–8; natural land type B_{13-2s}; Storie index rating 40)

Fresno, El Peco, and Chino soils, moderately saline-alkali, 0 to 1 percent slopes (FgbA).—These soils are similar to Fresno, El Peco, and Chino soils, slightly saline-alkali, 0 to 1 percent slopes, but 25 to 70 percent of the acreage is saline-alkali to the surface.

Use and management.—These soils are used mostly for range, but some areas have been leveled and irrigated. Gypsum or sulfur should benefit the saline-alkali areas. Irrigated pasture is the best use during and following reclamation. (Capability unit IVs–8; natural land type B_{13-2m}; Storie index rating 23)

Fresno, El Peco, and Lewis soils, moderately saline-alkali, 0 to 1 percent slopes (FhbA).—This unit consists of Fresno, El Peco, and Lewis fine sandy loams and loams associated in a variety of ways. It occurs mostly along the lower margin of the alluvial fan of the Fresno River. The microrelief is hogwallowed, but the general topography is nearly level. From 25 to 70 percent of the area is saline-alkali to the surface.

Use and management.—These soils are almost all in range. Reclamation would be difficult because of the hardpan. If reclamation were attempted, the measures discussed under Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes, would be necessary. Irrigated pasture would probably be the best use if the soils were improved. (Capability unit IVs–8; natural land type B_{13-2m}; Storie index rating 10)

Fresno, El Peco, and Lewis soils, strongly saline-alkali, 0 to 1 percent slopes (FhcA).—Seventy percent or more of the area is saline-alkali to the surface, but in other respects these soils are similar to Fresno, El Peco, and Lewis soils, moderately saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are almost all in range. Reclamation would be difficult. If it were attempted, the measures necessary would be the same as for Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes. Irrigated pasture would probably be the best use if the soils were improved. (Capability unit VIs–8; natural land type B_{13-2a}; Storie index rating 5)

Fresno, El Peco, and Pozo soils, slightly saline-alkali, 0 to 1 percent slopes (FkaA).—Less than 25 percent of the area of this unit is saline-alkali to the surface. Most of the salts and alkali are in the Fresno and El Peco soils. The darker colored Pozo soils lie at slightly lower elevations than the Fresno and El Peco soils.

Use and management.—Most of the acreage is in range. If irrigated, these soils produce fairly good pasture. Gypsum or sulfur treatment of the saline-alkali areas should be beneficial. (Capability unit IIIs–8; natural land type B_{13-2s}; Storie index rating 19)

Fresno, El Peco, and Pozo soils, moderately saline-alkali, 0 to 1 percent slopes (FkbA).—These soils are similar to Fresno, El Peco, and Pozo soils, slightly saline-alkali, 0 to 1 percent slopes, except that 25 to 70 percent of the area is saline-alkali to the surface.

Use and management.—Most of the acreage is in range. Reclamation would be difficult. If it were attempted, the measures necessary would be the same as for Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes. Irrigated pasture would probably be the best use if the soils were improved. (Capability unit IVs–8; natural land type B_{13-2m}; Storie index rating 11)

Grangeville Series

The soils of the Grangeville series occupy nearly level, low parts of recent alluvial fans and flood plains. The parent material was derived from granitic and other micaceous rocks. Under natural conditions these soils were imperfectly drained and subject to flooding and a periodic high water table, but, as a result of pumping, those in this Area are now mostly moderately well drained. There are mottles and slight amounts of lime in the subsoil and substratum. Salts and alkali, principally in the subsoil but in places in the surface soil, are common. The vegetation is annual grasses, herbs, and scattered oaks. Saltgrass and other tolerant plants grow in the saline-alkali areas.

The Grangeville soils are similar to the Hanford soils, but are darker colored, contain lime, and are mottled chiefly in the subsoil and substratum. Under natural conditions, they are somewhat better drained than the Foster soils, but they are not so high in organic matter, nor so dark colored, nor do they contain so much lime. In many respects the Grangeville soils are transitional between the Hanford and the Foster soils.

These soils are used extensively for irrigated cotton, alfalfa, sugar beets, grapes, and pasture. Orchard sites must be carefully chosen because, if the subsoil is strongly alkaline, the trees will be stunted or shortlived.

Grangeville fine sandy loam, 0 to 1 percent slopes (GaA).—This soil occurs extensively on alluvial fans and flood plains in the irrigated portion of the Area.

Representative profile:

0 to 11 inches, grayish-brown and soft (very dark grayish-brown and very friable when moist) fine sandy loam; weak, very fine, granular structure; mildly alkaline; moderately low in organic matter.

11 to 20 inches, light brownish-gray and soft (dark grayish-brown and very friable when moist) fine sandy loam; few yellowish-brown and strong-brown streaks and mottles;

Figure 10.—Grapevines on Grangeville fine sandy loam, 0 to 1 percent slopes. Olive trees in background.

weak, very fine, granular structure; mildly alkaline; slightly calcareous; moderately low in organic matter.
20 to 60 inches, pale-brown and soft (dark-brown and very friable when moist) stratified fine sandy loam, loamy fine sand, and loam; common, yellowish-brown and strong-brown mottles; massive; moderately alkaline; slightly calcareous; lime is mainly disseminated and decreases with depth.

The principal variations are in the amount of lime and its distribution in the profile. The degree of mottling is also variable. A few areas that have a loam surface texture are included.

In its natural condition, this soil was imperfectly drained and subject to flooding and an intermittent high water table. Extensive pumping has now nearly eliminated the high water table, and drainage is moderately good in most places. Runoff is very slow, and internal drainage is moderately rapid. The root zone is very deep, and the water-holding capacity and natural fertility are moderate. The erosion hazard is slight, and there are no excess salts or alkali.

Use and management.—This soil is suited to a wide range of crops. It is used for irrigated alfalfa, cotton, sorghum, sugar beets, pasture, grapes (fig. 10), and peaches (fig. 11). Nitrogen on nonleguminous crops and phosphorus and sulfur on legumes are the only nutrients to which responses are likely to be obtained. (Capability unit I–1; natural land type A_1; Storie index rating 100)

Grangeville fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes (GbA).—This soil is similar to Grangeville fine sandy loam, 0 to 1 percent slopes, but up to 25 percent of the area is saline-alkali to the surface. The saline-alkali spots are slightly calcareous to the surface. In many ways this soil is similar to the Wunjey very fine sandy loams, but it is darker colored and contains more organic matter.

Use and management.—This soil is used in much the same way as Grangeville fine sandy loam, 0 to 1 percent slopes. It is best suited to shallow-rooted row and forage crops and pasture. Under continued irrigation the saline-alkali spots tend to become smaller, and crop yields increase. Applying gypsum or sulfur to the saline-alkali spots probably would speed reclamation. If the excess salts and alkali were eliminated, the reaction would change from strongly alkaline to moderately alkaline, and this soil would be comparable to Grangeville fine sandy loam, 0 to 1 percent slopes, and have similar crop suitability and management problems. (Capability unit IIs–6; natural land type $A_{1\text{-}2s}$; Storie index rating 79)

Grangeville sandy loam, 0 to 1 percent slopes (GmA).—Except for being coarser textured throughout, this soil is similar to Grangeville fine sandy loam, 0 to 1 percent slopes. Internal drainage is rapid.

Use and management.—This soil has much the same uses and management problems as Grangeville fine sandy loam, 0 to 1 percent slopes. (Capability unit I–1; natural land type A_1; Storie index rating 95)

Grangeville sandy loam, slightly saline-alkali, 0 to 1 percent slopes (GnA).—This soil is similar to Grangeville sandy loam, 0 to 1 percent slopes, but up to 25 percent of the acreage is saline-alkali to the surface. The saline-alkali spots are slightly calcareous to the surface.

Use and management.—This soil is used in much the same way as Grangeville sandy loam, 0 to 1 percent slopes. It is best suited to shallow-rooted crops and pasture. Reclamation measures are the same as for Grangeville fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes. After reclamation this soil would be comparable to Grangeville sandy loam, 0 to 1 percent slopes, in crop suitability and management problems. (Capability unit IIs–6; natural land type $A_{1\text{-}2s}$; Storie index rating 76)

Grangeville fine sandy loam, over Traver soils, 0 to 1 percent slopes (GcA).—This soil is extensive on the alluvial fan of the Chowchilla River and its distributaries. The Grangeville fine sandy loam material is 15 to 48 inches thick, and it overlies an older, strongly alkaline Traver soil that contains excess salts and alkali. The root zone is moderately deep to deep. Internal drainage is moderately rapid to the underlying Traver soils, then moderately slow.

Use and management.—This soil is used for irrigated cotton, sorghum, alfalfa, and pasture. It is not well suited to orchards or vineyards because of the excess salts and alkali in the underlying Traver soil. Periodic deep leaching should slowly improve this soil; otherwise, use suitability and management problems are the same as for Grangeville fine sandy loam, 0 to 1 percent

Figure 11.—Peach orchard on Grangeville fine sandy loam, 0 to 1 percent slopes. At center, where there are no trees, is a saline-alkali soil of the Traver series.

slopes. (Capability unit IIs–6; natural land type A_{1-2s}; Storie index rating 90)

Grangeville fine sandy loam, over Traver soils, slightly saline-alkali, 0 to 1 percent slopes (GdA).—This soil is similar to Grangeville fine sandy loam, over Traver soils, 0 to 1 percent slopes, except that up to 25 percent of the acreage is saline-alkali to the surface. The largest area of this soil is southwest of Chowchilla.

Use and management.—This soil is used in much the same way as Grangeville fine sandy loam, over Traver soils, 0 to 1 percent slopes. Periodic deep leaching and gypsum treatment of the saline-alkali spots should improve this soil. (Capability unit IIs–6; natural land type A_{1-2s}; Storie index rating 70)

Grangeville fine sandy loam, moderately deep and deep over Temple soils, 0 to 1 percent slopes (GeA).—This soil consists of a 20- to 48-inch layer of Grangeville fine sandy loam overlying finer textured soils of the Temple series. Drainage is imperfect. Internal drainage is moderately rapid to the Temple materials, then slow. The root zone is deep.

Use and management.—This soil is used mainly for row and forage crops. Excessive irrigation should be avoided, to prevent waterlogging and a temporary perched water table. Otherwise, this soil should be used and managed in about the same way as Grangeville fine sandy loam, 0 to 1 percent slopes. (Capability unit IIw–7; natural land type A_2; Storie index rating 100)

Grangeville fine sandy loam, deep over hardpan, 0 to 1 percent slopes (GfA).—This soil consists of about 36 inches or more of Grangeville fine sandy loam overlying an indurated iron-silica hardpan like that in the Madera soils. Internal drainage is moderately rapid to the hardpan, then very slow. The root zone is deep.

Use and management.—This soil is used mainly for irrigated pasture, row and forage crops, and orchards. It is not well suited to the deeper rooted crops, such as orchard crops, because of its restricted depth. It should be irrigated carefully to prevent waterlogging and a perched water table. Otherwise, it has about the same use and management problems as Grangeville fine sandy loam, 0 to 1 percent slopes. (Capability unit IIs–3; natural land type A_9; Storie index rating 70)

Grangeville fine sandy loam, deep over alkali hardpan, 0 to 1 percent slopes (GhA).—This soil is similar to Grangeville fine sandy loam, deep over hardpan, 0 to 1 percent slopes, except that it overlies an alkali (lime-silica) hardpan like that in the Fresno and Lewis soils. The depth to the unrelated hardpan is 40 inches or more. Included are small areas that have a loam or sandy loam surface texture. The root zone is deep.

Use and management.—This soil is used for irrigated pasture and for row and forage crops. It is not well suited to the deeper rooted crops, such as orchards, because of the restricted depth and strongly alkaline reaction in the substratum. It is essential to irrigate carefully, to avoid waterlogging and a perched water table. Use suitability and management problems are about the same as for Grangeville fine sandy loam, 0 to 1 percent slopes. (Capability unit IIs–3; natural land type A_9; Storie index rating 63)

Grangeville fine sandy loam, deep over alkali hardpan, slightly saline-alkali, 0 to 1 percent slopes (GkA).—This soil is similar to Grangeville fine sandy loam, deep over alkali hardpan, 0 to 1 percent slopes, except that up to 25 percent of it is saline-alkali to the surface.

Use and management.—This soil is used in much the same way as Grangeville fine sandy loam, deep over alkali hardpan, 0 to 1 percent slopes. Growth of crops is poor on the saline-alkali spots. Periodic deep leaching, combined with gypsum or sulfur treatment of the saline-alkali spots, should improve this soil. Other management problems are about the same as for Grangeville fine sandy loam, deep over alkali hardpan, 0 to 1 percent slopes. (Capability unit IIs–3; natural land type A_{9-2s}; Storie index rating 49)

Gravel Pits

Gravel pits (Gp).—This miscellaneous land type consists of areas from which sand or gravel for construction material has been removed. These areas have no agricultural value. (Capability class VIIIs–1; natural land type A_{14}; Storie index rating 5)

Greenfield Series

The soils of the Greenfield series occupy gently sloping to undulating, well-drained, relatively narrow areas, principally along local streams in the old, low terraces. The streams are entrenched somewhat, and normally the soils are no longer subject to overflow and deposition. The parent material is slightly older alluvium, in places somewhat reworked by wind, derived predominantly from granitic rocks. In places, a hardpan substratum of an older, unrelated soil underlies the profile. The vegetation is annual grasses and herbs and scattered oaks.

The Greenfield soils have a little more clay in the subsoil than in the surface soil and represent a somewhat more advanced stage of soil development than the Hanford soils, which developed from recent deposits of similar parent materials and have no accumulation of clay in the subsoil. They have less subsoil clay and represent a somewhat less advanced stage of soil development than the Ramona soils, which developed from older deposits of similar parent materials.

These soils are used mostly for dryfarmed grain, but a few small areas have been planted to irrigated row and forage crops, vineyards, and orchards. They are well suited to a wide variety of crops, provided irrigation water is available.

Greenfield coarse sandy loam, 0 to 3 percent slopes (GrA).—This soil occurs along some of the local streams in the old, low terraces.

Representative profile:

0 to 23 inches, pale-brown and slightly hard (dark-brown and very friable when moist) coarse sandy loam; very weak, very fine, granular structure when moist, and essentially massive when dry; slightly acid; very low in organic matter.

23 to 37 inches, light yellowish-brown and slightly hard (dark yellowish-brown and very friable when moist) heavy sandy loam with thin colloidal coatings; neutral; weak, fine, subangular blocky structure.

37 to 51 inches, light yellowish-brown and slightly hard (dark yellowish-brown and friable when moist) heavy fine sandy loam with colloidal coatings; neutral; moderate, medium, subangular blocky structure.

51 to 72 inches, brownish-yellow and yellow and soft (yellowish-brown and very friable when moist) stratified loamy sand, sandy loam, and fine sandy loam; neutral; massive.

The surface soil is grayish brown to pale brown or brown, and in places the subsoil has a strong brownish cast.

Drainage is good, surface runoff is very slow, and internal drainage is moderately rapid. The available water holding capacity and natural fertility are moderate. The root zone is very deep, and the erosion hazard is slight.

Use and management.—This soil is suitable for many row, forage, vine, and orchard crops. It is used principally for dryfarmed grain, but a few small areas are irrigated and planted to crops. Dryfarmed grain will probably respond to phosphorus or phosphorus with small amounts of nitrogen. Irrigated nonleguminous crops will respond to nitrogen, and irrigated legumes to phosphorus and probably to sulfur. (Capability unit I–1; natural land type A_1; Storie index rating 87)

Greenfield coarse sandy loam, 3 to 8 percent slopes (GrB).—This soil is similar to Greenfield coarse sandy loam, 0 to 3 percent slopes, but it occupies undulating and sloping areas on stream terraces that have been subject to slight erosion or have been deposited at different stream levels. Runoff is slow.

Use and management.—Because of the undulating topography, this soil is used only for dryland range and small grain. Sprinkler systems would probably be the best means of irrigation. Use suitability and management problems are about the same as for Greenfield coarse sandy loam, 0 to 3 percent slopes, except for the need to control the application of water and to control erosion. (Capability unit IIe–1; natural land type A_1; Storie index rating 81)

Greenfield sandy loam, 3 to 8 percent slopes (GuB).—This soil is similar to Greenfield coarse sandy loam, 3 to 8 percent slopes, except for having a slightly finer textured surface layer that contains less coarse and very coarse sand and fine gravel. The available moisture holding capacity is slightly greater because of the finer texture.

Use and management.—This soil is used in about the same way as Greenfield coarse sandy loam, 3 to 8 percent slopes. (Capability unit IIe–1; natural land type A_1; Storie index rating 77)

Greenfield sandy loam, 0 to 3 percent slopes (GuA).—Except for having gentler slopes, this soil is similar to Greenfield sandy loam, 3 to 8 percent slopes. Surface runoff is very slow.

Use and management.—This soil is used in much the same way as Greenfield coarse sandy loam, 0 to 3 percent slopes. (Capability unit I–1; natural land type A_1; Storie index rating 86)

Greenfield sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes (GvA).—This soil is similar to Greenfield sandy loam, 0 to 3 percent slopes, except that it overlies a hardpan, or semiconsolidated substratum, like that in the San Joaquin soils. The depth to the hardpan is 40 to 50 inches in most places. In a few places it is as little as 18 inches, as a result of leveling. The root zone is moderately deep to deep, and the water-holding capacity is somewhat reduced in areas where the hardpan is at moderate depth.

Use and management.—This soil is used in much the same way as Greenfield coarse sandy loam, 0 to 3 percent slopes. It cannot be leveled and irrigated quite so readily, however, because of the restricted depth to hardpan, and yields are apt to show more variation. Care must be taken in irrigation to prevent waterlogging and a temporary perched water table. (Capability unit IIs–3; natural land type A_9; Storie index rating 70)

Greenfield sandy loam, moderately deep and deep over hardpan, 3 to 8 percent slopes (GvB).—Except for having stronger slopes, this soil is similar to Greenfield sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes.

Use and management.—This soil is used in much the same way as Greenfield sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes. (Capability unit IIs–3; natural land type A_9; Storie index rating 70)

Greenfield fine sandy loam, 0 to 3 percent slopes (GsA).—Except for being somewhat finer textured throughout, this soil is similar to Greenfield sandy loam, 0 to 3 percent slopes. The available water holding capacity is slightly higher because of the slightly finer texture.

Use and management.—This soil is used in much the same way as Greenfield sandy loam, 0 to 3 percent slopes. Use and management problems are similar for the two soils. (Capability unit I–1; natural land type A_1; Storie index rating 95)

Greenfield fine sandy loam, 3 to 8 percent slopes (GsB).—Except for having slightly stronger slopes, this soil is similar to Greenfield fine sandy loam, 0 to 3 percent slopes.

Use and management.—In use and management, this soil is similar to Greenfield sandy loam, 3 to 8 percent slopes. (Capability unit IIe–1; natural land type A_1; Storie index rating 86)

Hanford Series [2]

The soils of the Hanford series consist of moderately coarse textured recent alluvium derived chiefly from granitic rocks high in micaceous minerals. The alluvial deposits were stratified and channeled during deposition. The profile is nearly uniform throughout and shows little modification other than a slightly darker color and a higher organic-matter content in the surface soil. The vegetation is principally annual grasses and herbs and scattered oaks. Along the streambanks there are cottonwoods, alders, sycamores, and willows.

The Hanford soils are similar to, but lack the subsoil clay content of, the slightly older Greenfield soils, which were derived from similar parent material. They are more brownish, lower in organic matter, and better drained than the Grangeville soils, also derived from similar parent material, and they lack lime and mottling in the subsoil. In places an unrelated hardpan, like that in the Madera and San Joaquin soils, occurs at moderate

[2] This series includes soils described under the name "Ripperdan" in University of California Soil Survey Report No. 12, Soils of Madera County, California, and in some other University of California publications.

depth. In other places the profile is shallow to moderately deep over an unrelated silty substratum.

The Hanford soils are suitable for a wide range of crops. They are used for most of the row, forage, pasture, vine, and orchard crops for which the climate is suitable.

Hanford fine sandy loam, 0 to 1 percent slopes (HaA).—A uniform profile derived from recent alluvial deposits more than 5 feet deep is the outstanding characteristic of this soil. At depths of more than 5 feet, there may be an unrelated silty substratum like that of the Dinuba soils, or the profile may show little variation, apart from stratification, to depths of 10 or more feet.

Representative profile:

0 to 12 inches, pale-brown and slightly hard (dark-brown and very friable when moist) fine sandy loam; slightly acid; very weak, very fine, granular structure when moist, and essentially massive when dry; low in organic matter.

12 to 36 inches, pale-brown and slightly hard (dark-brown and very friable when moist) fine sandy loam; neutral; massive.

36 to 60 inches +, light yellowish-brown and slightly hard to soft (yellowish-brown and very friable when moist) stratified fine sandy loam, sandy loam, and loamy sand; massive; mildly alkaline.

Some areas are grayish brown at the surface and more gray throughout the profile. The reaction may be more acid, especially in areas where large quantities of acidic nitrogenous fertilizers have been applied. The lower part of the profile is stratified to varying degrees. Some included areas are a loamy sand below a depth of 24 inches.

Drainage is good, surface runoff is very slow, and internal drainage is moderately rapid. The root zone is very deep, and the water-holding capacity and natural fertility are moderate. The erosion hazard is slight.

Use and management.—This soil is suited to and used for a wide variety of irrigated row, forage, pasture, vine, and orchard crops. All nonleguminous irrigated crops respond to nitrogen, and legumes are likely to respond to phosphorus and sulfur. Dryfarmed small grain would probably respond to phosphorus, alone or with small amounts of nitrogen. (Capability unit I-1; natural land type A_1; Storie index rating 100)

Hanford fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes (HbA).—This soil is similar to Hanford fine sandy loam, moderately deep and deep over silt, 0 to 3 percent slopes, except that it overlies an unrelated iron-silica hardpan like that in the San Joaquin and Madera soils. The depth to the hardpan is most commonly about 36 inches, but it varies from 20 to 50 inches. Some of this variation is the result of leveling a somewhat undulating or hummocky surface. Surface runoff is very slow to slow, and internal drainage is moderately rapid to the hardpan, then very slow. The root zone is moderately deep to deep, and the available water holding capacity and natural fertility are moderate. The erosion hazard is slight.

Use and management.—This soil is used for range, dryfarmed grain, and irrigated grapes, cotton, alfalfa, and sorghum. Range grasses can be expected to respond to nitrogen, and legumes to phosphorus and sulfur. Grain will probably respond to phosphorus, alone or with small amounts of nitrogen. Irrigated nonleguminous crops will probably respond to nitrogen, and irrigated legumes to phosphorus and sulfur.

Because of the very slowly permeable hardpan, a perched water table and temporary waterlogging are possible if this soil is overirrigated. Deep-rooted crops are most likely to be adversely affected. Breaking up and removing the hardpan are costly but are becoming common practices. They are of greatest benefit to deep-rooted crops, such as tree fruits and nuts. If the depth to the hardpan is more than 3 feet, shallow-rooted crops are not likely to benefit much from the elimination of the hardpan. It is in areas where the depth to the hardpan is less than 3 feet, either naturally or as a result of leveling, that breaking up the hardpan is most likely to be worthwhile. (Capability unit IIIs-3; natural land type A_9; Storie index rating 70)

Hanford sandy loam, 0 to 3 percent slopes (HfA).—Because it is somewhat coarser textured throughout, this soil is slightly lower in water-holding capacity and in natural fertility than Hanford fine sandy loam, 0 to 1 percent slopes. Internal drainage is rapid, and the erosion hazard is slight.

Use and management.—This soil is used in much the same way as Hanford fine sandy loam, 0 to 1 percent slopes. It requires somewhat more fertilizer and a little more frequent irrigation. Some care is needed to control wind drifting, which can damage germinating crops. (Capability unit I-1; natural land type A_1; Storie index rating 95)

Hanford sandy loam, moderately deep over sand, 0 to 3 percent slopes (HhA).—This soil is similar to Hanford sandy loam, 0 to 3 percent slopes, but it overlies sand at depths of 18 to 36 inches. The water-holding capacity and natural fertility are low. Drainage is good to somewhat excessive, depending on the depth to the underlying sand.

Use and management.—This soil is used in much the same way as Hanford sandy loam, 0 to 3 percent slopes, but because of the sandy substratum it requires more careful irrigation and different fertilizer practices. Water must be applied in smaller amounts and at shorter intervals, because of the low water-holding capacity and rapid internal drainage. Split applications of fertilizer are also probably advisable. (Capability unit IIIe-4; natural land type A_1; Storie index rating 76)

Hanford sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes (HgA).—Except for having a sandy loam texture above the hardpan, this soil is similar to Hanford fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes.

Use and management.—This soil is used in much the same way as Hanford fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes, and has similar uses and management problems. (Capability unit IIIs-3; natural land type A_9; Storie index rating 67)

Hanford gravelly sandy loam, 3 to 8 percent slopes (HeB).—This soil occurs along the edge of the San Joaquin River, on the terrace slopes. The gravel is well rounded, and some of it is of metamorphic origin. Internal drainage is rapid. The water-holding capacity and natural fertility are low.

Use and management.—This soil is used in much the same way as Hanford sandy loam, 0 to 3 percent slopes. In most places the gravel does not interfere with cultivation, but it necessitates more frequent irrigation and larger amounts of fertilizer. (Capability unit IIe-1; natural land type A_7; Storie index rating 57)

Hanford (Ripperdan) fine sandy loam, moderately deep and deep over silt, 0 to 3 percent slopes (HdA) [3].—This soil occurs extensively in the southern part of the Area, on the higher part of the recent alluvial fan along the San Joaquin River. Generally, it is east of the somewhat similar but lower lying Dinuba soils, which have more lime and more mottles in the subsoil and substratum. It is similar to and associated with the very deep Hanford soil, and differs from them principally in having the unrelated silty substratum.

Representative profile:

0 to 10 inches, pale-brown and slightly hard (dark-brown and very friable when moist) fine sandy loam; neutral; very weak, very fine, granular structure when moist, and essentially massive when dry; low in organic matter.

10 to 26 inches, pale-brown and slightly hard (dark-brown and very friable when moist) fine sandy loam; neutral; very weak, very fine, granular structure when moist, and essentially massive when dry; abrupt boundary.

26 to 48 inches +, light-gray and hard (firm when moist) softly consolidated silt loam unrelated to material above; moderately alkaline; massive; a small amount of disseminated lime or very thin, hard plates in places; a few brownish to yellowish-brown mottles; lower part may be stratified with fine sand.

The most important variation is in the depth to the silty substratum. The depth is most commonly 30 inches, but it ranges from 12 to 60 inches and may vary considerably within a few feet. In part, this variation is the result of leveling. In some places there is a thin, weakly cemented layer immediately above the silty substratum. Small amounts of lime may occur in the lower part of the subsoil and in the substratum, particularly where this soil is associated with the Dinuba soils.

Drainage is good, surface runoff is very slow to slow, and internal drainage is moderately rapid to the silty substratum, then slow to very slow. The root zone is moderately deep to deep, depending on the depth to the silty substratum. The water-holding capacity and natural fertility are moderate. The erosion hazard is slight.

Use and management.—This soil is suited to and used for a wide variety of orchard, vine, row, forage, and pasture crops. In the main, the uses and management problems are similar to those of Hanford fine sandy loam, 0 to 1 percent slopes. Irrigated nonleguminous crops generally respond to nitrogen, but phosphorus has not been beneficial except at the higher levels of production. Phosphorus and sulfur will improve the quality of irrigated legumes, although they may not increase yields.

In general, the silty substratum is not so close to the surface nor so dense and impermeable as to be a major problem. The mat of fine root hairs commonly found just above the substratum indicates that the substratum does restrict the movement of moisture and the development of roots. Periodic plowing to a depth of 18 inches or more probably would help prevent the development of plowsoles, which are common in this intensively cultivated soil.

These soils require careful management to prevent overirrigation and a temporary perched water table. Excessive use of water could create problems but has not, heretofore, because of the scarcity of water and the high cost of pumping. Waterlogging, even for short periods, is serious for the deeper rooted row, forage, and tree crops. Common results of the excessive use of water on these soils in other localities include stunted, missing, and dying trees and vines; reduced yields; and fewer years of full production. Also, excess water moving laterally above the silty substratum is partly responsible for the high water table in associated lower lying soils. (Capability unit IIIs-3; natural land type A_2; Storie index rating 90)

Hanford (Ripperdan) fine sandy loam, shallow variant, 0 to 3 percent slopes (HcA) [4].—This soil is similar to Hanford (Ripperdan) fine sandy loam, moderately deep and deep over silt, 0 to 3 percent slopes, except that the depth to the silty substratum is ordinarily about 12 inches and it may be as little as 6 inches. The moisture-holding capacity and natural fertility are low, and the root zone is shallow.

Use and management.—Irrigated pasture and shallow-rooted crops are the principal and best uses for this soil. Areas large enough to be managed separately need smaller and more frequent applications of irrigation water and fertilizer than the deeper Hanford soils. Many of the areas are small and are associated with more extensive areas of deeper Hanford and other soils; in these areas special practices are difficult or impractical to apply. Periodic cultivation to depths of more than 18 inches probably will help to increase the effective rooting and moisture-holding depth and to prevent or eliminate plowsoles, which are common in the intensively cultivated areas. (Capability unit IIIs-3; natural land type A_9; Storie index rating 42)

Hideaway Series

The Hideaway series consists of very shallow, brown, medium-textured soils derived from basaltic lava flows that cap mesas in the foothills of the Sierra Nevada at an elevation of about 2,200 feet (fig. 12). Stones almost cover the surface in many places, and in other places bedrock is at the surface. The soils are nearly level to gently sloping. Near the margins of the basaltic flows there are steep, escarpmentlike breaks. The vegetation consists of annual grasses and herbs and, along the edges of the mesas, some brush and Digger pine.

The principal associated soils are the Ahwahnee and Auberry soils, which were derived from the granitic rocks that generally underlie the lava flows.

These soils are used for range exclusively.

Hideaway very stony loam, 0 to 8 percent slopes (HkB).—This soil occurs in the foothills of the Sierra Nevada, principally in association with the Ahwahnee and Auberry soils. Most of the acreage is nearly level, but irregularities and other variations in slope ranging up to 8 percent occur within short distances.

[3] This soil was described under the series name "Ripperdan" in University of California Soil Survey Report No. 12, Soils of Madera County, California, and in some other University of California publications.

[4] See footnote 3.

Figure 12.—**Stony Hideaway soils on flat, basaltic mesa, in background; Vista and Ahwahnee soils on dissected lower areas.**

Representative profile:

0 to 10 inches, brown and slightly hard to hard (dark-brown and friable when moist) very stony loam; very weak, very fine, granular structure; strongly acid; moderate in organic matter; abrupt boundary.
10 inches +, black to very dark gray, scoriaceous basalt that shows little or no weathering.

Soil-filled cracks extend several feet into the bedrock. The usual depth to bedrock is about 12 inches. In some areas the material just above the bedrock is reddish brown.

Drainage is good, surface runoff is very slow to slow, and internal drainage is medium. The root zone is very shallow to shallow, and the moisture-holding capacity and natural fertility are low. The erosion hazard is slight.

Use and management.—This soil is used exclusively for range. Except for good range management, little can be done for a soil that is so stony, shallow, and low in water-holding capacity. (Capability unit VIIe-9; natural land type E_8; Storie index rating 14)

Hideaway very stony loam, 15 to 30 percent slopes (HkD).—This soil consists of small hills of basalt with a small amount of soil material between the rocks. It has more rock outcrops than Hideaway very stony loam, 0 to 8 percent slopes. Runoff is medium, and the erosion hazard is severe.

Use and management.—This soil is used for range exclusively. It produces little forage. It has about the same management problems as Hideaway very stony loam, 0 to 8 percent slopes. (Capability unit VIIe-9; natural land type E_8; Storie index rating 10)

Hildreth Series

The soils of the Hildreth series occupy very gently sloping swales and drainageways in the terraces and lower foothills along the edge of the Sierra Nevada. These soils are dark gray and fine textured. They rest, at a moderate depth, on an unrelated substratum of metamorphic rock, granitic rock, or softly consolidated old granitic alluvium. The parent material was probably derived largely from granitic rocks. The vegetation is annual grasses and herbs and, in the wetter areas, rushes.

These soils are associated with the Cometa and San Joaquin and, in places, the Daulton and Vista soils.

The Hildreth soils are used for dryfarmed grain and for range.

Hildreth sandy clay, 0 to 3 percent slopes (HmA).—This inextensive soil occupies swales in the terraces and lower foothills of the Sierra Nevada.

Representative profile:

0 to 12 inches, dark-gray and extremely hard (darker gray and very firm when moist) sandy clay; neutral; weak, very coarse to fine, blocky structure when dry, and essentially massive when moist; moderately low in organic matter.
12 to 21 inches, dark-gray and extremely hard (darker gray and very firm when moist) sandy clay; moderately alkaline; slightly calcareous; lime mostly segregated in soft nodules and streaks; weak, very coarse to fine, blocky structure when dry, and essentially massive when moist; moderately low in organic matter.
21 to 34 inches, gray and extremely hard (dark-gray and very firm when moist) sandy clay loam; moderately calcareous, the lime mostly in seams and soft nodules; moderately alkaline; weak, coarse, blocky structure; abrupt boundary.

34 inches +, partly weathered granitic rock not related to the soil above.

The principal variations are in the depth to and nature of the unrelated substratum. The depth varies from 30 to 60 inches. There may be a few lime-coated pebbles just above the substratum. The substratum may be metamorphic rock, granitic rock, or softly consolidated, old granitic alluvium. There are a few alkali spots.

Although this soil may have been poorly drained at some previous time, it is now imperfectly drained. Surface runoff is very slow, and internal drainage is slow. Intermittent ponding occurs, and there are slowly seeping springs in places. The root zone is moderately deep. The natural fertility is moderate, and the water-holding capacity is moderate to high, depending on the depth to the substratum. The erosion hazard is slight.

Use and management.—This soil is used exclusively for dryfarmed grain and for range. Grain might respond to phosphorus, alone or with small amounts of nitrogen, if the fertilizer were placed close to the seed. Range remains green longer on this soil than on the adjacent soils and provides more green forage late in spring. Legumes are likely to respond to phosphorus and sulfur. Range grasses would benefit from the nitrogen supplied by the legumes.

If this soil were irrigated, nonleguminous crops would respond to nitrogen and legumes to phosphorus and sulfur. (Capability unit IIIw–5; natural land type A_4; Storie index rating 40)

Hildreth-San Joaquin complex, 0 to 8 percent slopes (HnB).—This complex consists of channels or swales of Hildreth sandy clay and slightly higher "islands" of San Joaquin sandy loam, so closely associated that separating them was impractical. The San Joaquin soils are similar to those described under the heading "San Joaquin Series."

Use and management.—This complex is used for range and dryfarmed grain. It has the management problems of both kinds of soils and requires a compromise plan of management that can be applied to the complex as a whole. Managing the two soils differently is impractical. (Capability unit IIIw–5; natural land types A_4, C_{13}; Storie index rating 34)

Holland Series

The soils of the Holland series developed from residuum weathered from coarse-grained granitic rocks. They occupy the more strongly sloping higher foothills and lower mountains. In this Area they are generally at altitudes of 2,800 to 3,500 feet or more. The annual precipitation ranges from about 25 to 40 inches; some of it is snow. These soils have a grayish-brown, moderately coarse textured surface soil and a reddish-brown, moderately fine textured subsoil. They resemble the Auberry soils, which occur at lower elevations and are brownish throughout. At the lower elevations the vegetation is open and parklike and consists of annual grasses and herbs, scattered blue oaks, live oaks, black oaks, and Digger pines, groves of ponderosa pines, and some ceanothus and manzanita brush. At the higher elevations, the trees are more numerous and are mainly ponderosa pines; some sugar pines and incense-cedars grow on north-facing slopes.

These soils are used chiefly for woodland range at the lower elevations and for timber production at the higher elevations.

Holland sandy loam, 15 to 30 percent slopes (HoD).—This soil occupies an extensive area in the higher foothills and lower mountains, generally in areas above the Auberry soils.

Representative profile:

0 to 6 inches, grayish-brown and slightly hard (very dark brown and friable when moist) sandy loam; slightly acid; highly micaceous; moderate, medium and fine, granular structure; moderate in organic matter.

6 to 11 inches, brown and slightly hard (dark-brown and friable when moist) heavy sandy loam; medium acid; weak, fine, granular structure when moist, and nearly massive when dry; somewhat lower in organic matter than layer above.

11 to 22 inches, light-brown and hard (dark-brown and firm when moist) light sandy clay loam; medium acid; weak, coarse, subangular blocky structure.

22 to 44 inches, reddish-brown and very hard (yellowish-red and firm when moist) sandy clay loam; strongly acid; moderate, medium, subangular blocky structure.

44 to 58 inches, very pale brown and hard (yellowish-brown and friable when moist) sandy loam; medium acid; massive.

58 inches +, varicolored, weathered, disintegrating granitic rock, less altered with increasing depth.

The principal variations are in reaction and color. The reaction is less acid at the lower elevations and more acid at the higher elevations; the color is more brownish at the lower elevations and reddish brown at the higher elevations. The surface litter varies in kind and thickness, depending on the vegetative cover.

This soil is well drained; surface runoff is medium, and internal drainage is moderately slow. The root zone is deep. The available water holding capacity and natural fertility are moderate. There is a moderate hazard of erosion.

Use and management.—These soils are used mainly for commercial production of coniferous trees. They are also valuable as part of the watershed, as wildlife habitats, and for recreational purposes. Some areas, mostly at the lower elevations, have been used for woodland range. Orchard crops, principally apples and pears, have been grown on Holland soils where irrigation water is available, but there has been little of this kind of use in the Madera Area.

Timber production is probably the best use, especially for the areas at the higher elevations. Ponderosa pine and sugar pine are the most valuable conifers. The forestry potential is fairly high. This soil has a class II site index on the Dunning scale for ponderosa pine; that is, the trees will be about 150 feet tall at 300 years of age. (Capability unit VIe–4; natural land type E_1; Storie index rating 46)

Holland sandy loam, 30 to 45 percent slopes (HoE).—This soil is similar to Holland sandy loam, 15 to 30 percent slopes, but the depth to bedrock is less in most places. Runoff is rapid.

Use and management.—This soil is used for woodland range and for timber. If used for timber, it is managed in about the same way as Holland sandy loam, 15 to 30 percent slopes. Woodland range on this soil is more difficult to keep clear of brush, and fertilizing is not feasible. (Capability unit VIIe–4; natural land type E_9; Storie index rating 17)

Holland rocky sandy loam, 30 to 45 percent slopes (HrE).—Except for being shallower in many places and having many large outcrops of granitic rock, this soil is similar to Holland sandy loam, 30 to 45 percent slopes.

Use and management.—This soil is used for woodland range and timber. In use and management it is similar to Holland sandy loam, 30 to 45 percent slopes. (Capability unit VIIe-4; natural land type E_{12}; Storie index rating 13)

Hornitos Series

The soils of the Hornitos series occupy rolling to hilly areas in the lower foothills. They were derived from conglomerate and sandstone of the Ione formation. These soils are typically shallow to very shallow and rest abruptly on weathered bedrock. Rock outcrops are numerous in places. The parent rock was derived from weathered resistant minerals, mainly quartz and kaolinite, and both the rock and the soil are medium to strongly acid. The vegetation is annual grasses and herbs and, in the rougher areas of outcropping bedrock, a few scattered oaks.

The principal associated soils are of the Daulton, Sesame, Vista, Corning, and Redding series.

The Hornitos soils are used for range, except for a few fringe areas planted to dryfarmed grain.

Hornitos gravelly sandy loam, 3 to 8 percent slopes (HsB).—Like the other Hornitos soils in the Madera Area, this soil was derived mostly from Ione conglomerate rather than sandstone, and, consequently, it is gravelly. It occurs in several localities in the lower foothills, mainly just to the west of Vista soils.

Representative profile:

0 to 9 inches, pale-brown and slightly hard (dark-brown and very friable when moist) gravelly sandy loam; medium acid; very weak, very fine, granular structure when moist, and essentially massive when dry; moderately low in organic matter.

9 to 22 inches, banded light olive-brown to olive-yellow and strong-brown, weathered, massive, softly consolidated Ione conglomerate; the strong-brown bands are finer textured; the yellowish bands are gravelly and moderately coarse textured; strongly acid.

22 inches +, predominantly light olive-brown or olive-yellow, slightly weathered Ione conglomerate, strongly acid.

The depth to bedrock is variable, but typically it is less than 15 inches. In small areas in swales, in pockets, and on colluvial foot slopes, a thin zone that has a somewhat finer texture and a weak, subangular block structure is present in the subsoil, just above the bedrock. In the spots where the bedrock is sandstone, the profile is free of gravel.

Drainage is good, runoff is slow, and internal drainage is rapid. The root zone is shallow to very shallow. The natural fertility and water-holding capacity are low, and the erosion hazard is moderate.

Use and management.—This soil is used mainly for range, but small tracts are in dryfarmed grain. The possibilities for more intensive use are very limited. (Capability unit VIIe-9; natural land type E_8; Storie index rating 22)

Hornitos gravelly sandy loam, 8 to 30 percent slopes (HsD).—Except for being steeper and somewhat shallower, this soil is similar to Hornitos gravelly sandy loam, 3 to 8 percent slopes. Drainage is good to somewhat excessive. Runoff is slow to medium, and the erosion hazard is severe.

Use and management.—This soil is used exclusively for range. It has about the same management problems as Hornitos gravelly sandy loam, 3 to 8 percent slopes. (Capability unit VIIe-9; natural land type E_8; Storie index rating 20)

Hornitos very rocky sandy loam, 8 to 30 percent slopes (HvD).—This soil consists of many outcrops of parent rock and relatively small pockets of Hornitos gravelly sandy loam. Drainage is good to somewhat excessive. Runoff is slow to medium, and the erosion hazard is severe.

Use and management.—This soil is suited only to limited grazing. It produces meager forage in spring. (Capability unit VIIe-9; natural land type E_{16}; Storie index rating 8)

Jesbel Series

The Jesbel series consists of dark-colored soils that have both a claypan and a lime-cemented hardpan in the subsoil. These soils occur on old, low terraces. The parent material consisted of gravelly and cobbly alluvium derived from metamorphosed sedimentary rocks, chiefly slate of the Mariposa formation, judging by the number of chiastolite crystals throughout the profile. The slopes are gentle, and the vegetation is chiefly annual grasses and herbs.

These soils are similar to the Buchenau soils but have been leached of lime and have a claypan above the lime-cemented hardpan. In places they have a clay texture to the surface; the soil in these areas is either eroded or at a more highly weathered stage of soil formation.

Jesbel soils are used mostly for range and dryfarmed grain.

Jesbel gravelly clay loam, 0 to 3 percent slopes (JyA).—This inextensive soil is on old low terraces. Numerous chiastolite crystals throughout the profile, especially in the surface soil, suggest that the parent material was derived from the Mariposa formation and the Daulton soils.

Representative profile:

0 to 5 inches, dark grayish-brown and hard (very dark grayish-brown and firm when moist) gravelly clay loam; neutral; weak, fine, granular structure; moderate in organic matter.

5 to 14 inches, dark grayish-brown and hard (very dark grayish-brown and firm when moist) gravelly clay loam; weak, fine, granular structure; neutral; moderately low in organic matter.

14 to 24 inches, dark-brown and very hard (darker brown and very firm when moist) gravelly light clay with colloidal coatings; neutral; strong, medium, blocky structure.

24 to 33 inches, white (light-gray when moist), strongly lime-cemented gravelly hardpan (caliche).

33 to 42 inches, brown and slightly hard (dark-brown and very friable when moist) gravelly sandy loam; mildly alkaline; moderately calcareous; massive; amount of gravel increases with depth.

All areas contain some gravel, but not all areas have enough to be mapped as gravelly soil. The depth to and thickness of both the claypan and the lime hardpan are variable.

Although possibly less well drained at some previous time, this soil is now well drained. Runoff is slow. Internal drainage is very slow because of the claypan and hardpan. The root zone is shallow. The moisture-holding capacity and natural fertility are moderate. The erosion hazard is slight.

Use and management.—This soil is used for range and dryfarmed grain. It has about the same management problems as Madera fine sandy loam, 0 to 3 percent slopes. If irrigated, it would be best suited to shallow-rooted row and forage crops and grass-legume pasture. (Capability unit IVs–3; natural land type C_{16}; Storie index rating 28)

Jesbel clay, 0 to 3 percent slopes (JeA).—This soil is blocky clay to the surface and contains little gravel. Otherwise, it is similar to Jesbel gravelly clay loam, 0 to 3 percent slopes.

Use and management.—This soil is used in much the same way and has much the same management problems as Raynor clay, 0 to 3 percent slopes. Because of its fine texture it is suitable for cultivation only within a narrow range of moisture content. This characteristic would be significant if the soil were irrigated, but it is not especially important under present circumstances. Prospects of irrigation are remote. (Capability unit IIIs–5; natural land type C_{14}; Storie index rating 21)

Jesbel gravelly clay, 3 to 8 percent slopes (JgB).—Except for having gravel in the surface soil and having stronger slopes, this soil is similar to Jesbel clay, 0 to 3 percent slopes. Runoff is slow to medium.

Use and management.—This soil is used in about the same way as Jesbel clay, 0 to 3 percent slopes, but needs more precautions to control erosion. The gravel interferes somewhat with cultivation. (Capability unit IIIs–5; natural land type C_{14}; Storie index rating 19)

Lewis Series

The soils of the Lewis series contain a lime-silica hardpan much like that in the Fresno soils. They developed from mixed alluvium. They occupy the lower ends of old low terraces and are nearly level but have a hogwallow microrelief. The vegetation is saltgrass, alkali-tolerant plants, annual grasses, and herbs.

These soils are associated with and transitional in character between the Madera and the Fresno soils. They differ from the Fresno soils in having a fine-textured subsoil with a strong blocky structure just above the hardpan. A strongly alkaline subsoil and a lime-silica rather than an iron-silica hardpan are the principal characteristics that distinguish them from the Madera soils.

The Lewis soils are used mainly for dry range, but some areas have been leveled and used for irrigated pasture, grain, row, and forage crops.

Lewis loam, slightly saline-alkali, 0 to 1 percent slopes (LeA).—This hardpan soil occurs between the Madera and Fresno soils on old, low terraces. Up to 25 percent of the area is salt- and alkali-affected to the surface.

Representative profile:

0 to 5 inches, pale-brown and hard (dark yellowish-brown and firm when moist) loam; very weak, thin, platy structure to massive; mildly alkaline; very slightly calcareous; moderate in organic matter.

5 to 11 inches, dark grayish-brown and very hard (very dark grayish-brown and very firm when moist) loam; essentially massive; mildly alkaline; very slightly calcareous; moderately low in organic matter.

11 to 40 inches, brown and very hard (dark-brown and very firm when moist) clay loam with colloidal coatings; strong, fine, angular blocky structure; moderately calcareous; strongly alkaline; lime occurs in light-colored, soft masses and also in small nodules.

40 to 48 inches, brown (dark-brown when moist), weakly cemented lime-silica hardpan; strongly calcareous; strongly alkaline; the lime is in very hard, veinlike segregations.

48 to 60 inches +, brownish-yellow and hard (yellowish-brown and firm when moist) loam; slightly stratified and very weakly cemented in places; massive; slightly calcareous; moderately alkaline.

The depth to the hardpan is variable; it ranges from 20 to as much as 45 inches. The hardpan is weakly to strongly cemented, and it varies in hardness, and in thickness also, within short distances. In places the subsoil structure is not so well developed as in the profile described.

Drainage is imperfect. Runoff and internal drainage are very slow. The root zone is moderately deep. The natural fertility and water-holding capacity are moderate. The erosion hazard is slight.

Use and management.—Range is the principal use. Some areas have been leveled and planted to irrigated pasture, cotton, and grain. The management problems are about the same as for Fresno and El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes.

If reclaimed, this soil is best suited to irrigated pasture or shallow-rooted crops. Because there is both a claypan and a hardpan, reclamation is slow. Irrigated nonleguminous crops need nitrogen, and legumes need phosphorus and sulfur. In other localities Lewis soils have been used successfully for irrigated rice, particularly while in the process of reclamation. Deep leaching and applying gypsum or sulfur bring improvement most rapidly. (Capability unit IIIs–8; natural land type $B_{13\text{-}2s}$; Storie index rating 17)

Lewis loam, moderately saline-alkali, 0 to 1 percent slopes (LwA).—Except that 25 to 70 percent of the acreage is saline-alkali to the surface, this soil is similar to Lewis loam, slightly saline-alkali, 0 to 1 percent slopes.

Use and management.—Range is the principal use, especially of the areas most affected by salts and alkali. There are numerous barren spots.

This soil is more difficult to reclaim than Lewis loam, slightly saline-alkali, 0 to 1 percent slopes. It requires more leaching and larger amounts of gypsum or sulfur, and it improves more slowly. If reclaimed it would be best suited to irrigated pasture or shallow-rooted crops. (Capability unit IVs–8; natural land type $B_{13\text{-}2m}$; Storie index rating 10)

Madera Series

The Madera series consists of iron-silica hardpan soils on old, low terraces. The parent material was somewhat mixed, but most of it was derived from granitic rocks. The subsoil is neutral and in some places is slightly calcareous just above the hardpan. The hardpan is yellowish brown and contains slight amounts of segregated lime. Unleveled areas have a hummocky, or hogwallow, microrelief and in the intermound areas may merge with small bodies of Alamo clay. The vegetation is mainly annual grasses and herbs.

In many ways the Madera soils resemble the associated San Joaquin soils, but they are brownish in both the surface soil and the subsoil.

Unirrigated areas are used for range and dryfarmed grain. Irrigated areas are planted to pasture, row, forage, and vine crops, principally alfalfa, cotton, sorghum, and grapes.

Madera fine sandy loam, 0 to 3 percent slopes (MaA).—This soil occurs extensively on the low, old terraces, principally in association with the San Joaquin and Alamo soils.

Representative profile:

0 to 9 inches, light yellowish-brown and extremely hard (dark yellowish-brown and friable when moist) fine sandy loam; very weak, very fine, granular structure when moist, and essentially massive when dry; medium acid; low in organic matter.

9 to 18 inches, yellowish-brown and extremely hard (dark yellowish-brown and firm when moist) light sandy clay loam; neutral; weak, coarse, prismatic structure.

18 to 25 inches, yellowish-brown and extremely hard (dark yellowish-brown and firm when moist) sandy clay; neutral; weak, coarse, prismatic and moderate, medium, blocky structure.

25 to 28 inches, yellowish-brown (dark yellowish-brown when moist) indurated hardpan; silica and iron appear to be the principal cementing agents; lime is segregated in fine seams; cementation strongest in uppermost few inches, less strong in the lower part; manganese stainings conspicuous throughout the mass.

28 to 60 inches +, pale-brown and hard (brown and firm when moist) gritty sandy loam; slightly stratified and very weakly cemented in places; massive; mildly alkaline.

The reaction is somewhat variable but typically becomes more alkaline with increasing depth; just above the hardpan, it is neutral. In places there is a slight amount of disseminated lime just above the hardpan. In texture, the subsoil ranges from heavy loam to sandy clay. The depth to and hardness of the hardpan vary only slightly.

Drainage is good. Surface runoff is very slow to slow, and internal drainage is very slow. The root zone is moderately deep, and the natural fertility and available water holding capacity are moderate. The erosion hazard is slight.

Use and management.—Unirrigated areas are used for range and dryfarmed small grain. Stands of legumes are likely to be improved by the application of phosphorus and gypsum or some other carrier of sulfur. In turn, the additional nitrogen supplied by the legumes benefits the grasses, and more forage is produced. Dryfarmed grain benefits from phosphorus, alone or with a small amount of nitrogen.

If irrigated, these soils are used principally for pasture and for row and forage crops, including alfalfa, cotton, sorghum, and grapes. Because of its restricted rooting depth, this soil is best suited to pastures of shallow-rooted legumes and grasses. Ladino clover is one of the best suited legumes. Phosphorus and sulfur benefit the legumes in the stand, and the legumes provide sufficient nitrogen for the grasses. Nonleguminous field crops respond to nitrogen. At high levels of production, they also respond to phosphorus. (Capability unit IVs–3; natural land type C_{13}; Storie index rating 28)

Madera-Lewis complex, slightly saline-alkali, 0 to 1 percent slopes (MdA).—Up to 15 percent of this complex is affected by salts and alkali to the surface. The soil in the saline-alkali affected areas is Lewis fine sandy loam; the rest is Madera fine sandy loam.

Use and management.—This complex is used in much the same way as Madera fine sandy loam, 0 to 3 percent slopes. Periodic leaching and applications of gypsum or sulfur and manure improve the saline-alkali areas. (Capability unit IVs–3; natural land type $C_{13\text{-}2s}$; Storie index rating 26)

Madera loam, 0 to 3 percent slopes (MbA).—Except for a finer textured surface layer, this soil is similar to Madera fine sandy loam, 0 to 3 percent slopes. It has slightly higher water-holding capacity and is a little more fertile.

Use and management.—This soil is used in much the same way as Madera fine sandy loam, 0 to 3 percent slopes. (Capability unit IVs–3; natural land type C_{13}; Storie index rating 25)

Madera-Alamo complex, 0 to 1 percent slopes (McA).—This complex consists of Madera fine sandy loam and Alamo clay in such close association that it was impractical to separate them in mapping. Alamo clay is described under the heading "Alamo Series."

Use and management.—This complex is used mostly for dryfarmed grain and for range. In use and management it is similar to the San Joaquin-Alamo complex described under "San Joaquin Series." Management is difficult because of the contrasting nature of the two soils and their complex association. (Capability unit IVs–3; natural land type C_{13}; Storie index rating 17)

Marguerite Series

The soils of the Marguerite series developed from alluvium derived from dark-colored (graphitic) slate and schist of the Mariposa formation and from the soils formed thereon. These soils occupy gently sloping, slightly elevated positions on the somewhat older terraces and alluvial fans near the foothills along Berenda Creek and its tributaries. Drainage is good, but there are saline-alkali spots, probably old seep spots, in which the profile is slightly calcareous. The vegetation is annual grasses and herbs and, in the saline-alkali spots, some saltgrass and other salt-tolerant plants.

These soils are used for dryfarmed grain and range.

Marguerite loam, 0 to 3 percent slopes (MoA).—This gently sloping terrace soil occurs in the lower foothills along Berenda Creek and its tributaries. The parent material was alluvium derived from the Mariposa formation and the Daulton soils.

Representative profile:

0 to 10 inches, gray and hard (very dark gray and friable when moist) loam; weak, fine, granular structure when moist, and essentially massive when dry; slightly acid; moderately low in organic matter.

10 to 29 inches, grayish-brown and hard (very dark grayish-brown and friable when moist) heavy loam with thin colloidal coatings; neutral; weak, fine, subangular blocky structure.

29 to 38 inches, grayish-brown and hard (very dark grayish-brown and friable when moist) heavy loam with thin colloidal coatings; neutral; weak, medium, subangular blocky structure.

38 to 60 inches +, brown and hard (dark-brown and friable when moist), massive, stratified fine sandy loam and loam; neutral; very slightly calcareous in a few places; some strong-brown iron stains.

The lower part of the subsoil and the substratum range from lime free to very slightly calcareous. The lime is mainly in streaks or seams.

Drainage is good. Surface runoff is very slow to slow, and internal drainage is medium. The root zone is very deep, and the available moisture holding capacity and natural fertility are moderate. The erosion hazard is slight.

Use and management.—This soil is used exclusively for dryfarmed grain and for range. Grain responds to phosphorus, alone or with small amounts of nitrogen. Range grasses respond to nitrogen, and range legumes to phosphorus and sulfur.

If irrigated, this soil would be suited to most row, forage, and pasture crops. It would need nitrogen for nonleguminous crops and phosphorus and sulfur for legumes. (Capability unit I–1; natural land type A_1; Storie index rating 95)

Marguerite loam, slightly saline-alkali, 0 to 3 percent slopes (MrA).—This soil is similar to Marguerite loam, 0 to 3 percent slopes, but up to 25 percent of the acreage is saline-alkali to the surface. The saline-alkali spots are slightly calcareous throughout the profile, and they support saltgrass and other tolerant plants.

Use and management.—This soil is used in much the same way as Marguerite loam, 0 to 3 percent slopes. Without irrigation, little can be done to remove the salts and alkali. In irrigated areas salts and alkali can be removed readily by deep leaching and the application of gypsum or sulfur. (Capability unit IIs–6; natural land type $A_{1\text{-}2s}$; Storie index rating 66)

Marguerite loam, moderately saline-alkali, 0 to 3 percent slopes (MsA).—From 25 to 70 percent of this soil is saline-alkali to the surface. In the saline-alkali spots, water moves slowly through the profile, and saltgrass and other salt- and alkali-tolerant plants are common.

Use and management.—This soil is used in much the same way as Marguerite loam, slightly saline-alkali, 0 to 3 percent slopes. For unreclaimed areas, range is probably the best use. For irrigated areas in the process of reclamation, pasture is probably the best use. (Capability unit IIIs–6; natural land type $A_{1\text{-}2m}$; Storie index rating 38)

Marguerite clay loam, 0 to 3 percent slopes (MmA).—This soil occupies small local drainages that extend from the foothills onto the terraces and fans. Part of the parent material is alluvium washed from the Raynor soils. Presumably this material accounts for the moderately fine texture of the soil. Internal drainage is moderately slow, and the water-holding capacity and natural fertility are high.

Use and management.—This soil is used in much the same way as Marguerite loam, 0 to 3 percent slopes. (Capability unit I–1; natural land type A_1; Storie index rating 81)

Marguerite clay loam, moderately saline-alkali, 0 to 3 percent slopes (MnA).—Except that 25 to 70 percent of the acreage is saline-alkali to the surface, this soil is similar to Marguerite clay loam, 0 to 3 percent slopes. Saltgrass and alkali-tolerant plants are common.

Use and management.—This soil is used primarily for range. Because of the salts and alkali, range is probably its best use. If irrigated, it could be reclaimed by deep leaching and applications of gypsum or sulfur. If reclaimed, it would be comparable to Marguerite clay loam, 0 to 3 percent slopes, and would have similar management problems. (Capability unit IIIs–6; natural land type $A_{1\text{-}2m}$; Storie index rating 32)

Montpellier Series

The soils of the Montpellier series occupy undulating to rolling, dissected, old, low terraces. These soils have a coarse sandy loam surface soil and a dense, reddish to reddish-brown sandy clay loam subsoil. They were derived from gritty, moderately coarse textured, granitic sediments. The vegetation is chiefly annual grasses and herbs.

The Montpellier soils occupy the same topographic position as the Whitney soils. The Whitney soils, however, are brown and have only a slight accumulation of clay in the subsoil. The Cometa soils have a profile similar to that of the Montpellier, but their subsoil is somewhat thinner and is a sandy clay.

Montpellier soils are used mostly for dryfarmed grain. Uncultivated areas are used as range.

Montpellier coarse sandy loam, 3 to 8 percent slopes (MtB).—This is a gently rolling soil on old, low terraces.

Representative profile:

0 to 11 inches, brown and hard (dark-brown and friable when moist) coarse sandy loam; slightly acid; very weak, very fine, granular structure when moist, and essentially massive when dry; low in organic matter.

11 to 23 inches, reddish-brown and very hard (red and firm when moist) light sandy clay loam with colloidal coatings; slightly acid; weak, medium, prismatic and weak, medium, blocky structure.

23 to 40 inches, reddish-brown and very hard (red and firm when moist) light sandy clay loam with colloidal coatings; slightly acid; weak, coarse, blocky structure to massive.

40 to 60 inches, yellowish-red and hard (darker yellowish-red and firm when moist) coarse sandy loam interstratified with some fine gravel; slightly acid; massive.

This soil varies mainly in color of the surface soil and depth to and thickness of the subsoil. The surface soil may be grayish brown, brown, or pale brown. The subsoil ranges from heavy sandy loam to clay loam and contains considerable gritty sand.

This soil is well drained. Surface runoff and internal drainage are slow. The root zone is only moderately deep because of the dense, slowly permeable, claypanlike subsoil. The available moisture holding capacity and natural fertility are low. The erosion hazard is moderate.

Use and management.—This soil is used mainly for dryfarmed grain and range. In use and management it is comparable to Cometa sandy loams, 3 to 8 percent slopes. (Capability unit IVe–3; natural land type D_9; Storie index rating 43)

Montpellier coarse sandy loam, 8 to 15 percent slopes (MtC).—The profile of this soil is more variable than that of Montpellier coarse sandy loam, 3 to 8 percent slopes, and the average depth to the claypanlike subsoil is slightly less. Erosion may partly account for the shallower profile. Runoff is medium, and the erosion hazard is severe.

Use and management.—This soil is used mostly for range and dryfarmed small grain. It needs about the same management as Montpellier coarse sandy loam, 3 to 8 percent slopes, but needs a little more attention to erosion control. Range, with only an occasional crop of small grain, is probably the best use. Legume-grass pasture is the best use for irrigated areas. (Capability unit IVe-3; natural land type D_9; Storie index rating 40)

Pachappa Series

The soils of the Pachappa series are on nearly level alluvial fans composed mostly of slightly older granitic alluvium. The areas are no longer subject to overflow. Over most of the acreage, the subsoil is strongly alkaline because of the presence of salts and alkali. Drainage is now generally good, but the salts and alkali indicate that in the past drainage was restricted. The vegetation is annual grasses and herbs and, in the saline-alkali areas, saltgrass and other tolerant plants.

The Pachappa soils are similar to the Greenfield soils but contain lime in the subsoil. They resemble the Chino soils but have a grayish-brown surface soil and contain less lime in the subsoil. The Grangeville soils also resemble the Pachappa, but they were derived from more recent alluvium, they lack the accumulation of clay in the subsoil, and they are typically less calcareous than the Pachappa soils.

Some areas are used for dryfarmed grain and range, but most of the acreage is irrigated and planted to cotton, alfalfa, row crops, and grapes.

Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes (PbA).—This soil occurs throughout the major alluvial fans. It occupies the slightly older parts of the fans and is no longer subject to overflow. Up to 25 percent of this soil is saline-alkali.

Representative profile:

0 to 14 inches, grayish-brown and slightly hard (very dark grayish-brown and very friable when moist) fine sandy loam; noncalcareous; neutral; very weak, very fine, granular structure when moist, and essentially massive when dry; micaceous; low in organic matter.

14 to 28 inches, brown and hard (dark-brown and friable when moist) loam with colloidal coatings; strongly alkaline; weak, medium, subangular blocky structure; micaceous; moderately calcareous; lime both disseminated and segregated along tubular pores and in small concretions.

28 to 45 inches, brown and hard (dark-brown and friable when moist) fine sandy loam; very weak, medium, subangular blocky structure; slightly calcareous; strongly alkaline.

45 to 60 inches +, brown and slightly hard (dark-brown and very friable when moist) stratified fine sandy loam and loamy sand; moderately alkaline; massive; very slightly calcareous.

The surface soil ranges from pale brown to grayish brown. The depth to lime ranges up to 24 inches; it depends chiefly on the presence or absence of salts and alkali. A few areas that have a loam surface soil are included.

Drainage is good, surface runoff is very slow, and internal drainage is medium. The root zone is very deep, and the moisture-holding capacity and natural fertility are moderate. The erosion hazard is slight.

Use and management.—This soil is used for many crops, including irrigated pasture, cotton, alfalfa, and grapes and dryfarmed grain and range. Because of the salts and alkali, it is best suited to shallow-rooted pasture, row, and forage crops and is not well suited to orchard crops. Under irrigation, nonleguminous crops are most likely to respond to nitrogen, and legumes to phosphorus and sulfur. Dryfarmed grain is most likely to benefit from phosphorus, alone or with a small amount of nitrogen. Stands of range legumes increase if phosphorus and sulfur are applied, and the additional nitrogen fixed by the legumes benefits the grasses and consequently improves the carrying capacity of the range.

The salts and alkali in the subsoil do not seriously affect dryfarmed grain, range, or shallow-rooted irrigated crops. Eliminating the excess salts and alkali and reducing the alkalinity would broaden the suitability of the soil to include deep-rooted irrigated crops. Periodic deep leaching alone will gradually remove the excess salts and alkali. Applying gypsum or sulfur speeds reclamation somewhat. (Capability unit IIs-6; natural land type A_{1-2s}; Storie index rating 76)

Pachappa fine sandy loam, 0 to 1 percent slopes (PaA).—This soil is similar to Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes, but has a moderately alkaline reaction in the subsoil and is not affected by excess salts and alkali.

Use and management.—This soil is used in much the same way as Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes, but is suited to a wider range of crops. It is one of the better soils for irrigated crops and especially for deep-rooted crops sensitive to salts and alkali in the subsoil. (Capability unit I-1; natural land type A_1; Storie index rating 95)

Pachappa sandy loam, 0 to 1 percent slopes (PcA).—This soil is somewhat coarser textured throughout than Pachappa fine sandy loam, 0 to 1 percent slopes. Consequently, internal drainage is slightly more rapid, and the natural fertility and water-holding capacity are a little lower. Included are a few small areas of Pachappa and Chino soils covered with an overwash of Hanford sandy loam.

Use and management.—This soil is used and managed in much the same way as Pachappa fine sandy loam, 0 to 1 percent slopes. (Capability unit I-1; natural land type A_1; Storie index rating 90)

Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes (PdA).—This soil is somewhat coarser textured throughout than Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes. Up to 25 percent of the acreage is saline-alkali to the surface.

Use and management.—This soil is used and managed in much the same way as Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes. (Capability unit IIs-6; natural land type A_{1-2s}; Storie index rating 72)

Pachappa sandy loam, moderately deep and deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes (PeA).—This soil is similar to Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes, but it is underlain at a depth of 30 to 60 inches by an unrelated lime-silica hardpan like that in the Fresno soils. Internal drainage is medium to the hardpan, then very slow. Depending on the depth to the hardpan, the root zone is moderately deep to deep.

Use and management.—Most of this soil is used for range, but if properly managed, it could be used for irrigated pasture, cotton, or grain. Care in irrigation is essential to prevent waterlogging above the hardpan. Otherwise, this soil can be used and managed in about the same way as Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes. (Capability unit IIIs–8; natural land type A_{9-2s}; Storie index rating 60)

Porterville Series

The soils of the Porterville series are reddish brown and fine textured. They were derived from alluvium from fine-grained basic igneous rocks. They are in small, isolated bodies on low foothills and on high terraces, in association with Vista, Daulton, Raynor, and Redding soils. The profile is moderately deep. In this Area the underlying material is typically an unrelated acid igneous rock, but normally the Porterville soils are underlain by alluvium from dark-colored basic igneous rocks. Slopes are gentle to undulating. Drainage is good. The vegetation consists of annual grasses and herbs. In favorable seasons burclover and wild oats grow profusely.

These soils are used exclusively for range, a use to which they are well suited.

Porterville clay, 0 to 3 percent slopes (PfA).—This reddish-brown, fine-textured soil occurs in the lower foothills and higher terraces, principally in association with the Vista, Daulton, and Redding soils. It is similar to Raynor clay, from which it differs mainly in color and in being less calcareous in the subsoil.

Representative profile:

0 to 14 inches, reddish-brown and extremely hard (dark reddish-brown and very firm when moist) clay; noncalcareous; neutral; strong, coarse, blocky structure; when thoroughly dry, granular in the uppermost 1 or 2 inches; moderately low in organic matter.

14 to 22 inches, yellowish-red and extremely hard (reddish-brown and very firm when moist) clay; slightly calcareous; mildly alkaline; moderate, coarse, blocky structure; lime mostly segregated in soft, light-colored masses; small amount of gravel.

22 to 36 inches, slightly lighter colored clay that contains a small amount of gravel; slightly calcareous; mildly alkaline; weak, coarse, blocky structure; becomes more brownish and less calcareous with depth.

36 inches +, coarse-grained acid igneous rock unrelated to the profile above; partially decomposed, and more consolidated with increasing depth.

The color varies between reddish brown and dark brown. In places the subsoil is lime free. The depth to and nature of the unrelated underlying rock is variable. In some places the soil is more than 60 inches deep, but characteristically it is only moderately deep.

Drainage is good, surface runoff is very slow to slow, and internal drainage is slow. The root zone is moderately deep, and the water-holding capacity and natural fertility are moderate. The erosion hazard is slight.

Use and management.—In this Area, this soil is used exclusively for range, but elsewhere it is used for dry-farmed grain and for irrigated pasture, sorghum, figs, and other orchard crops. It is not suited to peaches, almonds, or other lime-sensitive crops.

Range legumes will likely benefit from phosphorus, and range grasses from nitrogen. Dryfarmed grain benefits from phosphorus, alone or with nitrogen, if the fertilizer is placed close to the seed. Figs and other irrigated crops, except legumes, will probably respond to nitrogen. For irrigated areas, grass-legume pasture is probably the best use. (Capability unit IIIs–5; natural land type C_4; Storie index rating 54)

Porterville clay, 3 to 8 percent slopes (PfB).—This soil has a slightly greater erosion hazard than Porterville clay, 0 to 3 percent slopes. Surface runoff is slow.

Use and management.—This soil is used and managed in much the same way as Porterville clay, 0 to 3 percent slopes. (Capability unit IIIs–5; natural land type C_4; Storie index rating 48)

Porterville rocky clay, 3 to 8 percent slopes (PgB).—Except for having numerous outcrops of unrelated bedrock, this soil is similar to Porterville clay, 3 to 8 percent slopes. The depth of the root zone is more variable.

Use and management.—This soil is best suited to range. In management needs it is similar to Porterville clay, 3 to 8 percent slopes. (Capability unit IIIs–5; natural land type C_8; Storie index rating 43)

Pozo Series

The soils of the Pozo series occur in the basin area, at the lower end of old alluvial fans. The parent material was alluvium derived chiefly from granitic rocks. Surface drainage was very slow and the water table was high while these soils were developing. The vegetation is mostly alkali mallow, alkali sacaton, pickleweed, saltgrass, lippia, soft chess, and burclover.

The Pozo soils differ from the associated Rossi soils in having a lime-silica hardpan. They are like the Fresno and El Peco soils except for having a dark-colored, noncalcareous surface soil.

The Pozo soils are used mostly for range. Some areas are irrigated and used for grain, cotton, alfalfa, sorghum, sugar beets, and pasture.

Pozo loam, 0 to 1 percent slopes (PoA).—This soil is similar to and is associated with the slightly saline-alkali Fresno and El Peco loams, but it has a dark-colored surface soil and is free of excess salts and alkali. It occurs quite extensively in the basin and on the lower parts of the alluvial fans.

Representative profile:

0 to 11 inches, dark-gray and hard (black and friable when moist) loam; neutral; weak, very fine, granular structure; moderate in organic matter.

11 to 22 inches, white and hard (light brownish-gray and friable when moist) heavy loam; moderately calcareous; moderately alkaline; massive.

22 to 24 inches, thin white seams alternating with thicker seams of light-gray (grayish-brown when moist), strongly cemented lime-silica hardpan; strongly calcareous; in many places there are several cemented layers alternating with softer material similar to that in the layer below.

24 to 36 inches +, white and hard (light brownish-gray and friable when moist) fine sandy loam; massive; strongly calcareous; moderately alkaline.

The thickness of the dark-colored surface layer and the thickness of and depth to the hardpan are somewhat variable. In leveled areas, the dark-colored surface soil may be entirely removed and the light-colored calcareous material above the hardpan exposed.

Drainage is imperfect; surface runoff and internal drainage are very slow. The root zone is shallow to moderately deep, and the water-holding capacity is low to moderate, depending on the depth to the hardpan. The natural fertility is moderate, and the erosion hazard is slight.

Use and management.—This soil is used for range primarily, but some areas are irrigated and planted to grain, cotton, alfalfa, sorghum, sugar beets, and pasture. Irrigated grass-legume pasture is probably the best use, and narrowleaf (prostrate) trefoil the best suited legume.

In use and management this soil is similar to the slightly saline-alkali Fresno and El Peco loams, but the dark-colored surface soil is more favorable for the establishment and growth of plants, particularly of those that are not salt tolerant. Legumes are most likely to respond to phosphorus and sulfur, and nonleguminous crops to nitrogen. (Capability unit IIIs–3; natural land type B_{13}; Storie index rating 28)

Pozo loam, slightly saline, 0 to 1 percent slopes (PsA).—This soil is similar to Pozo loam, 0 to 1 percent slopes, but is slightly saline. The salts are generally concentrated near the surface.

Use and management.—This soil is used in much the same way as Pozo loam, 0 to 1 percent slopes, and has similar management problems. Correcting the slight salinity by periodic deep leaching makes this soil comparable to Pozo loam. Irrigated grass-legume pasture is probably the best use during and following the reclamation period, because of the hardpan in the subsoil. (Capability unit IIIs–8; natural land type $B_{13\text{-}2s}$; Storie index rating 24)

Pozo loam, moderately saline, 0 to 1 percent slopes (PtA).—This soil is similar to Pozo loam, slightly saline, 0 to 1 percent slopes, but is moderately saline. The salts are generally concentrated near the surface.

Use and management.—This soil is mostly in range. It is not suited to most irrigated crops unless the excess salts are removed by periodic deep leaching. Irrigated grass-legume pasture is probably the best crop to grow during reclamation. If the excess salts are removed, this soil is like Pozo loam, 0 to 1 percent slopes, and needs similar management. (Capability unit IVs–8; natural land type $B_{13\text{-}2m}$; Storie index rating 17)

Pozo loam, strongly saline, 0 to 1 percent slopes (PvA).—This soil is similar to Pozo loam, moderately saline, 0 to 1 percent slopes, but is so strongly saline that only a few salt-tolerant plants survive.

Use and management.—This soil supports only meager plant cover and is all in range. It could be improved by deep leaching and the application of amendments. A number of years of restricted vegetative growth are probable. Irrigated pasture is probably the best use during and following reclamation. (Capability unit VIs–8; natural land type $B_{13\text{-}2a}$; Storie index rating 9)

Pozo clay loam, 0 to 1 percent slopes (PhA).—Except for having a finer surface texture, this soil is similar to Pozo loam, 0 to 1 percent slopes. Infiltration and movement of water through the surface soil are somewhat slower.

Use and management.—This soil is used in much the same way as Pozo loam, 0 to 1 percent slopes. Because of the finer texture, however, more care must be taken to cultivate at the proper moisture content, or infiltration problems will develop. Irrigated grass-legume pasture is probably the best use. (Capability unit IIIs–3; natural land type B_{13}; Storie index rating 24)

Pozo clay loam, slightly saline, 0 to 1 percent slopes (PkA).—This soil is similar to Pozo clay loam, 0 to 1 percent slopes, but is slightly saline. The salts are generally concentrated near the surface.

Use and management.—This soil is used in much the same way as Pozo loam, slightly saline, 0 to 1 percent slopes, and can be reclaimed by similar measures. If reclaimed, it is like Pozo clay loam, 0 to 1 percent slopes, and has similar management requirements. (Capability unit IIIs–8; natural land type $B_{13\text{-}2s}$; Storie index rating 21)

Pozo clay loam, moderately saline, 0 to 1 percent slopes (PmA).—This soil is similar to Pozo clay loam, slightly saline, 0 to 1 percent slopes, but is moderately saline.

Use and management.—This soil is used mostly for range. It is not suited to irrigated crops unless reclaimed. Deep leaching is necessary to eliminate the excess salts. Irrigated grass-legume pasture is probably the best use during reclamation. If reclaimed, this soil is like Pozo clay loam, 0 to 1 percent slopes, and has similar management problems. (Capability unit IVs–8; natural land type $B_{13\text{-}2m}$; Storie index rating 15)

Pozo clay loam, strongly saline, 0 to 1 percent slopes (PnA).—This soil is similar to Pozo clay loam, moderately saline, but is strongly saline.

Use and management.—This soil supports only meager plant cover and is all in range. It can be improved by deep leaching and application of amendments. A number of years of restricted vegetative growth are probable. Irrigated pasture is probably the best use during and following reclamation. If reclaimed, this soil is like Pozo clay loam, 0 to 1 percent slopes, and has similar management requirements. (Capability unit VIs–8; natural land type $B_{13\text{-}2a}$; Storie index rating 7)

Ramona Series

The soils of the Ramona series occupy level to gently sloping areas on the old, low terraces. The parent material was old alluvium derived principally from granitic rocks. The vegetation is mostly annual grasses and herbs and, in places, a few widely scattered oaks.

The Ramona soils occur in long, narrow tracts, most of which traverse areas of the San Joaquin and Madera soils, and are slightly higher than the associated soils. They have more clay in the subsoil and are at a more advanced stage of soil development than the Greenfield soils, which were derived from similar parent material. They are less well developed than the San Joaquin or Madera soils and lack an iron-silica hardpan in the subsoil.

The Ramona soils are used mostly for dryfarmed grain and range, but some are irrigated and planted to figs, grapes, pasture, alfalfa, and cotton.

Ramona sandy loam, 0 to 3 percent slopes (RaA).—This soil is on old, low terraces. It is in a stage of development transitional between that of the Greenfield soils and that of the San Joaquin and Madera soils, which have a hardpan in the subsoil. It is associated with the San Joaquin and Madera soils.

Representative profile:

0 to 8 inches, light-brown and very hard (dark-brown and very friable when moist) sandy loam; medium acid; very

weak, very fine, granular structure when moist, and essentially massive when dry; low in organic matter.
8 to 22 inches, strong-brown and very hard (dark-brown and friable when moist) heavy sandy loam; slightly acid; essentially massive.
22 to 42 inches, strong-brown and very hard (strong-brown and firm when moist) light sandy clay loam with colloidal coatings; slightly acid; weak, medium, prismatic and moderate, coarse, blocky structure.
42 to 60 inches, brown and hard (dark-brown and firm when moist) heavy sandy loam; slightly acid; massive.

This is about the northern limit of distribution of the Ramona soils. In some places a pale brownish color in the surface soil indicates a transition to the Snelling soils, which occur to the north in Merced and Stanislaus counties. In some places the subsoil is reddish brown, which is normal for the Ramona soils of southern California.

Drainage is good, surface runoff is very slow to slow, and internal drainage is moderately slow. The root zone is deep, and the water-holding capacity and natural fertility are moderate. The erosion hazard is slight.

Use and management.—This soil is used principally for dryfarmed grain and range, but irrigated figs, grapes, alfalfa, and cotton are also grown. Dryfarmed grain is most likely to respond to phosphorus, alone or with nitrogen. Range legumes are likely to benefit from phosphorus and sulfur, and the grasses benefit from the increased nitrogen fixed by the legumes. Under irrigation, nonleguminous crops respond to nitrogen, and legumes to phosphorus and sulfur. (Capability unit IIs–7; natural land type C_2; Storie index rating 81)

Ramona sandy loam, 3 to 8 percent slopes (RaB).—This soil occupies small benches and terraces along streams, principally in association with other Ramona soils. The profile is similar to that of Ramona sandy loam, 0 to 3 percent slopes. Runoff is slow.

Use and management.—This soil is used in much the same way as Ramona sandy loam, 0 to 3 percent slopes, and has similar management problems except that more care is required to control erosion. Very little of it is irrigated. Contour cultivation is advisable, but, because of slope irregularities and undulations, it is not always practical. (Capability unit IIIe–1; natural land type C_2; Storie index rating 73)

Ramona sandy loam, deep over hardpan, 0 to 3 percent slopes (RbA).—An unrelated iron-silica hardpan, like that in the San Joaquin and Madera soils, occurs in the substratum of this soil at a depth of 40 to 60 inches. Otherwise, the profile is similar to that of Ramona sandy loam, 0 to 3 percent slopes.

Use and management.—This soil is used in about the same way as Ramona sandy loam, 0 to 3 percent slopes, but somewhat greater care must be taken with the deeper rooted crops. They need especially to be protected from waterlogging under irrigation. Otherwise, this soil can be managed in about the same way as Ramona sandy loam, 0 to 3 percent slopes. (Capability unit IIs–7; natural land type C_2; Storie index rating 66)

Raynor Series

The soils of the Raynor series occupy low, rolling hills formed by the dissection of old, high terraces adjacent to the foothills. The parent material weathered from andesitic tuff. Drainage is good. The vegetation is annual grasses and herbs. In favorable seasons dense stands of burclover and wild oats are produced.

The Raynor soils differ from the Porterville soils chiefly in being dark gray instead of reddish brown, and from the Zaca soils in being leached of lime in the surface horizon. In many places the Raynor soils are surrounded by Redding soils.

These soils are used only for dryland grain and range.

Raynor clay, 0 to 3 percent slopes (RcA).—This dark-colored, fine-textured soil is not extensive. It occurs adjacent to the lower foothills, chiefly in association with Redding soils.

Representative profile:

0 to 3 inches, dark-gray and very hard (slightly darker gray and very firm when moist) clay; slightly acid; noncalcareous; strong, coarse, blocky structure; when thoroughly dry, coarsely granular in the uppermost 1 or 2 inches; low in organic matter.
3 to 27 inches, gray and very hard (dark-gray and very firm when moist) clay; mildly alkaline; moderate, coarse, blocky structure; slightly calcareous, the lime mostly segregated and in the lower part of the horizon; low in organic matter.
27 to 37 inches, gray and hard (dark-gray and firm when moist) clay loam; moderate, coarse, subangular blocky structure; moderately calcareous; the lime mostly segregated; mildly alkaline.
37 inches +, light-gray (gray when moist), massive, hard, andesitic tuff material containing considerable lime in the upper part; rather softly consolidated and less weathered with increasing depth.

In some places the tuffaceous parent material is entirely weathered into soil material, and the profile rests on unrelated hard rock. Outcrops of unrelated rocks occur. The amount of and depth to lime are variable. A few small spots are alkali affected.

Drainage is good, surface runoff is very slow to slow, and internal drainage is slow. The root zone is moderately deep to deep, and the water-holding capacity and natural fertility are moderate. The erosion hazard is slight.

Use and management.—This soil is used for dryfarmed grain and for range. Range legumes benefit from phosphorus and sulfur. Range grasses benefit from nitrogen. Dryfarmed grain benefits from phosphorus, alone or with nitrogen, if the fertilizer is placed close to the seed.

In other areas, Raynor clay has been irrigated and planted to fig trees or used for pasture. If that in the Madera Area could be irrigated, it could best be used for grass-legume pasture. Irrigated legumes would probably respond to phosphorus and sulfur, and other irrigated crops to nitrogen. (Capability unit IIIs–5; natural land type E_2; Storie index rating 54)

Raynor clay, 3 to 8 percent slopes (RcB).—This soil has a slightly shallower profile than Raynor clay, 0 to 3 percent slopes. It developed from thinner deposits of andesitic tuff and has more outcrops of unrelated rock. Runoff is slow.

Use and management.—This soil is used in much the same way as Raynor clay, 0 to 3 percent slopes, and has much the same management problems. It needs a little more care in cultivation, but only simple practices are feasible, because of slope irregularities and undulations. (Capability unit IIIs–5; natural land type E_2; Storie index rating 48)

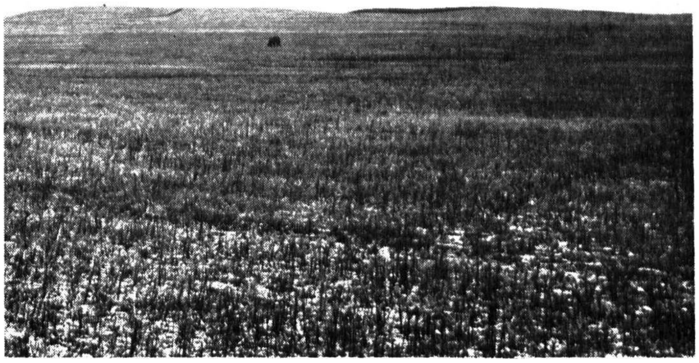

Figure 13.—**Redding soil on remnant of a terrace, in background; San Joaquin soil on lower areas, in foreground.**

Redding Series

The Redding series consists of reddish claypan-hardpan soils developed in gravelly and cobbly old alluvium derived from many kinds of rocks, mostly hard metasedimentary and igneous. These soils occupy small remnants of old high terraces near the foothills (fig. 13). The terraces were probably once extensive. The vegetation is annual grasses and herbs.

These soils are similar to and associated with the Corning soils and differ from them chiefly in having a dense, iron-silica hardpan in addition to a claypan in the subsoil. They also resemble the San Joaquin soils, but they are usually more reddish and distinctly more gravelly and cobbly, particularly in the lower part of the profile, and they were derived from mixed rather than granitic material.

The Redding soils are used for range and, in some places, for dryfarmed grain.

Redding gravelly loam, 0 to 3 percent slopes (RdA).—This soil occupies the nearly level to gently sloping tops of old high terraces. The parent material was gravelly and cobbly alluvium derived chiefly from hard metasedimentary and igneous rocks. Most of the weatherable minerals have been altered to reddish clay, and unweatherable quartzose gravel and cobblestones remain throughout the profile.

Representative profile:

0 to 6 inches, reddish-brown and hard (dark reddish-brown and friable when moist) gravelly loam; strongly acid; weak, very fine, granular structure when moist, and massive when dry; very low in organic matter; gravel is very hard and mainly cherty and quartzose.

6 to 14 inches, reddish-brown and very hard (dark reddish-brown and firm when moist) gravelly heavy loam with colloidal coatings; weak, fine, blocky structure; strongly acid.

14 to 22 inches, red and extremely hard (dark-red and very firm when moist) gravelly clay with colloidal coatings; weak, medium, prismatic and strong, coarse, blocky structure; strongly acid; dark-colored coatings and concretions of manganese dioxide.

22 to 28 inches, red (dark-red when moist), indurated, iron-silica hardpan; dark-colored coatings of manganese dioxide; some thin seams of segregated lime in places.

28 to 60 inches, yellowish-red and hard (red and firm to friable when moist) gravelly sandy clay loam; somewhat stratified and weakly cemented in places; less reddish with depth; massive; neutral.

The color ranges from yellowish red to reddish brown or brown in the surface soil and from red to yellowish red in the subsoil. A thin, bleached, transitional horizon of pinkish-gray clay occurs above the hardpan in some places. The depth to and thickness of the claypan and hardpan are somewhat variable.

Drainage is good; surface runoff is very slow to slow, and internal drainage is very slow. The root zone is shallow, and the water-holding capacity and natural fertility are low. The erosion hazard is slight.

Use and management.—This soil is used for range and dryfarmed grain. Fertilizer tests show that it is deficient in nitrogen and phosphorus, and it is probably deficient in sulfur as well.

This soil is not suitable for irrigated crops, except possibly for shallow-rooted grasses and legumes for pasture. Pasture plants would probably respond to phosphorus and sulfur, alone or with nitrogen, and to lime. Irrigated crops other than legumes would need large amounts of nitrogen and phosphorus, or even a complete fertilizer containing potash. (Capability unit IVs-3; natural land type D_{28}; Storie index rating 18)

Redding gravelly loam, 3 to 15 percent slopes (RdC).—Except for having stronger slopes, this soil is like Redding gravelly loam, 0 to 3 percent slopes. Runoff is slow to medium, and the erosion hazard is moderate to severe.

Use and management.—This soil is used in much the same way as Redding gravelly loam, 0 to 3 percent slopes. It needs to be handled very carefully when cultivated and kept under cover as much of the time as possible, to control erosion. Range is probably its best use. (Capability unit IVe-3; natural land type D_{28}; Storie index rating 16)

Redding gravelly sandy loam, 3 to 15 percent slopes (RfC).—Except for having a coarser textured surface layer, this soil is similar to Redding gravelly loam, 3 to 15 percent slopes.

Use and management.—This soil is used in much the same way and has much the same management problems as Redding gravelly loam, 3 to 15 percent slopes. (Capability unit IVe-3; natural land type D_{28}; Storie index rating 14)

Redding-Raynor complex, 3 to 15 percent slopes (RgC).—This complex consists of small areas of Redding gravelly loam, 3 to 15 percent slopes, and Raynor clay, 3 to 8 percent slopes, so intricately associated that it was impractical to separate them in mapping. The Raynor clay typically occurs in swales and drainageways, and the Redding gravelly loam on the surrounding slopes.

Use and management.—This soil is used and managed in much the same way as Redding gravelly loam, 3 to 15 percent slopes. The best use is range. (Capability unit IVe-3; natural land type D_{28}, E_2; Storie index rating 32)

Riverwash

Riverwash (Rh).—This miscellaneous land type is composed of the sandy and gravelly areas that lie in the beds of some of the major streams (fig. 14). It produces limited amounts of vegetation seasonally but has little

Figure 14.—**Riverwash.**

or no agricultural value. It is used in some places for building material. (Capability unit VIIIs–1; natural land type A_{14}; Storie index rating 5)

Rock Land, Hornitos Soil Material

Rock land, Hornitos soil material (Rk).—This miscellaneous land type is composed of nearly barren exposures of Ione sandstone and conglomerate. It ranges in slope from undulating to very steep. Except for a small amount of forage that grows in small pockets of soil, it has no agricultural value. (Capability unit VIIIs–1; natural land type E_{17}; Storie index rating 5)

Rocklin Series

The soils of the Rocklin series occupy undulating to hilly, partly dissected, old, low terraces. The parent material was alluvium, somewhat variable but predominantly granitic. North of Friant, in the vicinity of the pumice quarries, the parent material contained considerable pumice. These soils are brown to reddish brown. There is a slight to moderate accumulation of clay in the subsoil and a thin, iron-silica hardpan in the lower part of the subsoil, just above the weakly to moderately consolidated substratum. The vegetation is annual grasses and herbs.

These soils are closely associated with the Whitney soils and are mapped mostly with them (see descriptions under the heading "Whitney Series"). The Whitney soils are similar to the Rocklin in the upper part of the profile but lack the thin hardpan in the subsoil. The San Joaquin soils are similar to the Rocklin except that they have gentler slopes, a hogwallow microrelief, a distinct reddish-brown horizon of clay accumulation, and a thick hardpan. In some places the Rocklin soils are associated with the Cometa soils, which are more reddish than the Rocklin, have much clay in the subsoil, are coarse textured in the substratum, and lack a hardpan.

The Rocklin soils are used for range and for dry-farmed grain.

Rocklin rocky sandy loam, pumiceous variant, 3 to 8 percent slopes (RmB).—This soil occurs northwest of Friant, near the foothills. The parent material contains a large proportion of pumice. It is more acid than the parent material of the Rocklin sandy loams (in this Area mapped with the Whitney soils) and was deposited at a different time.

This soil has numerous outcrops of hardpan and hardened parent material.

Representative profile (free of outcropping hardpan):

0 to 6 inches, light-brown and hard (dark-brown and very friable when moist) sandy loam; slightly acid; very weak, very fine, granular structure when moist, and essentially massive when dry; low in organic matter.

6 to 18 inches, light-brown and hard (dark-brown and very friable when moist) sandy loam; medium acid; very weak, very fine, granular structure when moist, and essentially massive when dry; very low in organic matter.

18 to 32 inches, light reddish-brown and very hard (reddish-brown and friable when moist) heavy fine sandy loam; strongly acid; moderate, fine, subangular blocky structure.

32 to 60 inches, light reddish-brown and hard (reddish-brown and firm when moist), weakly to moderately consolidated, stratified fine sandy loam containing considerable pumice; strongly acid; massive; a very thin section at the top (the hardpan) is strongly cemented or indurated with iron and silica; cementing material is also present in vertical cracks reaching deep into the substratum.

The depth to and thickness of the hardpan vary. In many places the pan is less than a fourth of an inch thick. It is most strongly cemented at the top. In places it is missing. The substratum is most strongly consolidated in the upper part.

Drainage is good; surface runoff is slow, and internal drainage is medium to the hardpan, then very slow. The root zone is variable because of the hardpan but is typically moderately deep. The water-holding capacity and natural fertility are low. The erosion hazard is moderate.

Use and management.—This soil is used for range, and the possibilities for more intensive use are extremely limited. (Capability unit VIIe–9; natural land type D_{28}; Storie index rating 43)

Rocklin rocky sandy loam, pumiceous variant, 8 to 30 percent slopes (RmD).—This variant is similar to Rocklin rocky sandy loam, pumiceous variant, 3 to 8 percent slopes, except for having steeper slopes and a slightly shallower profile. Runoff is slow to medium, and the erosion hazard is severe.

Use and management.—This soil is used in much the same way and has much the same management problems as Rocklin rocky sandy loam, pumiceous variant, 3 to 8 percent slopes. Range is its best use. (Capability unit VIIe–9; natural land type D_{32}; Storie index rating 38)

Rossi Series

The Rossi series consists of dark-colored, imperfectly drained, nearly level, saline-alkali soils developed in mixed but predominantly granitic alluvium. The salts and alkali are concentrated mainly in the upper part of the profile. These soils are in basins in the trough of the San Joaquin Valley and are at slightly higher elevations than the Temple soils. Before floods were controlled and pump irrigation was extensively practiced, floods were frequent and the water table was high. The vegetation consists of salt-tolerant grasses and shrubs, principally saltgrass, greasewood, pickleweed, and alkali heath.

These soils are associated with the Temple, Pozo, and

Chino soils. They are more strongly calcareous and more strongly affected by salts and alkali than the Temple soils. They lack the lime-silica hardpan that is typical of the Pozo soils. They have a thinner surface soil than the Chino soils, are more strongly affected by salts and alkali, and have more lime in the subsoil.

These soils are used mostly for range, but some areas have been leveled and planted to cotton, alfalfa, and grain sorghum. Yields are fair except where all the surface soil has been removed by leveling and the light-colored, very strongly calcareous subsoil is exposed.

Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes (RtA).—This dark-colored basin soil occupies a considerable acreage at a slightly higher elevation than the Temple soils and at a slightly lower elevation than the Pozo, Chino, and Fresno soils.

Representative profile:

0 to 3 inches, gray and very hard (very dark gray and friable when moist) silt loam; slightly calcareous; mildly alkaline; weak, fine, granular structure; moderately high in organic matter.

3 to 14 inches, gray and very hard (very dark gray and very firm when moist) clay loam; slightly calcareous; moderately alkaline; weak, medium, prismatic and strong, medium, subangular blocky structure; some segregated lime in small nodules and along root channels, the amount increasing with depth; a few strong-brown mottles in places.

14 to 38 inches, light-gray and hard (gray and firm when moist) clay loam; moderately alkaline; weak, fine, subangular blocky structure to massive; very strongly calcareous; hard nodules of lime, mainly at depths of more than 30 inches.

38 to 66 inches +, pale-yellow and slightly hard (light yellowish-brown and friable when moist) stratified loam and sandy loam; moderately calcareous; moderately alkaline; massive.

The thickness and color of the surface soil are somewhat variable. Typically, the surface soil is slightly calcareous, but it is noncalcareous in places. In number and size, the lime nodules in the lower part of the subsoil are variable.

Although this soil developed under poor drainage, almost all of it is now imperfectly drained as the result of the general lowering of the water table by extensive pumping for irrigation. Surface runoff is very slow, and internal drainage is slow. The root zone is deep. The water-holding capacity is high, and natural fertility is moderate. The erosion hazard is slight.

Use and management.—Range is the principal use. Because of the salts and alkali, only the most tolerant grasses, herbs, and shrubs will grow. Reclamation requires large quantities of water to leach the salts from the profile.

If reclaimed, this soil can be used for irrigated pasture and probably for salt- and alkali-tolerant crops, such as cotton, alfalfa, and sugar beets. Nonleguminous crops probably benefit most from nitrogen, and legumes from phosphorus. Leveling that exposes the light-colored, very strongly calcareous lower subsoil is not advisable. Crops growing on exposed subsoil are likely to require large amounts of both nitrogen and phosphorus, and some crops, such as grain sorghum, are likely to be chlorotic because of iron deficiency. (Capability unit IVw–6; natural land type $B_{2\text{-}2a}$; Storie index rating 26)

Rossi silt loam, moderately saline-alkali, 0 to 1 percent slopes (RsA).—This soil is like Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes, except that the concentrations of salts and alkali are only moderate.

Use and management.—This soil is used in about the same way as Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes, and has similar management problems. Somewhat smaller quantities of water are sufficient to leach the excess salts. (Capability unit IVw–6; natural land type $B_{2\text{-}2m}$; Storie index rating 51)

Rossi silt loam, slightly saline-alkali, 0 to 1 percent slopes (RrA).—Slight concentrations of salts and alkali characterize this soil, which is otherwise similar to Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes.

Use and management.—This soil is used in about the same way as Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes. The same methods of reclamation are applicable, but somewhat smaller amounts of water are sufficient. Some of the more salt- and alkali-tolerant crops, such as cotton, alfalfa, and sugar beets, can be grown, but irrigated pasture is probably the best use. (Capability unit IIIs–6; natural land type $B_{2\text{-}2s}$; Storie index rating 73)

Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes (RoA).—This soil has slower infiltration and slower internal drainage than Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes.

Use and management.—This soil is used in about the same way as Rossi silt loam, slightly saline-alkali, 0 to 1 percent slopes, and has similar management and reclamation problems. Because of the somewhat slower infiltration, however, somewhat larger quantities of water and a longer period of time are required for reclamation. (Capability unit IIIs–6; natural land type $B_{2\text{-}2s}$; Storie index rating 62)

Rossi clay loam, strongly saline-alkali, 0 to 1 percent slopes (RpA).—Except for finer surface texture and somewhat slower infiltration, this soil is similar to Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes; and, except for stronger salt and alkali concentration, it is similar to Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes.

Use and management.—This soil is all in range. It is managed in the same way as Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes, and can be reclaimed by the same methods. Because of finer surface texture and slower infiltration, reclamation is somewhat slower. Improvement of this soil should only be undertaken under the most favorable economic conditions. (Capability unit IVw–6; natural land type $B_{2\text{-}2a}$; Storie index rating 22)

San Joaquin Series

The San Joaquin series consists of shallow, iron-silica hardpan soils developed in old alluvium derived mostly from granitic rocks. These soils are extensive. They occupy hummocky, very gently sloping areas and remnants of rolling, dissected alluvial deposits in the old, low terraces. Water may stand in the small intermound areas during wet weather. Internal drainage is restricted by the impervious hardpan. The vegetation is chiefly annual grasses and herbs.

These soils are associated with the much darker colored, fine-textured Alamo soils, which occupy small depressions. They are similar to and associated with the brownish Madera soils. In some places San Joaquin soils

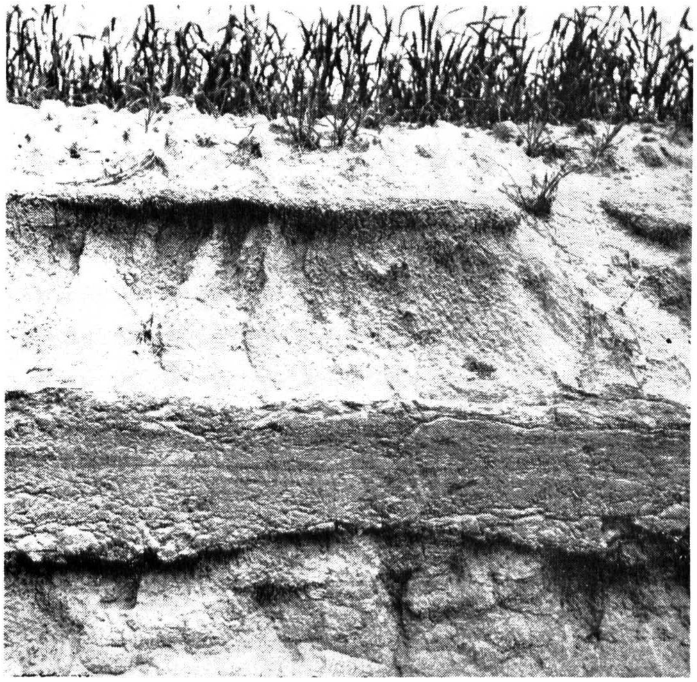

Figure 15.—Profile of San Joaquin sandy loams, 0 to 3 percent slopes.

cap low hills, the side slopes of which are occupied by the Whitney, Rocklin, and Cometa soils.

The San Joaquin soils are used mostly for range and dryfarmed grain. Some areas have been leveled, irrigated, and planted to pasture, cotton, figs, and grapes. Preparing these soils for irrigation is costly because of the hummocky microrelief and the hardpan. Breaking the hardpan is difficult, but in some places it has been broken and removed.

San Joaquin sandy loams, 0 to 3 percent slopes (SaA).—This complex includes fine sandy loam, sandy loam, and coarse sandy loam, so closely associated that separating them was impractical.

Representative profile (fig. 15) of San Joaquin sandy loam:

0 to 5 inches, yellowish-red and very hard (reddish-brown and very friable when moist) sandy loam; medium acid; very weak, very fine, granular structure when moist, and essentially massive when dry; low in organic matter.

5 to 11 inches, yellowish-red and hard (reddish-brown and friable when moist) loam; slightly acid; moderate, fine, subangular blocky structure.

11 to 19 inches, reddish-yellow and extremely hard (yellowish-red and firm when moist) sandy clay with colloidal coatings; slightly acid; medium, fine, blocky structure.

19 to 23 inches, reddish-yellow (red to yellowish-red when moist) hardpan, iron-silica cemented; smooth, very dense, and indurated in upper part; less strongly cemented in lower part; some dark-colored manganese stains; some segregated lime in lower part.

23 to 60 inches, light yellowish-brown and hard (dark yellowish-brown and firm when moist) gritty sandy loam; massive; softly consolidated; neutral to mildly alkaline; few yellowish-red mottles and stains, which are most prominent when soil is moist; less hard and less consolidated with increasing depth.

The color of the surface layer ranges from brown to reddish brown and yellowish red. Because of the hummocky microrelief, the hardpan is variable. It tends to be thinner, softer, and farther below the surface in the mounds and to be thicker, harder, and nearer the surface in the intermound areas. In some intermound areas the soil is finer textured and merges with small bodies of the Alamo soils. Small areas that have a loam surface layer are also included.

Drainage is good; surface runoff is very slow to slow, and internal drainage is very slow. The root zone is shallow, and the moisture-holding capacity and natural fertility are low. The erosion hazard is slight.

Use and management.—Range and dryfarmed grain are the principal uses of these soils. In some places, the surface has been leveled and the hardpan has been broken with heavy equipment or explosives. Such areas are used for irrigated crops, including pasture, alfalfa, cotton, figs, and grapes. Even where the hardpan has been removed, it is best to grow shallow-rooted crops because the substratum is softly consolidated. Pasture of shallow-rooted grasses and legumes is one of the best uses for irrigated areas, and ladino clover is one of the best suited legumes.

Fertility trials indicate that these soils are deficient in nitrogen, phosphorus, and, for legumes, sulfur. Under irrigation, legumes respond to phosphorus and sulfur; other crops respond to nitrogen and probably require phosphorus at the higher levels of production. Dryfarmed grain responds to phosphorus, alone or with small amounts of nitrogen. Range legumes are benefited by applications of phosphorus and sulfur, and the legumes supply the nitrogen needed by the grasses. (Capability unit IVs-3; natural land type C_{13}; Storie index rating 27)

San Joaquin-Alamo complex, 0 to 3 percent slopes (SbA).—This complex consists of small areas of Alamo clay within an area of San Joaquin sandy loams.

Use and management.—These soils are used principally for range and dryfarmed grain. They are extremely difficult to manage because of the wide range in texture of the surface layer. Some of the management practices suggested for San Joaquin sandy loams, 0 to 3 percent slopes, and Alamo clay, 0 to 1 percent slopes, are applicable. In most places, some compromise treatment is necessary.

The cost of preparing these soils for irrigation is high, and the benefits are likely to be small. Leveling is of little use unless the hardpan is broken and removed. Even if that is done, crop production may improve very little, because the substratum is softly consolidated. Substantial amounts of fertilizer, principally nitrogen, phosphorus, and sulfur, and possibly some lime are required.

Leveling tends to fill in the areas of Alamo soil and to make the whole complex more like the San Joaquin soil. (Capability unit IVs-3; natural land types C_{13}, C_{14}; Storie index rating 17)

San Joaquin-Whitney sandy loams, 0 to 8 percent slopes (ScB).—This complex consists of small, nearly level remnants of San Joaquin sandy loams capping gently sloping, low hills of Whitney fine sandy loam. The two soils occur in such a complex pattern that separating them was impractical.

Use and management.—This complex is mostly in range and dryfarmed grain. It is more easily managed than San Joaquin-Alamo complex, 0 to 3 percent slopes. Generally, the management practices suggested for San Joaquin sandy loams, 0 to 3 percent slopes, and Whitney fine sandy loam, 3 to 8 percent slopes, are applicable, though some compromises are necessary. (Capability unit IVe-3; natural land types C_{13}, E_1; Storie index rating 54)

Sesame Series

The Sesame series consists of well-drained soils in the lower foothills of the Sierra Nevada. The parent material weathered from the underlying coarse-grained granitic rocks. These soils are associated with the Vista soils, from which they differ chiefly in having a moderate amount of clay in the subsoil and a dark grayish-brown surface soil. Rock outcrops occur in places. Slopes are gentle to rolling. The vegetation consists of annual grasses and herbs and, in places, scattered oaks.

These soils are used for dryfarmed grain and for range.

Sesame sandy loam, 3 to 8 percent slopes (SyB).—This gently sloping soil is moderately shallow over granitic bedrock. It occurs principally in association with the Vista soils in the lower foothills of the Sierra Nevada.

Representative profile:

- 0 to 8 inches, dark grayish-brown and hard (very dark grayish-brown and friable when moist) heavy sandy loam; slightly acid; very weak, very fine, granular structure when moist, and essentially massive when dry; low in organic matter.
- 8 to 17 inches, dark-brown and very hard (dark yellowish-brown and very firm when moist) light sandy clay loam with colloidal coatings; slightly acid; moderate, medium, blocky structure.
- 17 to 27 inches, dark-brown and very hard (dark yellowish-brown and very firm when moist) light sandy clay loam with colloidal coatings; slightly acid; weak, medium, blocky structure.
- 27 to 40 inches +, varicolored, mostly slightly weathered, granitic bedrock with some soil material similar to that in layer above; grades into hard granitic bedrock.

The principal variations are in the depth to the subsoil, the amount of clay in the subsoil, and the depth to the parent rock. In places the lower part of the subsoil is sandy clay.

Drainage is good; surface runoff is slow, and internal drainage is moderately slow. The root zone is moderately deep, and the water-holding capacity and natural fertility are moderate. The erosion hazard is slight.

Use and management.—This soil is used for dryfarmed grain and for range. Dryfarmed grain responds to phosphorus, alone or with small amounts of nitrogen. Phosphorus and sulfur are beneficial to range legumes, and the legumes supply nitrogen for the grasses and herbs, thus increasing the quantity and improving the quality of the forage.

If irrigated, these soils would be best suited to legumes and grasses for hay or pasture. The legumes should respond to phosphorus and sulfur. Irrigated small grain and other nonleguminous field crops should respond to nitrogen. (Capability unit IIIe-1; natural land type E_1; Storie index rating 51)

Sesame rocky sandy loam, 3 to 8 percent slopes (SnB).—Except for having outcrops of granitic bedrock, this soil is like Sesame sandy loam, 3 to 8 percent slopes. The depth to bedrock is more variable, but in the rock-free areas the profiles of the two soils are comparable in depth.

Use and management.—This soil is suitable only for range. Cultivation with most kinds of mechanical equipment is difficult, so the possibilities for range improvements are limited. Range use and management are about the same as on Sesame sandy loam, 3 to 8 percent slopes. (Capability unit VIe-4; natural land type E_4; Storie index rating 32)

Sesame loam, 3 to 8 percent slopes (SeB).—Because of its finer textured surface layer, this soil is slightly higher in moisture-holding capacity and natural fertility than Sesame sandy loam, 3 to 8 percent slopes. The bedrock contains less quartz; this fact may partly account for the finer texture.

Use and management.—This soil is used in much the same way and has much the same management problems as Sesame sandy loam, 3 to 8 percent slopes. (Capability unit IIIe-1; natural land type E_1; Storie index rating 45)

Sesame loam, 8 to 15 percent slopes (SeC).—This soil is slightly shallower to bedrock than Sesame loam, 3 to 8 percent slopes. Runoff is medium, and the erosion hazard is moderate.

Use and management.—This soil is used for dryfarmed grain and for range. Range is probably the best use, because of the difficulties and hazards of cultivation. Considerable care is necessary to control erosion. In cultivation, the contour should be followed as closely as possible. Otherwise, this soil can be managed in about the same way as Sesame loam, 3 to 8 percent slopes. (Capability unit IVe-1; natural land type E_1; Storie index rating 43)

Sesame rocky loam, 8 to 15 percent slopes (SkC).—Except for having rock outcrops, this soil is similar to Sesame loam, 8 to 15 percent slopes. Except for having a finer textured surface soil and steeper slope, it is similar to Sesame rocky sandy loam, 3 to 8 percent slopes. The depth to bedrock is more variable, but in rock-free areas the profiles of the two rocky soils are comparable in depth.

Use and management.—This soil is suitable only for range. It can be managed in about the same way as Sesame rocky sandy loam, 3 to 8 percent slopes. (Capability unit VIe-4; natural land type E_4; Storie index rating 31)

Temple Series

The Temple series consists of dark-colored soils derived from mixed but mostly granitic alluvium. These soils occupy low parts of the valley near the San Joaquin River. Before these soils were farmed, periodic flooding and a high water table favored the accumulation of organic matter in the surface soil. Floods are now well controlled by a system of levees and by Friant Dam and Pine Flat Dam. The water table has been lowered by pumping ground water for irrigation and is in most places now too low to affect the soils. A perched water table occurs locally, however, because of overirrigation or lateral seepage above the slowly permeable substratum. The vegetation is grasses, herbs, and, in the swales, some rushes and tules. The saline spots support saltgrass and some salt-tolerant herbs.

The Temple soils are associated with the Rossi soils but occupy lower positions and are darker colored, less calcareous, and less saline. They are also associated with the Columbia soils, which are lighter-colored, lower in organic matter, coarser textured, and essentially lime free.

Most of the acreage has been leveled and planted to pasture, row, and forage crops. Some areas are still used for range. If well managed, these soils are productive.

Temple loam, 0 to 1 percent slopes (TdA).—This dark-colored soil occurs in the lower parts of the valley near the San Joaquin River. It is associated with the Columbia soils and, in places, the Rossi soils.

Representative profile:

0 to 5 inches, dark-gray and hard (black and friable when moist) loam; neutral; noncalcareous; weak, fine, granular structure; moderate in organic matter.

5 to 20 inches, gray and very hard (dark-gray and very firm when moist) sandy clay loam; moderately calcareous; moderately alkaline; weak, coarse, blocky structure; lime mostly disseminated but some soft segregations in lower part of layer.

20 to 28 inches, light olive-brown and very hard (brown and firm when moist) sandy clay loam; strongly calcareous; moderately alkaline; weak, medium, blocky structure; mottles in the form of soft, white lime segregations and strong-brown splotches.

28 to 54 inches, light-gray and very hard (light brownish-gray and firm when moist) sandy clay loam; strongly calcareous; moderately alkaline; weak, medium, blocky structure; lime segregations mainly in the form of small, hard nodules, particularly in upper part of layer.

54 to 64 inches +, pale-olive and hard (olive and friable when moist), stratified fine sandy loam; slightly to moderately calcareous; moderately alkaline; massive.

Typically, the surface soil is noncalcareous, but in places it is slightly calcareous. The subsoil ranges from moderately to strongly calcareous. The lower part of the substratum may have a wide range in texture, as a result of stratification at the time it was deposited.

For the most part, present drainage is imperfect rather than poor. Surface runoff is very slow to locally ponded, and internal drainage is moderately slow. The water-holding capacity is moderate, and the natural fertility is high. The root zone is deep, and there is no erosion hazard. There are no excess salts or alkali.

Use and management.—Some of this soil is used for range, but much of it has been leveled, irrigated, and planted to pasture, row, and forage crops, including alfalfa, cotton, grain, and sugar beets. Because of the imperfect to poor drainage, this soil is not well suited to deep-rooted crops, such as orchard crops. The natural fertility is high, and response to fertilizer is not appreciable. At the higher levels of production, nonleguminous crops might benefit from nitrogen, and legumes might benefit from phosphorus and sulfur. (Capability unit IIw–2; natural land type B_1; Storie index rating 90)

Temple clay loam, 0 to 1 percent slopes (TbA).—Except that it is finer textured in the uppermost 20 to 30 inches, this soil is similar to Temple loam, 0 to 1 percent slopes. Because of the finer texture, it has higher water-holding capacity and slower infiltration.

Use and management.—This soil is used in much the same way as Temple loam and has about the same management problems. The range of moisture content within which it is suitable for tilling is narrower, however, and more care must be taken to maintain favorable tilth. (Capability unit IIw–2; natural land type B_1; Storie index rating 77)

Temple clay, 0 to 1 percent slopes (TaA).—The uppermost 10 to 30 inches of this soil is slightly calcareous clay. In the lower part, the profile is similar to that of Temple loam, 0 to 1 percent slopes, or Temple clay loam, 0 to 1 percent slopes. Internal drainage is slow.

Use and management.—This soil is used in about the same way as Temple loam, 0 to 1 percent slopes, and Temple clay loam, 0 to 1 percent slopes. The range of moisture content within which it is suitable for tillage is much narrower, and irrigation practices must be modified to allow for the slow rate of infiltration. (Capability unit IIw–2; natural land type B_3; Storie index rating 54)

Temple loam, slightly saline, 0 to 1 percent slopes (TeA).—This soil is similar to Temple loam, 0 to 1 percent slopes, except for having slight concentrations of salts.

Use and management.—This soil is used in about the same way as Temple loam, 0 to 1 percent slopes, but the growth of most crops is inhibited by the salts. If there is adequate drainage, periodic deep leaching should reduce the salt concentrations and increase productivity. Removing the excess salts makes this soil comparable to Temple loam, 0 to 1 percent slopes. (Capability unit IIs–6; natural land type B_{1-2s}; Storie index rating 77)

Temple clay loam, slightly saline, 0 to 1 percent slopes (TcA).—Except for having slight concentrations of salts in the upper part of the profile, this soil is similar to Temple clay loam, 0 to 1 percent slopes.

Use and management.—This soil is used in about the same way as Temple clay loam, 0 to 1 percent slopes. The salts are more difficult to remove than from Temple loam, slightly saline, 0 to 1 percent slopes, because of the finer texture and somewhat slower rate of moisture movement. Nevertheless, if there is adequate drainage, periodic deep leaching should reduce the salt concentrations and increase productivity. If the excess salts are removed, this soil is similar to Temple clay loam, 0 to 1 percent slopes. (Capability unit IIs–6; natural land type B_{1-2s}; Storie index rating 65)

Terrace Escarpments

Terrace escarpments (Tf).—This miscellaneous land type consists of interstratified hard rocky ledges and softly consolidated alluvium. It occurs along the steep sidewalls of the major streams. The materials are unaltered and too variable to be classified as a soil. The vegetation is annual grasses, herbs, and, in places, brush. The areas cannot be tilled, but some produce some usable forage. (Capability unit VIIIs–1; natural land type D_{33}; Storie index rating 1 to 25)

Tollhouse Series

The Tollhouse series consists of dark-colored, shallow soils that developed from material weathered from granitic rocks. These soils occur in the lower parts of the mountains. The slopes are typically very steep. Outcrops of bedrock are common. The vegetation consists of shrub oaks and scattered Digger pines and an understory of annual grasses and herbs.

These soils are associated with the Auberry and Holland soils. The associated soils are deep and have a moderate amount of clay in the subsoil. The Auberry soils are grayish brown, and the Holland soils are reddish brown.

The Tollhouse soils are suited only to and used only for range.

Tollhouse rocky coarse sandy loam, 30 to 75 percent slopes (TgF).—This soil occurs in the lower part of the mountains. It consists of dark-colored, shallow, uniform materials that weathered from the underlying granitic rock. Rock outcrops are numerous.

Representative profile:

0 to 6 inches, very dark grayish-brown and soft (very dark brown and very friable when moist) coarse sandy loam; neutral; weak, fine, crumb structure; moderate in organic matter.

6 to 20 inches, grayish-brown and soft (dark-brown and very friable when moist) sandy loam; weak, very fine, crumb structure; slightly acid.

20 inches +, slightly weathered granitic bedrock that rapidly becomes more consolidated and less weathered with increasing depth.

The depth to the hard, unaltered bedrock ranges from 3 to 36 inches. The thickness and organic-matter content of the surface layer varies, depending on the slope, aspect, and amount of vegetation.

Drainage is excessive; surface runoff is very rapid, and internal drainage is rapid. The root zone is variable, depending on the presence of rock outcrops, but it is typically shallow even in areas relatively free of rocks and boulders. The water-holding capacity and natural fertility are somewhat variable, but ordinarily both are low. The erosion hazard is severe.

Use and management.—This soil is of limited use even for range. Because of the steep slopes and low water-holding capacity, there is little that can be done to improve its carrying capacity. This soil may be useful as part of the watershed, and it may provide shelter for wildlife. (Capability unit VIIe-4; natural land type E_{16}; Storie index rating 16)

Trabuco Series

The soils of the Trabuco series were derived from coarse-grained, dark-colored, basic rocks. They occur in the foothills and lower mountains. The vegetation consists of annual grasses, herbs, blue oaks, live oaks, Digger pines, and some brush. At the lower elevations, only annual grasses and herbs grow. These soils are not extensive in the Madera Area.

These soils are similar to the Coarsegold soils, with which they are associated, but are more reddish, have more clay in the subsoil, and were derived from basic igneous rocks. They are also associated with the Vista, Ahwahnee, and Auberry soils, which were derived from granitic rocks.

The Trabuco soils are used for range. They produce some of the best foothill forage in the Area.

Trabuco rocky loam, 8 to 15 percent slopes (TkC).—This reddish-brown soil occurs in the foothills and in the lower part of the Sierra Nevada. The largest area is in the vicinity of Trabuco Mountain. Rock outcrops are common.

Representative profile:

0 to 10 inches, brown and slightly hard (dark-brown and friable when moist) loam; slightly acid; moderate, fine and medium, granular structure; moderately low in organic matter.

10 to 27 inches, reddish-brown and hard (dark reddish-brown and firm when moist) gravelly clay loam with colloidal coatings; slightly acid; moderate, coarse, blocky structure.

27 to 42 inches, reddish-brown and very hard (dark reddish-brown and very firm when moist) clay with colloidal coatings; neutral; strong, medium, blocky structure.

42 to 56 inches, light-red (red when moist), massive soil material and partly decomposed parent rock that, with increasing depth, grades into consolidated, coarse-grained, dark-colored bedrock.

Fragments of the parent rock are found in the profile. The depth to bedrock ranges from a few inches to more than 6 feet. In places the subsoil is redder than in the profile described. Included are a few areas that have a clay loam surface layer.

Drainage is good; surface runoff is slow to medium, and internal drainage is slow. The root zone is variable, depending on the number of rock outcrops, but it is typically deep in the rock-free areas. The water-holding capacity, natural fertility, and erosion hazard are moderate.

Use and management.—Range is the principal use. Some of the best range forage in the Area is produced on this soil. Nitrogen is the nutrient to which range grasses are most likely to respond. Phosphorus and sulfur are the ones to which legumes respond. (Capability unit VIe-1; natural land type E_4; Storie index rating 42)

Trabuco rocky loam, 45 to 75 percent slopes (TkF).—This soil is similar to Trabuco rocky loam, 8 to 15 percent slopes, except for having stronger slopes. Some areas of rocky fine sandy loam are included. Drainage is somewhat excessive. Runoff is very rapid, and the erosion hazard is severe.

Use and management.—The very steep slopes and the rock outcrops limit the use of this soil to range. Limited brush control is about the only management practice possible. (Capability unit VIIe-1; natural land type E_{12}; Storie index rating 9)

Trabuco loam, 15 to 45 percent slopes (ThE).—Except that it is steeper and nearly free of bedrock outcrops, this soil is like Trabuco rocky loam, 8 to 15 percent slopes. Drainage is good to somewhat excessive. Runoff is medium to rapid. The moisture-holding capacity and the fertility are rather low. The erosion hazard is moderate to severe.

Use and management.—This soil is used entirely for range, a use to which it is well suited. It has the same management problems as Trabuco rocky loam, 8 to 15 percent slopes. (Capability unit VIe-1; natural land type E_9; Storie index rating 31)

Traver Series

The Traver series consists of light-colored, saline-alkali soils that developed in alluvium that originated mainly in areas of granitic rocks. These soils are in the basin and at the lower end of the somewhat older alluvial fans. They are calcareous to the surface. The microrelief is slightly hummocky, but the general topography is nearly level. The vegetation consists of salt- and alkali-tolerant grasses and herbs. The more strongly saline-alkali spots are essentially devoid of vegetation (fig. 16).

These soils are similar to the Fresno and El Peco soils, which have a lime-silica hardpan, and to the Dinuba soils, which have a softly consolidated, silty substratum. They are lighter colored than the somewhat similar Pachappa soils and contain more salts and alkali.

The Traver soils are used mostly for range, but some areas are irrigated and used for pasture, row, and forage crops, chiefly alfalfa and cotton. Reclamation of many areas is possible, but the cost is considerable.

Traver loam, strongly saline-alkali, 0 to 1 percent slopes (ToA).—This light-colored soil occurs extensively in the basin part of the Area. Most of the salts and alkali are concentrated in the upper part of the profile, and more than 70 percent of the soil is saline-alkali to the surface.

Representative profile:

0 to 3 inches, pale-brown and slightly hard (brown and very friable when moist) loam; very weak, very fine, granular structure when moist, and essentially massive when dry; slightly calcareous; strongly alkaline; vesicular; low in organic matter.

3 to 17 inches, light yellowish-brown and hard (light olive-brown and friable when moist) light sandy clay loam; strongly alkaline; slightly calcareous; weak, medium, subangular blocky structure.

17 to 24 inches, pale-yellow and hard (light olive-brown and friable when moist) fine sandy loam; strongly alkaline; slightly calcareous; weak, medium, subangular blocky structure; small lime segregations and nodules, mainly in lower part of layer.

24 to 64 inches, light yellowish-brown and slightly hard (dark yellowish-brown and friable when moist), stratified fine sandy loam; moderately calcareous; strongly alkaline; massive.

Most areas contain sufficient salts and alkali to be strongly alkaline to the surface, but some areas are moderately alkaline at the surface. The amount of clay in the subsoil is somewhat variable but there is usually slightly more than in the surface soil. The underlying material is variable as to color and texture because of stratification, but it is usually coarser and softer than the subsoil. It may be faintly mottled with brown and brownish yellow.

This soil is well drained because pump irrigation has lowered the water table, but it may have been less well drained in the past. Surface runoff is very slow, and internal drainage is moderately slow. The root zone is deep, and the water-holding capacity is moderate. The natural fertility is moderate, and the erosion hazard is slight.

Use and management.—This soil is used exclusively for range, and unless reclaimed it has little value for other uses. Large amounts of gypsum or sulfur, together with deep leaching, are required to reclaim this soil, and the attempt should be made only if economic conditions are favorable. Irrigated pasture or rice would probably be the best crop during the reclamation process. After reclamation, nonleguminous crops likely would require nitrogen, and legumes probably would respond to phosphorus and sulfur. Shallow-rooted crops, and salt- and alkali-tolerant crops, such as pasture, cotton, alfalfa, and sugar beets, probably would be the best for a considerable time following reclamation. (Capability unit IVs–6; natural land type $B_{1\text{-}2a}$; Storie index rating 19)

Figure 16.—**Effects of alkali on alfalfa. Good stand on Hanford fine sandy loam, 0 to 1 percent slopes, at right; barren spot on Traver loam, moderately saline-alkali, 0 to 1 percent slopes, at left.**

Traver loam, slightly saline-alkali, 0 to 1 percent slopes (TmA).—This soil is similar to Traver loam, strongly saline-alkali, 0 to 1 percent slopes, but the concentrations of soluble salts are weak, and less than 25 percent of the acreage is saline-alkali to the surface. Irrigated areas are somewhat less saline-alkali than the nonirrigated.

Use and management.—Range and irrigated pasture are the principal uses of this soil. Some cotton, alfalfa, and sugar beets are also grown. Periodic deep leaching should reduce the concentrations of salts, and applications of gypsum or sulfur should help to reclaim the alkali-affected areas. Salt- and alkali-tolerant crops, such as pasture, alfalfa, cotton, and sugar beets, are the best for reclaimed areas, and narrowleaf (prostrate) trefoil is the best legume for irrigated pasture. Legumes respond to phosphorus and sulfur, and other crops to nitrogen. (Capability unit IIs–6; natural land type $B_{1\text{-}2s}$; Storie index rating 66)

Traver loam, moderately saline-alkali, 0 to 1 percent slopes (TnA).—From 25 to 70 percent of this soil is saline-alkali to the surface. Otherwise, this soil is similar to Traver loam, strongly saline-alkali, 0 to 1 percent slopes.

Use and management.—This soil is used mostly for range. Some areas are in irrigated pasture, cotton, alfalfa, or sugar beets. Planting irrigated pasture, with or without amendments, is a common way of reclaiming this soil. In most cases, the use of gypsum or sulfur, together with periodic deep leaching, will speed reclamation (fig. 17). Legumes respond to phosphorus and sulfur, and other crops respond to nitrogen. (Capability unit IIIs–6; natural land type $B_{1\text{-}2m}$; Storie index rating 38)

Traver-Chino complex, slightly saline-alkali, 0 to 1 percent slopes (TpA).—This complex consists of Traver and Chino fine sandy loams and loams, in such close association it was impractical to show them separately.

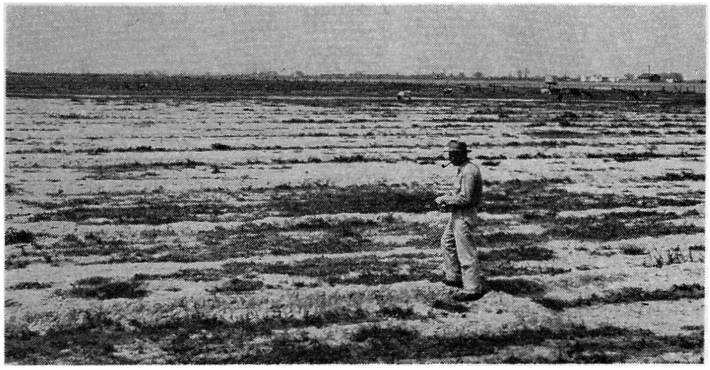

Figure 17.—**Traver loam, moderately saline-alkali, 0 to 1 percent slopes, in process of being reclaimed.**

Up to 25 percent of the area is saline-alkali to the surface, and most of the subsoil is affected by excess salts and alkali.

Use and management.—This complex is used in about the same way as Traver loam, slightly saline-alkali, 0 to 1 percent slopes, and it has about the same management and reclamation requirements. (Capability unit IIs–6; natural land type $B_{1\text{-}2s}$; Storie index rating 66)

Traver-Chino complex, moderately saline-alkali, 0 to 1 percent slopes (TrA).—This complex is similar to Traver-Chino fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes, but from 25 to 70 percent of the area is saline-alkali to the surface.

Use and management.—This complex is used in about the same way as Traver loam, moderately saline-alkali, 0 to 1 percent slopes, and has about the same requirements for management and reclamation. (Capability unit IIIs–6; natural land type $B_{1\text{-}2m}$; Storie index rating 38)

Traver, Fresno, and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes (TsA).—This complex is composed of Traver fine sandy loam in association with El Peco and Fresno fine sandy loam. The proportions of the El Peco and Fresno soils vary considerably from area to area. From 25 to 70 percent of the acreage is saline-alkali to the surface.

Use and management.—This complex is used in about the same way as Traver loam, moderately saline-alkali, 0 to 1 percent slopes. It has about the same management requirements but is more difficult and more expensive to reclaim because of the hardpan in the subsoil of the Fresno and El Peco soils. (Capability unit IVs–8; natural land type $B_{13\text{-}2m}$; Storie index rating 24)

Traver, Fresno, and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes (TtA).—This complex is similar to Traver, Fresno, and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes, but more than 70 percent of the acreage is saline-alkali to the surface.

Use and management.—This complex is all in range. Reclamation is possible only at considerable expense and should be attempted only under the most favorable economic conditions. Requirements for management and reclamation are similar to those of Traver loam, strongly saline-alkali, 0 to 1 percent slopes. (Capability unit VIs–8; natural land type $B_{13\text{-}2a}$; Storie index rating 12)

Trigo Series

The soils of the Trigo series developed in softly consolidated, old, silty, granitic alluvium similar to that in which the Whitney soils developed. These soils are shallow. They occupy the more strongly sloping parts of the old, low terraces. They are associated with the deeper, darker colored, and less acid Whitney soils and with the more reddish Cometa soils, which have a claypan subsoil. Drainage is good, and the silty substratum is fractured sufficiently to allow water to penetrate in most places. The vegetation consists of annual grasses and herbs.

These soils are used for range and dryfarmed grain.

Trigo fine sandy loam, 3 to 8 percent slopes (TuB).—This soil developed from softly consolidated, old, silty, granitic alluvium. It occurs in the dissected, old, low terraces, chiefly in association with the Whitney and Cometa soils.

Representative profile:

0 to 3 inches, pale-brown and slightly hard to hard (dark-brown and very friable when moist) fine sandy loam; slightly acid; very weak, very fine, granular structure when moist, and essentially massive when dry; moderately low in organic matter.

3 to 16 inches, pale-brown and slightly hard to hard (dark-brown and very friable when moist) loam; medium acid; very weak, very fine, granular structure when moist, and essentially massive when dry; low in organic matter.

16 inches +, white (light-gray when moist), massive, softly consolidated, silty alluvium with a few thin lime seams in places; neutral; few yellowish-brown mottles; similar to silty substratum of Whitney soils.

The depth to the softly consolidated substratum ranges from 6 to 20 inches. In places large pieces of the substratum have been brought to the surface during cultivation. There is some variation in the color of the surface soil, and the reaction in places is near neutral.

Drainage is good; surface runoff is slow, and internal drainage is moderately rapid to the substratum, then slow to very slow. The root zone is shallow, and the water-holding capacity and natural fertility are low. The erosion hazard is moderate.

Use and management.—Range and dryfarmed grain are the principal uses. Only small amounts of fertilizer can be utilized, because of the low and variable rainfall and the low water-holding capacity. Dryfarmed grains are likely to benefit most from phosphorus, alone or with small amounts of nitrogen. Nitrogen would probably be of greatest direct benefit to range grasses. Although the soil is probably low in phosphorus and sulfur, the response of range legumes is variable because of the shortage of moisture.

If this soil were irrigated, legumes would respond to phosphorus and sulfur, and other crops to nitrogen. Because of the shallow root zone, grass-legume pasture or shallow-rooted row and forage crops would be the best crops for irrigated areas. Deep chiseling and subsoiling might increase the depth of the root zone and improve the moisture-holding capacity. It is unlikely that the soil could be made suitable for orchard crops or other deep-rooted crops. (Capability unit IVe–3; natural land type E_5; Storie index rating 29)

Trigo fine sandy loam, 8 to 15 percent slopes (TuC).—Except for having steeper slopes, this soil is like Trigo fine sandy loam, 3 to 8 percent slopes. Runoff is medium, and the erosion hazard severe.

Use and management.—This soil is used in about the same way as Trigo fine sandy loam, 3 to 8 percent slopes. Precautions should be taken to minimize erosion. Range is probably the best use. (Capability unit IVe–3; natural land type E_5; Storie index rating 27)

Trigo-Cometa sandy loams, 3 to 8 percent slopes (TvB).—This complex consists of small bodies of Trigo and Cometa soils. It was impractical to separate them. The profiles are similar to those described under Trigo fine sandy loam, 3 to 8 percent slopes, and Cometa sandy loams, 3 to 8 percent slopes, respectively.

Use and management.—This complex is used for range and dryfarmed grain. Both soils are low in moisture-holding capacity and fertility, and hence have similar management problems. Grain is likely to respond to phosphorus, alone or with small amounts of nitrogen, and range legumes respond to phosphorus and sulfur. Responses are likely to be comparatively slight and to vary from year to year, depending on rainfall.

If these soils were irrigated, grass-legume pasture or shallow-rooted row and forage crops would be the best crops to grow. Irrigated legumes would respond to phosphorus and sulfur, and other irrigated crops to nitrogen. (Capability unit IVe–3; natural land type E_5; Storie index rating 34)

Tujunga Series

The Tujunga series consists of pale-brown, noncalcareous, coarse-textured, somewhat excessively drained soils derived from granitic sediments deposited on recent alluvial fans and flood plains. The profile is nearly uniform throughout, except for a small amount of organic matter in the surface layer and textural stratification during deposition of the material by swift-moving streams and flood waters. Although Tujunga soils in other areas contain stones and even boulders, those in the Madera Area contain no coarse fragments, except for gravel in the subsoil and substratum. The vegetation is chiefly annual grasses and herbs. Scattered trees grow along the stream courses. The slopes are typically gentle. The soils are free of excess salts and alkali.

Except for having a coarser texture, a lower organic-matter content, and lower moisture-holding capacity, these soils are similar to the Hanford soils, which formed from material derived from similar sources but of finer texture. In places the Tujunga soils occupy narrow, irregular, winding, present or old stream courses that traverse large bodies of the Hanford soils.

The Tujunga soils are used principally for irrigated pasture and for irrigated row, forage, vine, and orchard crops.

Tujunga loamy sand, 0 to 3 percent slopes (TwA).—This soil is similar to the Hanford fine sandy loams in many respects but is coarser textured, lower in organic matter, and lower in moisture-holding capacity. It usually occurs as narrow streaks traversing more extensive areas of Hanford and other soils.

Representative profile:

0 to 11 inches, pale-brown and loose (brown and loose when moist) loamy sand; neutral; single grained; very low in organic matter.

11 to 24 inches, pale-brown and loose (brown and loose when moist), stratified loamy sand and coarse sand; single grain; neutral.

24 to 60 inches, slightly lighter colored, stratified sand, coarse sand, and gravel; neutral; loose; single grained; generally many feet thick.

There is some variation in color, stratification, and organic-matter content. In places the surface soil and subsoil contain small amounts of gravel.

Natural drainage is somewhat excessive; surface runoff is very slow, and internal drainage is very rapid. The moisture-holding capacity and natural fertility are low. The root zone is very deep. The erosion hazard is severe.

Use and management.—Because most of it occurs in narrow, irregular areas, this soil is seldom farmed separately but is used with the surrounding soils, mostly for irrigated pasture, row, forage, vine, and orchard crops. Some operators carry water across the narrow areas by means of flumes or other bridging devices, but wider areas are difficult to cross in this way.

If the areas are large enough, this soil can be treated to correct its deficiencies, but water and fertilizer are needed in large amounts, and applying them is difficult and expensive. Generally, there is a deficiency of zinc for grapes and tree fruits. Many crops are likely to be damaged by nematodes. (Capability unit IIIe–4; natural land type A_5; Storie index rating 56)

Tujunga loamy sand, 3 to 8 percent slopes (TwB).—This soil consists of terrace facings along the major streams. Except for having steeper slopes, it is similar to Tujunga loamy sand, 0 to 3 percent slopes. Surface runoff is slow.

Use and management.—This soil is used mostly for range, but some of it is irrigated and contour planted to vines. Because of the steeper slopes and the low water-holding capacity, it is more difficult to manage than Tujunga loamy sand, 0 to 3 percent slopes. (Capability unit IIIe–4; natural land type A_5; Storie index rating 49)

Tujunga loamy sand, moderately deep and deep over hardpan, 0 to 3 percent slopes (TxA).—This soil consists of 30 to 50 inches of stratified loamy sand over an unrelated hardpan like that in the Fresno, Madera, and San Joaquin soils. Otherwise, it is similar to Tujunga loamy sand, 0 to 3 percent slopes. The root zone is moderately deep to deep.

Use and management.—This soil is farmed with the surrounding soils because it occurs in narrow, winding bodies within areas of other soils. In use and management it is similar to Tujunga loamy sand, 0 to 3 percent slopes, but the loss of irrigation water and nutrients by percolation is somewhat less serious. The hardpan prevents very rapid percolation and is in that respect an asset instead of a liability. Nevertheless, careful irrigation practices are necessary to prevent waterlogging just above the hardpan. (Capability unit IIIe–4; natural land type A_{11}; Storie index rating 45)

Tujunga and Hanford soils, channeled, 0 to 8 percent slopes (TzB).—These soils occur along the major streams, in wooded or brushy areas subject to frequent flooding. Both the surface soil and the subsoil have a wide range in texture and vary within short distances. The microrelief is channeled because of the shifting of streams, and slopes are variable. The flood hazard is severe.

Use and management.—These soils are used primarily for grazing, but a few small areas have been leveled and used for irrigated field crops. The severe flood hazard and the wide range in texture limits their value for agriculture. (Capability unit IIIe-4; natural land type $A_{5\text{-}5ch}$; Storie index rating 32)

Tujunga loamy sand, moderately deep and deep over silt, 0 to 3 percent slopes (TyA) [5].—This soil is associated with and is similar to Hanford (Ripperdan) fine sandy loam, moderately deep and deep over silt, 0 to 3 percent slopes. It consists of single-grained loamy sand over a silty substratum. The depth to the silty substratum is normally 30 inches but ranges from 20 to 60 inches. Internal drainage is very rapid to the substratum, then slow to very slow. Surface runoff is very slow. The moisture-holding capacity and natural fertility are low, and the erosion hazard is severe.

Use and management.—This soil is used in much the same way as Hanford (Ripperdan) fine sandy loam, moderately deep and deep over silt, 0 to 3 percent slopes. Because of its low moisture-holding capacity and fertility, it is less productive than the associated soil. It needs smaller and more frequent applications of irrigation water and fertilizer. Such special treatment is usually difficult or impossible, because the areas are small and narrow and are surrounded by the Hanford soil and associated soils. If irrigation water flows across narrow areas of Tujunga soils, large quantities of water can be lost. To minimize the loss of water, fields should be arranged so that it will not be necessary to convey water across the Tujunga soil. If this is not possible, flumes or other bridging devices should be used.

There is generally a deficiency of zinc for grapes and orchard crops. Swabbing the fruiting stubs will correct this deficiency for Malaga grapes but not for the Thompson variety. It is advisable to use special rooting stock to get vines that can obtain moisture and nutrients from a large volume of soil. (Capability unit IIIe-4; natural land type A_{11}; Storie index rating 72)

Visalia Series

The soils of the Visalia series occupy swalelike and other nearly level positions on low, recent alluvial fans and flood plains. These soils were derived from sediments washed from granitic and other micaceous rocks. Under natural conditions they were imperfectly drained and subject to flooding and a periodic high water table, but, as a result of pumping, those in this Area are now mostly moderately well drained. Except for variations resulting from stratification, the profiles are moderately coarse textured and dark colored to considerable depths. The vegetation is mainly annual grasses and herbs and some moisture-loving plants.

These soils are similar to the Grangeville soils but have very little or no mottling in the subsoil and substratum and are typically lime free throughout. They also resemble the Hanford soils in many characteristics but are darker colored, higher in organic matter, and naturally less well drained. In many respects the Visalia soils are transitional between the Grangeville and Hanford soils.

These soils are used extensively for irrigated row, forage, pasture, vine, and orchard crops.

Visalia fine sandy loam, 0 to 1 percent slopes (VaA).—This soil occurs chiefly on low, recent alluvial fans or flood plains, in spots that naturally receive somewhat more moisture than the Hanford and Tujunga soils, the principal associated soils.

Representative profile:

0 to 12 inches, gray to dark-gray and slightly hard (very dark gray to almost black and very friable when moist) fine sandy loam; micaceous; neutral; weak, fine, granular structure when moist, and essentially massive when dry; moderately low in organic matter.

12 to 35 inches, grayish-brown to dark grayish-brown and slightly hard (very dark grayish-brown and very friable when moist) fine sandy loam; micaceous; mildly alkaline; weak, very fine, granular structure when moist, and essentially massive when dry; moderately low in organic matter.

35 to 60 inches, brown and slightly hard (dark-brown and very friable when moist) stratified sandy loam and fine sandy loam; micaceous; moderately alkaline; massive.

Variations in the profile are chiefly the results of stratification. Locally, a very small amount of lime may occur in the subsoil and substratum.

In its natural condition, this soil was imperfectly drained and subject to flooding and periodic high water tables. Extensive pumping has now eliminated the high water tables, and drainage is moderately good. Surface runoff is very slow, and internal drainage is moderately rapid. The root zone is very deep, and the water-holding capacity and natural fertility are moderate. The erosion hazard is slight, and there are no excess salts or alkali.

Use and management.—This soil is suited to many irrigated row, forage, vine, and orchard crops and to irrigated pasture. Legumes respond to phosphorus and sulfur, and other crops to nitrogen. (Capability unit I-1; natural land type A_1; Storie index rating 100)

Visalia sandy loam, 0 to 3 percent slopes (VdA).—This soil is slightly lower in moisture-holding capacity and natural fertility than Visalia fine sandy loam, 0 to 1 percent slopes, but is otherwise similar to it. Internal drainage is rapid.

Use and management.—To compensate for its lower water-holding capacity and natural fertility, this soil needs lighter and more frequent irrigation than Visalia fine sandy loam, 0 to 1 percent slopes, and somewhat more fertilizer. Otherwise, the two soils can be managed in about the same way. (Capability unit I-1; natural land type A_1; Storie index rating 95)

Visalia sandy loam, moderately deep over sand, 0 to 3 percent slopes (VnA).—This soil is similar to Visalia sandy loam, 0 to 3 percent slopes, but it overlies sand at depths of 18 to 36 inches. The water-holding capacity and natural fertility are low.

Use and management.—Managing this soil requires a compromise between the practices suitable for Visalia sandy loam, 0 to 3 percent slopes, and those suitable for

[5] This soil was described under the series name "Ripperdan" in the University of California Soil Survey No. 12, Soils of Madera County, California, and in some other University of California publications.

Delhi sand, 0 to 3 percent slopes. Because of its sandy substratum, this soil requires more care in irrigation and fertilization than Visalia sandy loam, 0 to 3 percent slopes. Its low water-holding capacity and rapid internal drainage necessitate lighter and more frequent irrigation. Split applications of fertilizer are advisable. (Capability unit IIIe-4; natural land type A_1; Storie index rating 66)

Vista Series

The Vista series consists of brown, well-drained, gently sloping to steep upland soils that developed from material weathered in place from granitic rocks. At the lower elevations, the vegetation consists of annual grasses, herbs, and scattered blue oaks; at the higher elevations it includes these together with live oaks, Digger pines, and many kinds of brush.

These soils are associated with the Sesame soils at the lower elevations, and with the Ahwahnee soils at the higher elevations in the foothills of the Sierra Nevada. The Sesame soils have a moderate amount of clay in the subsoil. The Ahwahnee soils are deeper than the Vista soils, darker colored, higher in organic matter in the surface soil, and somewhat more acid in the subsoil. The Vista soils are in the same climatic zones as the Daulton soils, which were derived from metamorphic schist.

The greater part of the acreage is used for woodland range, but small areas have been used for small grain.

Vista-Sesame complex, 3 to 8 percent slopes (VsB).—The soils in this complex are so closely associated that it is impractical to separate them.

Representative profile of Vista coarse sandy loam:

0 to 12 inches, brown and slightly hard (dark-brown and very friable when moist) coarse sandy loam; neutral; very weak, very fine, granular structure when moist, and essentially massive when dry; low in organic matter.

12 to 27 inches, pale-brown and hard (dark-brown and friable when moist) coarse sandy loam; contains slightly more clay than horizon above; neutral; very weak, medium, subangular blocky structure to essentially massive.

27 to 36 inches, light yellowish-brown and hard (yellowish-brown and firm when moist) coarse sandy loam and disintegrating, weathered, granitic bedrock; neutral; massive.

36 inches +, very pale brown, very slightly decomposed, granitic bedrock that is less decomposed with depth.

In places the color is more reddish, particularly in the subsoil. There is some variation in depth, and in the shallower areas the profile is nearly uniform. Normally the acidity decreases with depth. In the surface soil the reaction is neutral or slightly acid, and in the subsoil it is neutral or mildly alkaline. There are a few boulders and outcrops of granite.

The Sesame soil in this complex is like that described under the heading "Sesame Series."

Natural drainage is good; surface runoff is slow, and internal drainage is rapid in the Vista soil but moderately slow in the Sesame. The root zone is moderately deep to deep. The moisture-holding capacity and natural fertility are moderate, and the erosion hazard is slight.

Use and management.—This complex is used for woodland range in about the same way as Ahwahnee and Vista coarse sandy loams, 3 to 8 percent slopes, and has similar management requirements. The Sesame soil has a higher water-holding capacity than the Vista, so yields of forage should be slightly greater. (Capability unit IIIe-1; natural land type E_1; Storie index rating 49)

Whiterock Series

The soils of the Whiterock series were derived from metamorphosed sandy sediments washed from rocks of the Mariposa formation, principally sandy slate and schist. There are many "tombstone" outcrops of the nearly vertical parent rock. These soils are shallow. They occupy small hills in the lower foothills. The slopes are undulating to steep. The vegetation is annual grasses and herbs. In years of favorable rainfall, wild oats grow well. The total area is small.

The Whiterock soils are associated with the Daulton soils, which were derived from the same geologic formation but are light brownish gray and medium to strongly acid.

These soils are used only for range, because they are so shallow and rocky.

Whiterock rocky fine sandy loam, 3 to 8 percent slopes (WaB).—This undulating, shallow to very shallow, light-colored soil occurs in the lower foothills, principally in association with the Daulton soils, which were derived from darker colored, less acid, metamorphosed rocks of the Mariposa formation. Nearly vertical slabs of the schistose bedrock are common.

Representative profile in a rock-free area:

0 to 8 inches, light brownish-gray and hard (grayish-brown and very friable when moist) fine sandy loam; medium acid; weak, very fine, granular structure when moist, and coarse, platy structure to massive when dry; moderate in organic matter.

8 inches +, yellow (brownish-yellow when moist) schistose bedrock; nearly vertical cleavage; well shattered in the uppermost 2 or 3 inches and has a small amount of soil material in the cracks; less weathered and less altered immediately below.

In many places this soil is yellowish brown or light yellowish brown. The reaction is somewhat variable but is typically medium acid to strongly acid. The texture ranges from fine sandy loam to silt loam, depending on the parent rock, which ranges from dark-colored slate to light-colored, fine-grained, schistose sandstone. Typically, the soils are very shallow to shallow, but the depth varies considerably within short distances.

Drainage is good; surface runoff is slow, and internal drainage is moderately rapid. The root zone is very shallow to shallow in the less rocky areas. The natural fertility and water-holding capacity are low. The erosion hazard is moderate.

Use and management.—This soil is used entirely for range. It is naturally low in fertility. Possibilities for more intensive use are very limited. (Capability unit VIIe-3; natural land type E_8; Storie index rating 12)

Whiterock rocky fine sandy loam, 30 to 45 percent slopes (WaE).—Except for having steeper slopes, this soil is like Whiterock rocky fine sandy loam, 3 to 8 percent slopes. Drainage is somewhat excessive. Runoff is rapid, and the erosion hazard severe.

Use and management.—Range is the only use for this soil. Because of shallowness, rock outcrops, and low moisture-holding capacity, possibilities for increasing the forage production are very limited. (Capability unit VIIe-3; natural land type E_{16}; Storie index rating 6)

Whiterock very rocky fine sandy loam, 8 to 30 percent slopes (WbD).—This soil consists mostly of rock outcrops and a very little soil between the rocks. Drainage is good to somewhat excessive. Surface runoff is medium to rapid. The erosion hazard is severe.

Use and management.—Range is the only use for this very rocky soil. The forage is very meager, and livestock have difficulty grazing because of the rock outcrops. (Capability unit VIIe-3; natural land type E_8; Storie index rating 10)

Whitney Series

The soils of the Whitney series developed in weakly consolidated sedimentary materials derived chiefly from granitic rocks. They occupy dissected, old, low terraces, chiefly in the eastern part of the San Joaquin Valley. The slopes are undulating to hilly, and drainage is good. The vegetation is annual grasses and herbs and a few scattered oaks.

The Whitney soils are associated with the older San Joaquin soils, which cap low hills of Whitney soils. They occupy the same topographic position as the Rocklin, Cometa, and Trigo soils, which were derived from somewhat similar sedimentary material. The Rocklin soils usually have more clay in the upper part of the subsoil and a thin hardpan in the lower part. The Cometa soils are reddish brown and have a claypan subsoil, and the Trigo soils are shallow and light colored and have a softly consolidated, light-colored, silty substratum.

These soils are used almost entirely for range and dryfarmed grain.

Whitney fine sandy loam, 3 to 8 percent slopes (WfB).—This undulating soil occurs quite extensively in the dissected parts of the old, low terraces. In places, older San Joaquin soils cap low hills that have this soil on the lower slopes. The principal associated soils are in the Rocklin, Cometa, and Trigo series.

Representative profile:

0 to 19 inches, brown and hard (dark-brown and friable when moist) fine sandy loam; neutral; very weak, very fine, granular structure when moist, and essentially massive when dry; low in organic matter.

19 to 28 inches, light yellowish-brown and hard (dark yellowish-brown and friable when moist) heavy fine sandy loam with colloidal coatings; neutral; weak, medium, subangular blocky structure.

28 inches +, very pale brown (yellowish-brown when moist), weakly consolidated granitic sediments of fine sandy loam texture; mildly alkaline; massive.

The depth to the weakly consolidated substratum varies from 20 to 50 inches but is typically moderate. In the shallower areas, there is little accumulation of clay in the subsoil, and the profile is fairly uniform above the substratum. The reaction ranges from slightly acid to mildly alkaline; it is especially variable in the surface soil but is typically less acid with increasing depth. In a few places, some lime occurs in the lower part of the subsoil, and there are a few seams of lime in the weakly consolidated substratum.

Drainage is good; surface runoff is slow, and internal drainage is moderately rapid. The root zone is moderately deep, and the moisture-holding capacity and natural fertility are moderate. The erosion hazard is slight.

Use and management.—Dryfarmed grain and range are the principal uses. Dryfarmed grain would probably respond to phosphorus, alone or with small amounts of nitrogen. This soil is deficient in nitrogen for grasses and in phosphorus and sulfur for range legumes. Fertilized seedings of rose clover, subterranean clover, or crimson clover on previously fallowed areas provide considerable hay or forage, depending on rainfall.

If irrigated, this soil would be suited to numerous crops. It would be best suited to pasture. Cotton, alfalfa, and sorghum should do well. Shallow-rooted crops would do relatively better because of the weakly consolidated substratum. Irrigated legumes should respond to phosphorus and sulfur, and other irrigated crops to nitrogen. (Capability unit IIIe-1; natural land type E_1; Storie index rating 57)

Whitney fine sandy loam, 8 to 15 percent slopes (WfC).—Except for having steeper slopes, this soil is similar to Whitney fine sandy loam, 3 to 8 percent slopes. Runoff is slow to medium, and the erosion hazard is moderate.

Use and management.—This soil is used in about the same way as Whitney fine sandy loam, 3 to 8 percent slopes. Because of the steeper slopes, it is more difficult to cultivate and needs more care to control erosion. Wherever the slopes are uniform enough to make it practical, cross-slope or contour tillage is advisable. (Capability unit IVe-1; natural land type E_1; Storie index rating 54)

Whitney loam, 0 to 3 percent slopes (WmA).—Except for having gentler slopes and a slightly finer texture throughout, this soil is similar to Whitney fine sandy loam, 3 to 8 percent slopes. Internal drainage is medium. Runoff is very slow to slow, and the erosion hazard is slight.

Use and management.—This soil is used in about the same way as Whitney fine sandy loam, 3 to 8 percent slopes. (Capability unit IIIe-1; natural land type E_1; Storie index rating 70)

Whitney loam, 3 to 8 percent slopes (WmB).—Except for being slightly finer textured throughout, this soil is similar to Whitney fine sandy loam, 3 to 8 percent slopes, and except for having steeper slopes, it is similar to Whitney loam, 0 to 3 percent slopes. Runoff is slow, and the erosion hazard is slight.

Use and management.—This soil is used and managed in about the same way as Whitney fine sandy loam, 3 to 8 percent slopes. (Capability unit IIIe-1; natural land type E_1; Storie index rating 63)

Whitney loam, 8 to 15 percent slopes (WmC).—Except for having steeper slopes, this soil is similar to Whitney loam, 3 to 8 percent slopes. It is slightly finer textured throughout than Whitney fine sandy loam, 8 to 15 percent slopes. Runoff is slow to medium, and the erosion hazard is moderate.

Use and management.—This soil is used and managed in about the same way as Whitney fine sandy loam, 8 to 15 percent slopes. (Capability unit IVe-1; natural land type E_1; Storie index rating 60)

Whitney sandy loam, 15 to 30 percent slopes, eroded (WnD).—This soil occupies escarpments along some of the stream channels leading into the San Joaquin River. It was derived from coarse material similar to the parent material of the Rocklin soils, but it does not contain any hardpan lenses. Erosion has formed numerous shallow rills. Internal drainage is moderately rapid. Runoff is medium, and the erosion hazard is severe.

Use and management.—This soil is all in range. In range management requirements, it is similar to Whitney fine sandy loam, 8 to 15 percent slopes. Because of the slope, cultivation should not be attempted unless special measures are taken to control erosion. (Capability unit VIe–4; natural land type E_{1-3m}; Storie index rating 24)

Whitney-Trigo fine sandy loams, 3 to 8 percent slopes (WtB).—This complex consists of areas of Whitney fine sandy loam and Trigo fine sandy loam, so closely associated that it was impractical to separate them.

Use and management.—This complex is used in about the same way as Whitney fine sandy loam, 3 to 8 percent slopes. (Capability unit IIIe–1; natural land type E_1; Storie index rating 43)

Whitney and Rocklin sandy loams, 3 to 8 percent slopes (WrB).—This mapping unit consists of Whitney sandy loam and Rocklin sandy loam, so closely associated that it was not practical to separate them.

Use and management.—These soils are used in about the same way as Whitney fine sandy loam, 3 to 8 percent slopes. (Capability unit IIIe–1; natural land type E_1; Storie index rating 51)

Whitney and Rocklin sandy loams, 8 to 15 percent slopes (WrC).—Except for having steeper slopes, this mapping unit is like Whitney and Rocklin sandy loams, 3 to 8 percent slopes. Runoff is slow to medium, and the erosion hazard is moderate.

Use and management.—These soils are used in about the same way as Whitney fine sandy loam, 8 to 15 percent slopes. (Capability unit IVe–1; natural land type E_1; Storie index rating 48)

Whitney and Rocklin gravelly sandy loams, 3 to 15 percent slopes (WoC).—Except for having gravel throughout the profile and in the parent material, these soils are similar to Whitney and Rocklin sandy loams on comparable slopes. The erosion hazard is slight to moderate.

Use and management.—These soils are used in about the same way as Whitney and Rocklin sandy loams on comparable slopes. (Capability unit IVe–1; natural land type E_4; Storie index rating 36)

Wunjey Series

The Wunjey series consists of nearly level but hummocky soils formed from recently stream-deposited material derived chiefly from granitic rocks. These soils are slightly calcareous throughout and normally contain excess salts and alkali. Drainage is now adequate in most places, but the presence of salts in this permeable soil indicates that, before flood control and extensive pumping for irrigation, these soils were subject to a high water table. The vegetation is mainly saltgrass, alkali sacaton, and annual grasses and herbs.

These soils differ from the Grangeville soils in being pale brown in color and calcareous throughout. The Hanford soils are similar to the Wunjey soils in many respects but differ in being noncalcareous and free of salts and alkali.

The Wunjey soils are used mostly for range, but some areas have been leveled and planted to irrigated cotton, alfalfa, and pasture. Good management and irrigation with water of good quality will readily reduce the content of salts and alkali and increase the productivity.

Wunjey very fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes (WxA).—This pale-brown soil, derived from recently deposited granitic sediments, occupies the more recent alluvial fans and flood plains, chiefly in association with the Hanford and Dinuba soils. More than 70 percent of the acreage is saline-alkali to the surface.

Representative profile:

0 to 12 inches, pale-brown and soft (dark-brown to brown and very friable when moist) very fine sandy loam; strongly alkaline; slightly calcareous; very weak, very fine, granular structure; low in organic matter.

12 to 24 inches, yellowish-brown and soft (dark yellowish-brown and very friable when moist) very fine sandy loam; strongly alkaline; slightly calcareous; very weak, very fine, granular structure to massive.

24 to 60 inches +, yellowish-brown and soft (dark yellowish-brown and very friable when moist) very fine sandy loam stratified with fine sand; strongly alkaline; slightly calcareous; massive.

The principal variations result from textural stratification. Some areas of fine sandy loam are included.

Drainage is now moderately good in most places. Surface runoff is very slow, and internal drainage is medium. The root zone is very deep, natural fertility is moderate, and the water-holding capacity is moderate. The erosion hazard is slight.

Use and management.—Most of this soil is in range, its best use unless reclaimed. Deep leaching alone should remove most of the excess soluble salts, since the soil is moderately permeable. Gypsum or sulfur should shorten the time required for reclamation, but the lime naturally present is sufficient if gradual results are acceptable. Irrigated grass-legume pasture is probably the best use during the reclamation process, and prostrate (narrowleaf) trefoil is one of the best legumes. After reclamation, a number of shallow-rooted, salt- and alkali-tolerant, irrigated row and forage crops, such as cotton, alfalfa, sugar beets, sorghum, and pasture, can be grown. Irrigated legumes respond to phosphorus and sulfur, and other crops to nitrogen. (Capability unit IVs–6; natural land type B_{1-2a}; Storie index rating 20)

Wunjey very fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes (WvA).—From 25 to 70 percent of this soil is saline-alkali to the surface, and all of it is saline-alkali in the subsoil.

Use and management.—This soil is used in much the same way and has much the same management and reclamation problems as Wunjey very fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes. It can be reclaimed more readily and more rapidly because it contains smaller amounts of salts and alkali. (Capability unit IIIs–6; natural land type B_{1-2m}; Storie index rating 40)

Wunjey very fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes (WuA).—Partial reclamation of this soil has been effected. Less than 25 percent of the acreage is saline-alkali to the surface, but most of it is saline-alkali in the subsoil.

Use and management.—Range, irrigated pasture, and shallow-rooted row and forage crops are the principal uses of this soil. Continued irrigation should eliminate the excess salts, reduce the concentration of alkali, and improve productivity. This soil has much the same reclamation and management problems as Wunjey very fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes. Improvement is more readily and rapidly accomplished. (Capability unit IIs–6; natural land type $B_{1\text{-}2s}$; Storie index rating 79)

Wunjey very fine sandy loam, strongly saline-alkali, channeled, 1 to 8 percent slopes (WyB).—This soil occupies low alluvial benches and until recently was subject to frequent overflow. Except for the somewhat hummocky and undulating topography created by stream channeling, it is similar to Wunjey very fine sandy loam, strongly saline-alkali, 0 to 1 percent slope. In places it has a coarse-textured substratum.

Use and management.—Now that the overflow hazard has been eliminated or greatly reduced by the construction of Friant Dam and Pine Flat Dam, this soil can be used and managed in much the same way as Wunjey very fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes. More leveling is required to prepare this soil for cultivation. (Capability unit IVs–6; natural land type $B_{1\text{-}2a\text{-}5ch}$; Storie index rating 14)

Zaca Series

The Zaca series consists of grayish, fine-textured soils that developed from material weathered in place from softly consolidated calcareous rock. These soils occupy low, gently sloping knolls near the eastern edge of the San Joaquin Valley. The vegetation consists of annual grasses and herbs; burclover and wild oats flourish in favorable years. The total area is small.

These soils differ from the Raynor soils chiefly in being strongly calcareous throughout and from the Porterville soils in being dark gray and much higher in lime.

The Zaca soils are used for dryfarmed grain and for range, uses to which they are well suited.

Zaca clay, 3 to 8 percent slopes (ZaB).—This fine-textured, strongly calcareous soil occurs in the lower foothills, chiefly northeast of Madera.

Representative profile:

0 to 2 inches, dark-gray and hard (very dark gray and friable when moist) clay; strongly calcareous; mildly alkaline; moderate, fine, granular structure; moderate in organic matter.

2 to 19 inches, dark-gray and hard (very dark gray and firm when moist) clay; strongly calcareous; mildly alkaline; weak, medium, subangular blocky structure; moderately low in organic matter.

19 to 29 inches, dark-gray and hard (very dark gray and firm when moist) clay; strongly calcareous; mildly alkaline; weak, fine, subangular blocky structure.

29 to 35 inches, gray and hard (dark-gray and firm when moist) clay with whitish lime segregations; very strongly calcareous; many soft nodules and seams of lime; massive; mildly alkaline.

35 inches +, white, massive, softly consolidated, chalky to marly rock that becomes harder and somewhat stratified with depth; very strongly calcareous; mildly alkaline.

The depth to the bedrock ranges from 18 to 48 inches. The parent rock contains some dark-colored basic minerals in places. The number and hardness of the lime nodules is variable.

Drainage is good; surface runoff and internal drainage are slow. The root zone is moderately deep, and natural fertility and moisture-holding capacity are moderate. The erosion hazard is slight.

Use and management.—This soil is used for dryfarmed grain and range. Dryfarmed grain might benefit from phosphorus, alone or with nitrogen, if the fertilizer is placed close to the seed. Range legumes benefit from phosphorus and sulfur, and grasses benefit from nitrogen. If this soil were irrigated, it would be suitable for grass-legume pasture. The legumes would likely benefit from phosphorus and sulfur, and the grasses would benefit from the nitrogen fixed by the legumes. (Capability unit IIIs–5; natural land type E_2; Storie index rating 48)

Use, Management, and Estimated Yields

This section has four main parts. The first is a discussion of general management practices applicable to all the cultivated crops in the Area. The second consists of an explanation of the system of capability grouping used by the Soil Conservation Service, descriptions of the capability units in this Area, and suggestions for the use and management of the soils in each capability unit. In the third part the Storie index rating and natural land type of each soil are given. The fourth part provides estimates of yields of crops and forage under specified management practices.

General Management Practices

Although the soils of the Area differ in management needs, certain practices apply to all the soils that are cultivated. Among these general practices are the following: crop rotation, maintenance of the supply of organic matter, proper tillage, leveling, addition of plant nutrients in commercial fertilizer and other amendments, erosion control, drainage, and control of nematodes. Controlling salinity and alkalinity is also very important in this Area; it is discussed in the section, "Soluble Salts and Alkali."

Crop rotation.—Rotation of crops is necessary to maintain yields and improve the fertility of the soil. If irrigated alfalfa is alternated with irrigated cotton, small grain, corn, or sorghum, both crops do better than if either is grown continuously. Continued growing of row crops, such as cotton, lowers the content of plant nutrients and organic matter in the soil, gradually breaks down the soil structure, and encourages plant diseases and insect pests. Growing dryfarmed small grain continuously has the same general effects, but it is longer before they are evident.

Growing legumes and grasses has a good effect on the soil. Organic matter is supplied by the abundant and extensive root systems, the structure of the soil is improved, and the supply of certain nutrients, particularly nitrogen, is increased. Growing legumes and grasses for a year or more is the best way to counteract the soil-depleting effects of growing row crops and small grain. The soil improvement brought about by the legumes and grasses results in higher yields of the row crop or small-grain crop that follows.

The most common rotation in irrigated areas consists of 3 years of alfalfa, 2 years of cotton, and 1 year of corn, sorghum, or small grain. The most common row crop is cotton, but large acreages are used for sugar beets and for corn or sorghum for grain or silage. In dryfarmed areas barley is the principal small grain, but some wheat, oats, and rye are also grown. A small grain may be used as a companion crop for alfalfa.

Maintenance of organic-matter content.—Maintaining or increasing the organic-matter content is one of the most important management problems in the Area. In the western part of the Area, the organic-matter content is uniformly low. Most of the soils in the basin and on the recent alluvial fans and terraces contain 1 percent or less. The upland soils in the eastern part of the Area receive more rainfall, and their organic-matter content may be as much as 3 percent or more. The poorly drained soils of the recent alluvial fans and a few of the older basin soils are more than 5 percent organic matter, but the acreage of these soils is small.

Organic matter is chiefly responsible for the larger and more stable forms of soil structure. It also promotes favorable permeability and aeration of the soil. Organic matter contains appreciable amounts of nitrogen, phosphorus, sulfur, and other essential plant nutrients. It is a source of energy for the micro-organisms that inhabit the soil, and it aids these organisms in making many important nutrients available to plants.

Organic matter can be added to the soil by plowing under plant residues or green manure, adding barnyard manure, or growing mixtures of grasses and legumes. All plant residues should be returned to the soil.

Barnyard manure is valuable for adding organic matter to the soil. On decomposition, each ton furnishes about 10 pounds of nitrogen, 5 pounds of phosphorus, and 10 pounds of potash. Manure also improves temporarily the soil structure. To get the maximum benefit from manure, large quantities of bedding should be used to absorb all the urine. The manure should be kept moist but not exposed to leaching, and it should be plowed under as soon as possible after spreading. Many experiments show that manure decomposes almost completely within the year in which it is applied.

Grasses have an abundant and finely fibrous root system, well distributed through the upper part of the soil. The slow decay of the roots helps to improve soil structure and to bind the soil particles against erosion.

If legumes are properly inoculated with nitrogen-fixing bacteria, considerable nitrogen from the air will be added to the soil. Alfalfa and other legumes may provide several hundred pounds of nitrogen per acre when plowed under.

Tillage.—Proper tillage is necessary to prepare a good seedbed, destroy the weeds that compete with the crops for water and nutrients, improve the structure of the soil, and help control soil erosion. Tillage will loosen the surface soil, at least temporarily. Some farmers practice subsurface chiseling to loosen the dense subsurface layers of the soil. These layers, known as plowsoles or traffic pans, present an especially serious problem on the intensively managed irrigated soils that are low in organic matter.

The soils in this Area are dense because they contain little organic matter and are weakly aggregated. If the soils contained more organic matter, the beneficial effects of tillage would be greater and longer lasting. In general, the soils should be tilled as little as possible.

Tilling so as to leave a coarse and cloddy surface, using subsurface sweeps, and leaving a stubble mulch on the surface will help to control wind erosion on the coarse textured soils of the Area.

Leveling.—Almost all of the irrigated soils need some leveling. How well the job is done determines how easy it will be to distribute irrigation water quickly and evenly to a uniform depth. Some farmers do a better job than others, and the difference is reflected in uniformity of stands and in yields.

After the initial leveling of a field, some floating is required nearly every year to eliminate high spots, fill low spots where water stands, and obtain a uniform distribution without wasting water at the end of the row or border. Ordinarily, it takes a number of years to do a good job of leveling and establish a fast, efficient system of distributing water.

Addition of plant nutrients.—Adding commercial fertilizer is the usual means of correcting nutrient deficiencies. The irrigated soils in this Area are generally deficient in nitrogen. All crops except legumes benefit from the application of nitrogen. Available phosphorus is also needed for many irrigated crops, for dryland barley, and for range on some of the upland soils. Soils formed from granite or from granitic alluvium are generally low in sulfur for legumes. Responses to sulfur are general, but only the quality and not the quantity may be affected in some instances.

The potassium supply is adequate in almost all of the soils, but the addition of potassium might benefit specialty crops at the highest levels of management as well as some of the crops grown on coarse-textured soils.

Most of the soils have no known deficiencies of calcium, iron, or magnesium. Calcium and magnesium are especially abundant. In some soils calcium carbonate (lime) is so abundant that it interferes with the absorption of iron by some crops; this causes chlorosis in some deciduous fruit trees. Some of the coarse-textured soils are deficient in zinc and possibly manganese for grapes and stone fruits.

Very few of the soils in the Area need a complete fertilizer; that is, one that provides nitrogen, phosphorus, and potassium. The principal materials used for fertilizer are liquid and gaseous ammonia, ammonium sulfate, and ammonium nitrate for nitrogen; ammonium phosphate for both nitrogen and phosphorus; superphosphate or treble superphosphate for phosphorus alone; and gypsum or elemental sulfur for sulfur. Only the most water-soluble forms of phosphorus should be used, because most of the soils of the Area are slightly acid to very strongly alkaline. Little, if any, benefit is likely from raw rock phosphate.

The principal chemical amendments used are calcium sulfate (gypsum) and sulfur. They are applied mainly

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for the purpose of reclaiming soils that are affected by alkali. Lime is not used, and little if any is needed.

Erosion control.—On most well-managed irrigated soils, wind erosion is only a minor hazard. On dry-farmed soils, wind erosion can be controlled by plowing under crop residues, keeping the surface cloddy, and using subsurface tillage. On coarse-textured soils, strip-cropping at right angles to the wind direction helps to prevent damage. Leaving stubble or crop residue on the surface also provides some protection.

Water erosion is a relatively minor problem because only the more gently sloping soils are cultivated.

Drainage.—As a result of pumping for irrigation, a high water table is no longer a problem in most of the Madera Area.

Friant Dam and Pine Flat Dam have reduced the danger of floods but some of the local streams are still not controlled.

Surface drains and open drains will remove most of the excess water. Soils that have a hardpan or a restricting fine-textured substratum can develop drainage problems if carelessly irrigated.

Nematode control.—Root-knot nematodes are small animals that live on the roots of plants. For the most part, they are parasites and depend on the plants for food. They cause bumpy and knobby lesions or growths on the roots. In excess numbers, nematodes are harmful to plants.

The problem of controlling nematodes is most severe on coarse-textured soils low in natural fertility and water-holding capacity. Plants growing on such soils are naturally less vigorous and consequently are more susceptible to damage. Plants growing on the finer textured soils, which are generally high in fertility and water-holding capacity, are more vigorous, and nematodes, though they may be present, generally have little harmful effect.

A number of chemicals have been developed to control nematodes. These chemicals release, in the soil, gases that kill the nematodes. Because the gases are also harmful to most plants, it is usual to fumigate the soil when no crop is growing, but some recently developed chemicals can be used when plants are present.

It is advisable to obtain professional advice before using chemicals for nematode control.

Capability Groups of Soils

The capability classification is a grouping of soils that shows, in a general way, how suitable they are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so steep, shallow, or otherwise limited that they do not produce worthwhile yields of crops, grazing, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated 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* means that water in or on the soil will interfere 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, saline or alkali, or stony; and *c*, used in only some parts of the country, indicates 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 or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it have little or no erosion hazard but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils 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 of soils for many statements about their management. In California, capability units are given numbers that suggest the chief kind of limitation responsible for placement of the soils in the capability class and subclass. For this reason units within the subclasses are not numbered consecutively, and their symbols are a partial key to some of the soil features. The numerals used to designate units within the classes and subclasses are these:

1. An erosion hazard, actual or potential.
2. A problem or limitation of wetness because of a high water table or seepage.
3. A problem or limitation of shallow soil.
4. A problem or limitation of coarse-textured soil, excessive gravel, or rock outcrop.
5. A problem or limitation of fine-textured soil.
6. A problem or limitation of salts or alkali.
7. A problem or limitation of reduced permeability in the subsoil.
8. A problem or limitation of salts or alkali and shallow soil.
9. A problem or limitation of shallow soil and low fertility.

Soils are classified in capability classes, subclasses and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive land-forming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The eight classes in the capability system, and the subclasses and units in this Area, are described in the list that follows.

The capability classes, subclasses, and units in the Madera Area are as follows:

Class I.—Soils that are very good for crops and have few limitations that restrict their use.

Unit I-1.—Very gently sloping, deep or very deep, well-drained soils on recent alluvial fans and flood plains.

Class II.—Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.

Subclass IIe.—Soils likely to erode if not protected.

Unit IIe-1.—Gently sloping, deep to very deep, well-drained soils on terrace escarpments.

Unit IIe-4.—Deep to very deep, coarse-textured soils on low terraces.

Subclass IIw.—Soils moderately limited by excess water.

Unit IIw-2.—Deep, imperfectly drained soils on low, recent alluvial fans, on flood plains, and in the basin.

Unit IIw-7.—Soils of recently deposited alluvium over a slowly permeable substratum.

Subclass IIs.—Soils moderately limited by a pan or fine-textured subsoil, or by salts and alkali.

Unit IIs.-3.—Moderately coarse textured to medium textured soils underlain at a depth of more than 3 feet by unrelated hardpan or semiconsolidated substratum.

Unit IIs-6.—Slightly saline-alkali, level to gently sloping soils on recent alluvial fans, on flood plains, and in the basin.

Unit IIs-7.—Deep, well-drained, medium textured and moderately coarse textured soils that have a moderately fine textured subsoil.

Class III.—Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Subclass IIIe.—Soils that have a severe hazard of erosion if they are tilled and not protected.

Unit IIIe-1.—Gently sloping, moderately deep, well-drained soils on the uplands and the older terraces.

Unit IIIe-4.—Droughty, coarse-textured soils that have a severe hazard of wind erosion.

Subclass IIIw.—Soils severely limited by excess water.

Unit IIIw-5.—Fine-textured, shallow to moderately deep soils in depressions and drainageways on terraces.

Subclass IIIs.—Soils severely limited by fine texture, by salts and alkali, by restricted depth, or by slowly permeable subsoil.

Unit IIIs-3.—Moderately fine textured to moderately coarse textured soils underlain at a depth of less than 3 feet by hardpan or silty substratum.

Unit IIIs-5.—Fine-textured, shallow to moderately deep, well-drained soils on terraces and uplands.

Unit IIIs-6.—Moderately saline-alkali, moderately coarse textured to moderately fine textured soils on recent alluvial fans, on flood plains, and in the basin.

Unit IIIs-8.—Slightly saline-alkali soils that are shallow to moderately deep over hardpan or claypan.

Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe.—Soils very severely limited by risk of erosion if not protected.

Unit IVe-1.—Rolling, medium textured to moderately coarse textured soils on old terraces and uplands.

Unit IVe-3.—Shallow, rolling, medium textured to moderately coarse textured soils on old alluvial fans and terraces.

Unit IVe-4.—Very deep, coarse-textured soils on alluvial fans and low terraces.

Subclass IVw.—Soils severely limited by excess water.

Unit IVw-6.—Deep, moderately coarse textured to moderately fine textured, strongly saline-alkali soils.

Subclass IVs.—Soils severely limited by droughtiness, salts or alkali, or restricted depth.

Unit IVs-3.—Shallow, moderately coarse textured to moderately fine textured, gently sloping or undulating soils on old terraces.

Unit IVs-4.—Droughty, coarse-textured, moderately saline-alkali soils on recent alluvial fans, on flood plains, and in the basin.

Unit IVs-6.—Deep to very deep, medium-textured, strongly saline-alkali soils on recent alluvial fans, on flood plains, and in the basin.

Unit IVs-8.—Shallow, moderately saline-alkali soils on alluvial fans, on low terraces, and in the basin.

Class V.—Soils that have little or no erosion hazard but have other limitations impractical to remove that limit their use largely to pasture, range, woodland, or wildlife food and cover.

There are no class V soils in the Madera Area.

Class VI.—Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture, woodland, or food and cover for wildlife.

Subclass VIe.—Soils severely limited by hazard of erosion.

Unit VIe-1.—Rocky, medium-textured, rolling to steep soils on uplands.

Unit VIe-4.—Rocky, moderately coarse textured, moderately deep to deep, sloping to hilly soils on terraces and uplands.

Subclass VIs.—Soils unsuited to cultivation because of restricted depth or salts and alkali.

Unit VIs-6.—Strongly saline-alkali soils on recent alluvial fans, on flood plains, and in the basin.

Unit VIs-8.—Moderately coarse textured to moderately fine textured, shallow, strongly saline-alkali soils on alluvial fans, on low terraces, and in the basin.

Class VII.—Soils that have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe.—Soils very severely limited by risk of erosion if not protected.

Unit VIIe-1.—Very steep, rocky, medium textured, moderately deep to deep soils on uplands.

Unit VIIe-3.—Shallow to very shallow, gently sloping to steep, rocky, stony, or gravelly sandy loams to loams on uplands.

Unit VIIe-4.—Moderately coarse textured, moderately deep to deep, hilly to steep soils on uplands.

Unit VIIe-9.—Shallow to very shallow, gently sloping to hilly, rocky, stony, or gravelly sandy loams and loams on uplands.

Class VIII.—Soils and land types with limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIs.—Land types, mostly rock or rock fragments.

Unit VIIIs-1.—Miscellaneous land types.

Discussions of management for each of the capability units in the Madera Area follow.

Capability unit I-1

This unit consists of well-drained, very gently sloping soils of the recent alluvial fans and flood plains. The profiles are more than 5 feet deep and are fairly uniform. Permeability is moderately slow to rapid.

The soils in this unit are—

(GaA) Grangeville fine sandy loam, 0 to 1 percent slopes.
(GmA) Grangeville sandy loam, 0 to 1 percent slopes.
(GrA) Greenfield coarse sandy loam, 0 to 3 percent slopes.
(GuA) Greenfield sandy loam, 0 to 3 percent slopes.
(GsA) Greenfield fine sandy loam, 0 to 3 percent slopes.
(HaA) Hanford fine sandy loam, 0 to 1 percent slopes.
(HfA) Hanford sandy loam, 0 to 3 percent slopes.
(MoA) Marguerite loam, 0 to 3 percent slopes.
(MmA) Marguerite clay loam, 0 to 3 percent slopes.
(PaA) Pachappa fine sandy loam, 0 to 1 percent slopes.
(PcA) Pachappa sandy loam, 0 to 1 percent slopes.
(VaA) Visalia fine sandy loam, 0 to 1 percent slopes.
(VdA) Visalia sandy loam, 0 to 3 percent slopes.

Use and management.—In general, these are the most productive soils in the Area. All the crops suited to the climate and requiring good drainage do well. Row crops, forage crops, grain, grapes, fruits, nuts, and pasture are grown under irrigation.

Supplies of organic matter and nitrogen are low, but the natural fertility is otherwise high. Nitrogen fertilizer is needed for nonleguminous crops. Phosphorus and sulfur will improve the quality of legumes but may not increase yields. Field trials show that potatoes, and perhaps other specialty crops, will respond to potash at the highest levels of management. Grapevines occasionally show deficiencies in zinc and possibly manganese.

The supply of organic matter can be maintained by returning all crop residues to the soil and by using green manure crops and crop rotations. Rotations should include soil-improving crops, such as pasture, hay, or legumes or grasses for seed, at least 25 percent of the time. In orchards and vineyards a fertilized green-manure crop should be planted in the fall. Irrigated pastures should be grazed in rotation and fertilized to get maximum forage production.

Furrow, border, contour-basin, or sprinkler irrigation can be used. Leveling causes little difficulty and can be done with little or no injury to the soils. Excessive cultivation should be avoided, as it can result in the formation of a tillage pan. In orchards, tillage pans can be corrected by using methods other than tillage to control weeds. In open fields, they can be broken up by subsoiling.

Nematodes are a problem in some areas and may make replanting of vineyards and orchards difficult. Effective nematode controls for most crops are now available.

Capability unit IIe-1

This unit consists of gently sloping soils on terrace escarpments. These soils are similar to those in unit I-1 but have slightly more rapid runoff and a slight erosion hazard.

These soils are more than 5 feet deep. They are well drained and moderately coarse textured. Permeability is moderately rapid to rapid.

The soils in this unit are—

(GrB) Greenfield coarse sandy loam, 3 to 8 percent slopes.
(GuB) Greenfield sandy loam, 3 to 8 percent slopes.
(GsB) Greenfield fine sandy loam, 3 to 8 percent slopes.
(HeB) Hanford gravelly sandy loam, 3 to 8 percent slopes.

Use and management.—These soils are suited to the same crops as the soils in unit I-1 and need the same management practices to maintain productivity and supply organic matter. Irrigating presents a minor problem because of the slopes and the slight hazard of erosion. If the water is applied carefully, preferably by the contour or sprinkler method, it will soak into the soil and will not run off and cause erosion. A system for collecting and safely disposing of excess water is necessary. Sheet erosion can be controlled by cross-slope tillage, stubble mulching, cover crops, and other fairly simple means. Deep cuts can be made to level or to smooth slopes without long-time injurious effects on the soils.

Capability unit IIe-4

The soils in this unit were derived from wind-reworked granitic alluvium. Typically they occur on the leeward side of present or abandoned stream courses on low terraces. The moisture-holding capacity is moderate. The soils are more than 5 feet deep. Drainage is good, and internal drainage is moderately rapid. The wind erosion hazard is severe. Natural fertility is moderate.

The soils in this unit are—

(AtB) Atwater loamy sand, 3 to 8 percent slopes.
(AtA) Atwater loamy sand, 0 to 3 percent slopes.

Use and management.—These soils are suitable for a wide range of crops, including irrigated orchard, vineyard, row, forage, and specialty crops; dryfarmed grain; and range. Deep-rooted crops are best suited, but shallow-rooted crops can be grown under careful irrigation practices. Frequent, light irrigations are needed. Water should be applied carefully to prevent erosion. Short runs should be used with furrow or border irrigation, to prevent loss of water and leaching of plant nutrients. The slopes of 3 to 8 percent should have contour furrows or checks or be sprinkler irrigated.

Water erosion is not a problem, because of rapid infiltration. Severe wind erosion is likely if the soils are left without protective cover. Wind erosion can be controlled by using cover crops and crop mulches.

The supply of organic matter can be maintained by using green-manure crops, crop residues, and crop rotations.

Dryfarmed grain responds well to phosphate and nitrogen but not to nitrogen alone. Irrigated crops other than legumes respond to nitrogen. Phosphorus and sulfur are beneficial to legumes.

If these soils are leveled, cuts should not be so deep that the subsoil is exposed. If the subsoil is exposed, growth of crops is irregular and continues to be for a considerable time after leveling.

Capability unit IIw-2

These imperfectly drained soils are on low recent alluvial fans, on flood plains, and in the basin. They are more than 5 feet deep. Permeability ranges from moderately slow to rapid.

These soils developed under natural conditions of very slow surface runoff and a high ground-water level. The present drainage is much improved as a result of lowering the water table by pump irrigation and building flood-control structures, including Friant and Pine Flat Dams. There still remains, however, a hazard of a seasonal high or perched water table caused by excessive irrigation or movement of water from high areas.

The soils in this unit are—

(CgA) Chino loam, 0 to 1 percent slopes.
(CfA) Chino fine sandy loam, 0 to 1 percent slopes.
(CeA) Chino clay loam, 0 to 1 percent slopes.
(CmA) Columbia fine sandy loam, 0 to 1 percent slopes.
(CpA) Columbia sandy loam, 0 to 1 percent slopes.
(CpdA) Columbia sandy loam, moderately deep over sand, 0 to 1 percent slopes.
(FbA) Foster loams, 0 to 1 percent slopes.
(FbdA) Foster loams, sandy substratum, 0 to 1 percent slopes.
(FaA) Foster clay loam, 0 to 1 percent slopes.
(TdA) Temple loam, 0 to 1 percent slopes.
(TbA) Temple clay loam, 0 to 1 percent slopes.
(TaA) Temple clay, 0 to 1 percent slopes.

Use and management.—Crops do as well on these soils as on those in unit I-1, but the choice of crops is more restricted because of the hazard of an occasional high water table. Long-lived, deep-rooted, deciduous fruit and nut trees are not suitable, and alfalfa may be unfavorably affected. Row crops, forage crops, grain, and irrigated pasture are the crops best suited to these soils.

The water table can be controlled by the use of open or tile drains. Irrigation water should be applied carefully, to conserve water and to prevent the occurrence of a temporarily high or perched water table. Provision should be made for the disposal of excess surface water.

These soils are high in natural fertility. The supplies of organic matter and nitrogen, especially in the Foster and Temple soils, are much greater than in the soils in unit I-1. Crops other than legumes respond to nitrogen fertilizer. Legumes benefit from phosphorus and sulfur, from the standpoint of improvement of quality if not of increased yields. Specialty crops, such as potatoes, may benefit from potash, but the soils supply enough potassium for most crops. The supply of organic matter can be maintained by rotating crops, growing green-manure crops, and turning under all plant residues.

Except in areas that are somewhat channeled or marked by stream meanders, little leveling is required, and it can be done with little effect on the soils.

Capability unit IIw-7

This unit consists of two-story soils formed by the deposition of recent alluvial-fan and flood-plain materials over darker colored, finer textured, older basin sediments. The overlying materials range from 12 to 48 inches in thickness but are most commonly between 24 and 36 inches thick. They are lighter colored, coarser textured, and more rapidly permeable than the older materials in the substratum.

These soils have developed under conditions of very slow surface runoff and high ground water. Present drainage has been improved by large-scale pumping for irrigation and flood control. Nevertheless, waterlogging and a temporary perched water table are possible because of the slowly permeable substratum.

The soils in this unit are—

(CmtA) Columbia fine sandy loam, moderately deep and deep over Temple soils, 0 to 1 percent slopes.
(CotA) Columbia loamy sand, over Temple soils, 0 to 1 percent slopes.
(FbeA) Foster loams, moderately deep and deep over Temple soils, 0 to 1 percent slopes.
(GeA) Grangeville fine sandy loam, moderately deep and deep over Temple soils, 0 to 1 percent slopes.

Use and management.—In use and management requirements, this unit is similar to unit IIw-2. Deep drainage is not advisable, because of the slowly permeable substratum. Irrigation water should be carefully controlled, to prevent waterlogging and the formation of a perched water table. Frequent, light applications of water are best. Surface drainage and tail-water drainage should be provided.

Little leveling is required, and it can be done with little effect on the soils.

Capability unit IIs-3

The soils in this unit occupy the nearly level to gently sloping, recent alluvial fans and flood plains. They are underlain, at a depth of more than 3 feet, by an unrelated hardpan or semiconsolidated substratum. In texture, they range from moderately coarse to medium. Internal drainage is moderately rapid to medium down to the hardpan or substratum, then very slow.

All of these soils are very gently sloping, except for the Greenfield sandy loam on slopes of 3 to 8 percent, and after leveling this soil is like the others in the unit.

The soils in this unit are—

(BeA) Bear Creek loam, 0 to 3 percent slopes.
(CmdA) Columbia fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes.
(GfA) Grangeville fine sandy loam, deep over hardpan, 0 to 1 percent slopes.
(GhA) Grangeville fine sandy loam, deep over alkali hardpan, 0 to 1 percent slopes.
(GkA) Grangeville fine sandy loam, deep over alkali hardpan, slightly saline-alkali, 0 to 1 percent slopes.
(GvA) Greenfield sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes.
(GvB) Greenfield sandy loam, moderately deep and deep over hardpan, 3 to 8 percent slopes.

Use and management.—These soils are suited to most of the same crops as the soils in unit I–1, and they require similar but more careful management. They are not suited to deep-rooted orchard crops. Because of the hardpan and substratum, careful use of irrigation water is essential, to prevent waterlogging and the formation of a perched water table. Lighter and slightly more frequent applications of water are advisable.

Generally, little leveling is required. Moderate cuts can be made without harmful effects. If deeper cuts are made, eliminating or shattering the hardpan may be worthwhile; it is of greatest benefit to deep-rooted crops, such as tree fruits and nuts. Erosion is not a problem, but some of the coarser textured soils can be damaged by wind if improperly managed. Cover crops and crop mulches help control wind erosion.

Capability unit IIs–6

The soils in this unit are slightly saline-alkali but are otherwise similar to the soils in unit I–1. They occur on recent alluvial fans and flood plains and in the basin. The salts and alkali occur throughout the subsoil and affect up to 25 percent of the surface soil. Permeability is moderately rapid to moderately slow. Natural fertility is moderate to high.

The soils in this unit are—

- (CgaA) Chino loam, slightly saline-alkali, 0 to 1 percent slopes.
- (CfaA) Chino fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
- (CeaA) Chino clay loam, slightly saline-alkali, 0 to 1 percent slopes.
- (FbaA) Foster loams, slightly saline-alkali, 0 to 1 percent slopes.
- (FaaA) Foster clay loam, slightly saline-alkali, 0 to 1 percent slopes.
- (GbA) Grangeville fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
- (GnA) Grangeville sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
- (GcA) Grangeville fine sandy loam, over Traver soils, 0 to 1 percent slopes.
- (GdA) Grangeville fine sandy loam, over Traver soils, slightly saline-alkali, 0 to 1 percent slopes.
- (MrA) Marguerite loam, slightly saline-alkali, 0 to 3 percent slopes.
- (PbA) Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
- (PdA) Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
- (TeA) Temple loam, slightly saline, 0 to 1 percent slopes.
- (TcA) Temple clay loam, slightly saline, 0 to 1 percent slopes.
- (TmA) Traver loam, slightly saline-alkali, 0 to 1 percent slopes.
- (TpA) Traver-Chino complex, slightly saline-alkali, 0 to 1 percent slopes.
- (WuA) Wunjey very fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are best suited to row, forage, grain, and pasture crops that are tolerant of slightly saline-alkali soils. Grapes, fruits, and nuts, and other less salt- and alkali-tolerant crops grow unevenly and are likely to be short lived and less productive. Orchards and vineyards should be planted only on selected sites.

Leaching and applying organic matter and gypsum or sulfur should remove some of the salts and alkali from the surface soil. Gypsum or sulfur should be applied before the crop is planted. Removing excess salts and alkali from the subsoil is more difficult, and improvement will be more gradual.

Proper irrigation and tail-water disposal are important. Leveling should be done carefully, with provision for surface drainage. Frequent, light irrigations are best, except for periodic deep leaching as a soil improvement practice. Some of these soils have a drainage problem.

In other management requirements, these soils are similar to those in unit I–1.

Capability unit IIs–7

The soils of this unit occupy the higher, older alluvial fans and terraces. They are typically deep and well drained. The texture ranges from sandy loam to loam, and the subsoil is moderately fine textured. Surface runoff is very slow to slow, but subsoil drainage is moderately slow. There is a slight erosion hazard.

The soils in this unit are—

- (BfA) Borden fine sandy loam, 0 to 1 percent slopes.
- (BmA) Borden loam, 0 to 1 percent slopes.
- (RoA) Ramona sandy loam, 0 to 3 percent slopes.
- (RbA) Ramona sandy loam, deep over hardpan, 0 to 3 percent slopes.

Use and management.—These soils are best suited to shallow-rooted crops, such as grain, row crops, forage crops, and pasture.

These soils are lower in natural fertility than the soils in unit I–1. Irrigated crops other than legumes respond to nitrogen, and legumes respond to phosphorus and sulfur. Dryfarmed grain responds to nitrogen and phosphorus. Range grasses benefit from nitrogen and phophorus, and legumes benefit from phosphorus and sulfur.

Irrigation water should be applied carefully, to avoid waterlogging. Little leveling is required.

Organic matter can be supplied and soil structure maintained by using green-manure crops, crop rotations, and crop residues.

Capability unit IIIe–1

The soils in this unit occupy the gently sloping older terraces and upland areas. They are moderately deep, well-drained sandy loams to loams. The erosion hazard is slight.

The soils in this unit are—

- (AdB) Ahwahnee and Vista coarse sandy loams, 3 to 8 percent slopes.
- (RaB) Ramona sandy loam, 3 to 8 percent slopes.
- (SyB) Sesame sandy loam, 3 to 8 percent slopes.
- (SeB) Sesame loam, 3 to 8 percent slopes.
- (VsB) Vista-Sesame complex, 3 to 8 percent slopes.
- (WfB) Whitney fine sandy loam, 3 to 8 percent slopes.
- (WmA) Whitney loam, 0 to 3 percent slopes.
- (WmB) Whitney loam, 3 to 8 percent slopes.
- (WtB) Whitney-Trigo fine sandy loams, 3 to 8 percent slopes.
- (WrB) Whitney and Rocklin sandy loams, 3 to 8 percent slopes.

Use and management.—These soils are suited to grain, row crops, forage crops, and pasture. They are not well suited to deep-rooted deciduous fruit and nut crops. At present they are used principally for dryfarmed grain and range. If irrigation water is available, these soils are best suited to crops that require a moderate rooting depth.

Cross-slope cultivation, cover crops, and crop residues are needed to protect these soils from erosion. Water, if available, should be applied carefully, either on the contour or by sprinkler, to avoid erosion and to conserve moisture.

The natural fertility is moderate. Dryfarmed grain and range respond to nitrogen and phosphorus. Legumes benefit from phosphorus and sulfur. Irrigated crops other than legumes respond to nitrogen, and irrigated legumes to phosphorus and sulfur. Organic matter can be supplied and the soil structure maintained by using green-manure crops, crop rotations, and crop residues.

If used for range, these soils should be managed like the soils in unit VIe-4.

Capability unit IIIe-4

The soils in this unit occur on the recent and slightly older alluvial fans and flood plains. They are droughty because they are coarse textured. Some are underlain by a hardpan or a silty substratum, ordinarily at a depth of more than 3 feet.

These are very rapidly or rapidly permeable, well drained or somewhat excessively drained soils of low fertility and low water-holding capacity. The wind erosion hazard is severe, and water erosion is a hazard on irrigated slopes of 3 to 8 percent. Some areas are slightly saline-alkali.

The soils in this unit are—

(AwB) Atwater loamy sand, moderately deep and deep over hardpan, 3 to 8 percent slopes.
(AwA) Atwater loamy sand, moderately deep and deep over hardpan, 0 to 3 percent slopes.
(CaA) Cajon loamy sand, 0 to 1 percent slopes.
(CaaA) Cajon loamy sand, slightly saline-alkali, 0 to 1 percent slopes.
(CbaB) Calhi loamy sand, slightly alkali, 0 to 8 percent slopes.
(CcaA) Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 0 to 3 percent slopes.
(CcaB) Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 3 to 8 percent slopes.
(CrB) Columbia soils, channeled, 0 to 8 percent slopes.
(HhA) Hanford sandy loam, moderately deep over sand, 0 to 3 percent slopes.
(TwA) Tujunga loamy sand, 0 to 3 percent slopes.
(TwB) Tujunga loamy sand, 3 to 8 percent slopes.
(TxA) Tujunga loamy sand, moderately deep and deep over hardpan, 0 to 3 percent slopes.
(TzB) Tujunga and Hanford soils, channeled, 0 to 8 percent slopes.
(TyA) Tujunga loamy sand, moderately deep and deep over silt, 0 to 3 percent slopes.
(VnA) Visalia sandy loam, moderately deep over sand, 0 to 3 percent slopes.

Use and management.—The soils in this unit are similar to those in unit IIe-4 but have lower water-holding capacity. They are suited to vineyards, row crops, forage crops, and pasture. Selected locations are suited to orchards.

Wind erosion is a severe hazard if the soils are exposed or improperly managed. Cover crops and mulches of crop residues help to reduce this hazard. Water erosion resulting from irrigation can be controlled by irrigating with sprinklers or by using a small head and short runs with furrows or borders. Irrigating by one of these methods will also reduce loss of water and leaching of plant nutrients.

The natural fertility is low. Legumes respond to phosphorus and sulfur, and other crops to nitrogen. Specialty crops, such as potatoes, respond to potash. Split applications of fertilizer give the best results. Of the minor elements, zinc is deficient for grapes, deciduous fruits, and nuts. There may also be deficiencies of manganese and other minor elements. The supply of organic matter can be maintained by using manure, green-manure crops, crop rotations, and crop residues.

Areas affected by salts and alkali should be treated with manure and gypsum or sulfur, then leached.

Leveling ordinarily eliminates much of the difference in slope. Deep cuts can be made without longtime effects, except on the soils underlain by a hardpan or silty substratum.

A number of areas of these soils occur as long, narrow stringers through areas of finer textured soils. Such areas are hard to manage and they cause difficulty in irrigating the finer textured soils. If possible, fields should be arranged so that these droughty soils can be irrigated separately, preferably by sprinkler.

Capability unit IIIw-5

The soils in this unit are moderately deep to shallow, fine textured, and slowly permeable. They are poorly to imperfectly drained because they are in basins and drainageways. Surface drainage is very slow or, in some areas, ponded. Permeability is slow because of the fine texture. The erosion hazard is no more than slight.

These soils are associated with the lower terrace soils that are in unit IVs-3. The individual areas are usually small, narrow, and depressed, so it is difficult to handle them separately.

The soils in this unit are—

(AsA) Alamo clay, 0 to 1 percent slopes.
(HmA) Hildreth sandy clay, 0 to 3 percent slopes.
(HnB) Hildreth-San Joaquin complex, 0 to 8 percent slopes.

Use and management.—These soils are suited to grain, pasture, and shallow-rooted forage crops. Because of their size and position, most areas are used in the same way as the well-drained surrounding soils.

These soils need drainage but are difficult to drain because of their position. Irrigation water should be applied carefully, to avoid ponding and waterlogging. Adequate drainage should be provided.

The natural fertility is low, and without adequate drainage fertilizing is difficult. Grain, pasture, and range respond to nitrogen and phosphorus. Forage crops respond to nitrogen. Phosphorus and sulfur are beneficial to legumes. Organic matter can be supplied and soil structure maintained by using green-manure crops, crop rotations, and crop residues.

These soils can be leveled only if the surrounding soils are being leveled. Sometimes leveling fills in the depressions and eliminates these contrasting spots within the areas of well-drained soils.

Capability unit IIIs-3

The soils in this unit are similar to those in unit IIs-3, except that the hardpan or silty substratum is nearer the surface.

These soils are on the recent alluvial fans and flood plains and in the basin. They are moderately deep or deep over the hardpan or silty substratum. They range in texture from sandy loam to clay loam. Some are slightly saline-alkali. Permeability is moderately rapid to moderately slow. In the pan or silty substratum, however, it is slow to very slow. The natural fertility is moderate.

The soils in this unit are—

- (BzA) Buchenau loam, 0 to 3 percent slopes.
- (BuA) Buchenau fine sandy loam, 0 to 3 percent slopes.
- (CoA) Columbia loamy sand, 0 to 1 percent slopes.
- (DmA) Dinuba fine sandy loam, 0 to 1 percent slopes.
- (DoA) Dinuba loam, 0 to 1 percent slopes.
- (HbA) Hanford fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes.
- (HgA) Hanford sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes.
- (HdA) Hanford (Ripperdan) fine sandy loam, moderately deep and deep over silt, 0 to 3 percent slopes.
- (HcA) Hanford (Ripperdan) fine sandy loam, shallow variant, 0 to 3 percent slopes.
- (PoA) Pozo loam, 0 to 1 percent slopes.
- (PhA) Pozo clay loam, 0 to 1 percent slopes.

Use and management.—These soils are best suited to grain, vineyards, and shallow-rooted row, forage, and specialty crops.

Care must be used in irrigating these soils because of their restricted effective depth. Frequent, light irrigations are needed to prevent temporary waterlogging, formation of a perched water table, and reduced aeration.

Legumes respond to phosphorus and possibly sulfur, and other crops respond to nitrogen. Some specialty crops, such as potatoes, respond to potash at the highest levels of management, but for most crops the soils supply enough potassium. Organic matter can be supplied and the soil structure maintained by using green-manure crops, crop rotations, and crop residues.

Leveling must be done with care. Shallow cuts can reduce the effective rooting depth, and deeper cuts can expose the hardpan. Some attempts have been made to disrupt or eliminate the hardpan to increase the effective rooting depth. This practice is expensive, and it is of doubtful benefit because the substratum is consolidated.

Capability unit IIIs–5

This unit consists of well-drained, fine-textured soils of the terraces and uplands. These soils are shallow to moderately deep over bedrock or a hardpan. Slopes are gentle, drainage is good, and the erosion hazard is slight. Permeability is slow because of the clay texture. Natural fertility is moderate, and all of the soils contain more or less free lime.

The soils in this unit are—

- (JeA) Jesbel clay, 0 to 3 percent slopes.
- (JgB) Jesbel gravelly clay, 3 to 8 percent slopes.
- (PfA) Porterville clay, 0 to 3 percent slopes.
- (PfB) Porterville clay, 3 to 8 percent slopes.
- (PgB) Porterville rocky clay, 3 to 8 percent slopes.
- (RcA) Raynor clay, 0 to 3 percent slopes.
- (RcB) Raynor clay, 3 to 8 percent slopes.
- (ZaB) Zaca clay, 3 to 8 percent slopes.

Use and management.—These soils are best suited to grain, pasture, forage crops, and range.

Legumes respond to phosphorus and sulfur, and other crops to nitrogen. Dryfarmed grain responds to phosphorus and nitrogen. Organic matter can be supplied and structure maintained by using crop rotations, green-manure crops, and crop residues.

Irrigation water should be applied carefully, to prevent waterlogging and formation of a perched water table. Adequate surface drainage should be provided.

Leveling cuts should be shallow because of the restricted depth. No leveling is needed for sprinkler irrigation.

On slopes of 3 to 8 percent, cross-slope farming and stubble mulching will control erosion.

The range management practices described for capability unit VIe–1 are applicable.

Capability unit IIIs–6

The soils in this unit are similar to those in unit IIs–6 except for being moderately saline or saline-alkali. They occur on alluvial fans and flood plains and in the basin. In texture, they range from fine sandy loam to clay loam. Permeability is moderate to slow.

The soils in this unit are—

- (BkA) Borden fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
- (BoA) Borden loam, slightly saline-alkali, 0 to 1 percent slopes.
- (CgbA) Chino loam, moderately saline-alkali, 0 to 1 percent slopes.
- (CfbA) Chino fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes.
- (CebA) Chino clay loam, moderately saline-alkali, 0 to 1 percent slopes.
- (FbbA) Foster loams, moderately saline-alkali, 0 to 1 percent slopes.
- (FcbA) Foster loams, moderately deep and deep over Temple soils, moderately saline-alkali, 0 to 1 percent slopes.
- (FabA) Foster clay loam, moderately saline-alkali, 0 to 1 percent slopes.
- (MsA) Marguerite loam, moderately saline-alkali, 0 to 3 percent slopes.
- (MnA) Marguerite clay loam, moderately saline-alkali, 0 to 3 percent slopes.
- (RrA) Rossi silt loam, slightly saline-alkali, 0 to 1 percent slopes.
- (RoA) Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes.
- (TnA) Traver loam, moderately saline-alkali, 0 to 1 percent slopes.
- (TrA) Traver-Chino complex, moderately saline-alkali, 0 to 1 percent slopes.
- (WvA) Wunjey very fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are best suited to grain, row crops, forage crops, and pasture plants that will tolerate moderate amounts of salts and alkali. They are not suited to deep-rooted crops, such as orchard fruits. Management requirements are about the same as for the soils in unit IIs–6, except that larger amounts of water and gypsum or sulfur are needed for reclamation.

Capability unit IIIs–8

The soils in this unit occur in nearly level parts of the basin and the low terraces. They are moderately coarse textured to moderately fine textured. They are either shallow to moderately deep or deep over a hardpan or claypan. Salts and alkali are present throughout the subsoil and affect up to 25 percent of the surface soil. Because of the restricted depth, reclamation is difficult. Natural fertility is low.

The soils in this unit are—

- (BvA) Buchenau fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes.

(DpA) Dinuba-El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes.
(DtA) Dinuba-El Peco loams, slightly saline-alkali, 0 to 1 percent slopes.
(FeaA) Fresno and El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes.
(FfaA) Fresno and El Peco loams, slightly saline-alkali, 0 to 1 percent slopes.
(FgaA) Fresno, El Peco, and Chino soils, slightly saline-alkali, 0 to 1 percent slopes.
(FkaA) Fresno, El Peco, and Pozo soils, slightly saline-alkali, 0 to 1 percent slopes.
(LeA) Lewis loam, slightly saline-alkali, 0 to 1 percent slopes.
(PeA) Pachappa sandy loam, moderately deep and deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes.
(PsA) Pozo loam, slightly saline, 0 to 1 percent slopes.
(PkA) Pozo clay loam, slightly saline, 0 to 1 percent slopes.

Use and management.—These soils are best suited to shallow-rooted crops that can tolerate slight amounts of salts and alkali. Row crops, forage crops, grain, and pasture crops can be grown.

Gypsum or sulfur, together with water, should be used to move the excess salts and alkali as deep into the subsoil as possible.

Considerable care must be used in irrigating these soils, because of their restricted depth. Frequent, light irrigations are advisable, to prevent waterlogging, formation of a perched water table, and reduced aeration. Provision should be made for disposal of tail water, to prevent ponding.

Leveling should be done carefully, because even shallow cuts can reduce still further the effective rooting depth, and deeper cuts can expose the hardpan.

Legumes respond to phosphorus and sulfur, and other crops respond to nitrogen. Green-manure crops, crop residues, and crop rotations will help supply organic matter and to maintain soil structure.

Capability unit IVe-1

The soils in this unit occur on rolling slopes on the uplands and older terraces. They range in texture from loam to coarse sandy loam. Permeability is moderately slow to rapid. The natural fertility is moderate. These soils are steeper, shallower, and more erosive than those in unit IIIe-1.

The soils in this unit are—

(AaC) Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes.
(AdC) Ahwahnee and Vista coarse sandy loams, 8 to 15 percent slopes.
(ChD) Coarsegold loam, 8 to 30 percent slopes.
(SeC) Sesame loam, 8 to 15 percent slopes.
(WfC) Whitney fine sandy loam, 8 to 15 percent slopes.
(WmC) Whitney loam, 8 to 15 percent slopes.
(WrC) Whitney and Rocklin sandy loams, 8 to 15 percent slopes.
(WoC) Whitney and Rocklin gravelly sandy loams, 3 to 15 percent slopes.

Use and management.—These soils are best suited to dryfarmed grain, range, irrigated pasture, and forage crops. At present they are used for hay, grain, and range.

In fertilizer requirements and other management needs, these soils are similar to those of unit IIIe-1. If dryfarmed, they should be in permanent cover 3 out of 4 years. If used for range, they should be managed like the soils in unit VIe-4. If water for irrigation should become available, only close-growing crops should be grown, and those only under very careful management.

Capability unit IVe-3

The soils of this unit occupy the rolling, older alluvial fans and terraces. They are shallow, moderately coarse textured to medium textured, gravelly in places, and slowly permeable. The Montpellier soils are slightly deeper than the other soils in the unit. Runoff is slow to medium, and the erosion hazard is moderate to severe. Natural fertility is low.

The soils in this unit are—

(CuB) Cometa sandy loams, 3 to 8 percent slopes.
(CuC) Cometa sandy loams, 8 to 15 percent slopes.
(CsB) Cometa gravelly sandy loam, 3 to 8 percent slopes.
(CtB) Cometa loam, 3 to 8 percent slopes.
(CwB) Cometa-Whitney sandy loams, 3 to 8 percent slopes.
(CwC) Cometa-Whitney sandy loams, 8 to 15 percent slopes.
(CyB) Corning gravelly loam, 3 to 8 percent slopes.
(MtB) Montpellier coarse sandy loam, 3 to 8 percent slopes.
(MtC) Montpellier coarse sandy loam, 8 to 15 percent slopes.
(RdC) Redding gravelly loam, 3 to 15 percent slopes.
(RfC) Redding gravelly sandy loam, 3 to 15 percent slopes.
(RgC) Redding-Raynor complex, 3 to 15 percent slopes.
(ScB) San Joaquin-Whitney sandy loams, 0 to 8 percent slopes.
(TuB) Trigo fine sandy loam, 3 to 8 percent slopes.
(TuC) Trigo fine sandy loam, 8 to 15 percent slopes.
(TvB) Trigo-Cometa sandy loams, 3 to 8 percent slopes.

Use and management.—These soils are best suited to dryfarmed grain, range, forage crops, and irrigated pasture. Irrigated pasture is the best use.

Measures to control erosion are essential because of the shallowness and the rolling slopes. Cross-slope farming and the use of crop residues will help protect cultivated areas. Proper use is adequate protection against erosion of range.

Dryfarmed grain responds to phosphorus and nitrogen. Dryland range or irrigated pasture responds to nitrogen, phosphorus, and sulfur. The supply of organic matter can be maintained and the structure preserved by growing green-manure crops, by rotating crops, and by using crop residues.

If these soils are irrigated, careful practices are required to prevent erosion and water loss. Frequent light applications are best, because of the low available water holding capacity. Sprinkling is the best method, but contour irrigation may also be used.

Capability unit IVe-4

This unit consists of very deep, coarse-textured soils of the alluvial fans and low terraces. These soils are similar to those in unit IIIe-4 but are coarser textured, more droughty, and lower in fertility.

The soils in this unit are—

(DeB) Delhi sand, 3 to 8 percent slopes.
(DeA) Delhi sand, 0 to 3 percent slopes.
(DfA) Delhi sand, moderately deep and deep over hardpan, 0 to 3 percent slopes.

Use and management.—These soils are best suited to deep-rooted crops, such as alfalfa and orchard and vineyard crops. In management needs they are similar to the soils in unit IIIe-4, except that more frequent, light applications of water are needed. Slopes that cannot be leveled to less than 1 percent should be irrigated by sprinklers, because the large heads of water necessary for surface irrigation could result in severe erosion. Adequate cover should be maintained at all times to control wind erosion.

Capability unit IVw-6

The soils in this unit are deep, moderately coarse textured to moderately fine textured, moderately to slowly permeable, and strongly saline-alkali. Salts and alkali are present throughout the subsoil and affect more than 70 percent of the surface soil. These soils have a drainage problem. Reclamation is difficult because of the strong concentrations of salts and alkali and the drainage problem. Vegetation is scant or lacking over large areas.

The soils in this unit are—

- (CgcA) Chino loam, strongly saline-alkali, 0 to 1 percent slopes.
- (FbcA) Foster loams, strongly saline-alkali, 0 to 1 percent slopes.
- (FacA) Foster clay loam, strongly saline-alkali, 0 to 1 percent slopes.
- (FdcA) Foster-Chino loams, strongly saline-alkali, 0 to 1 percent slopes.
- (RtA) Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes.
- (RsA) Rossi silt loam, moderately saline-alkali, 0 to 1 percent slopes.
- (RpA) Rossi clay loam, strongly saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are best suited to crops that will tolerate strong concentrations of salts and alkali, such as grain, milo, and irrigated pasture.

Management practices are the same as for unit IVs-6, but drainage is essential for these soils. Drainage adequate to keep the water table at a safe level should be provided.

Large areas of these soils are used as range and should be managed like the soils in unit VIs-8.

Capability unit IVs-3

The soils in this unit are on the gently sloping or undulating old terraces. They are moderately coarse textured to moderately fine textured and slowly to very slowly permeable. Ordinarily, they are shallow over hardpan or claypan, or both. The surface soils are readily penetrated by roots and water, but the subsoils are almost impervious. Included are small tracts of a slightly saline-alkali Lewis soil in complex association with a Madera soil.

The soils in this unit are—

- (CuA) Cometa sandy loams, 0 to 3 percent slopes.
- (CyA) Corning gravelly loam, 0 to 3 percent slopes.
- (JyA) Jesbel gravelly clay loam, 0 to 3 percent slopes.
- (MaA) Madera fine sandy loam, 0 to 3 percent slopes.
- (MbA) Madera loam, 0 to 3 percent slopes.
- (MdA) Madera-Lewis complex, slightly saline-alkali, 0 to 1 percent slopes.
- (McA) Madera-Alamo complex, 0 to 1 percent slopes.
- (RdA) Redding gravelly loam, 0 to 3 percent slopes.
- (SaA) San Joaquin sandy loams, 0 to 3 percent slopes.
- (SbA) San Joaquin-Alamo complex, 0 to 3 percent slopes.

Use and management.—These soils are best suited to shallow-rooted crops, such as forage crops, pasture, grain, and range. In management needs they are similar to the soils in unit IIIs-3, but they need greater care in irrigation and land leveling. Because of the low available moisture holding capacity, frequent light applications of water are necessary to prevent waterlogging, a temporarily perched water table, and reduced aeration.

Capability unit IVs-4

The soils in this unit are on recent alluvial fans and flood plains and in the basin. They are coarse textured, very rapidly permeable, somewhat excessively drained, and low in available moisture holding capacity. Some are underlain by a silty substratum at depths of more than 36 inches. Salts and alkali are present throughout the subsoil and affect from 25 to 70 percent of the surface soil as well.

The soils in this unit are—

- (CobA) Cajon loamy sand, moderately saline-alkali, 0 to 1 percent slopes.
- (CbbB) Calhi loamy sand, moderately alkali, 0 to 8 percent slopes.
- (CcbA) Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 0 to 3 percent slopes.
- (CcbB) Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 3 to 8 percent slopes.

Use and management.—These soils are best suited to salt- and alkali-tolerant, irrigated forage and pasture crops.

For reclamation, moderate amounts of gypsum or sulfur and lime are required. Other management requirements are the same as for unit IIIe-4.

Capability unit IVs-6

The soils in this unit occur on recent alluvial fans, on flood plains, and in the basin. They are deep to very deep, medium textured, moderately permeable, and strongly saline-alkali. The natural fertility is moderate. Salts and alkali are present throughout the subsoil and affect more than 70 percent of the surface soil. Vegetation is scant or almost entirely lacking over large areas.

The soils in this unit are—

- (ToA) Traver loam, strongly saline-alkali, 0 to 1 percent slopes.
- (WxA) Wunjey very fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes.
- (WyB) Wunjey very fine sandy loam, strongly saline-alkali, channeled, 1 to 8 percent slopes.

Use and management.—These soils are best suited to crops that will tolerate strong concentrations of salts and alkali, such as irrigated pasture and forage crops.

Large amounts of gypsum or sulfur are required for reclamation. Surface and subsurface drainage should be provided to dispose of excess water. Deep leaching with excess water will help move the salts down and out of the soil.

Grain and grass respond to nitrogen, and legumes respond to phosphorus and sulfur. Organic matter should be added by using crop residues, rotating crops, and applying manure. Organic matter aids in the reclamation of these soils.

At present, large areas of these soils are used as range and should be managed like the soils in unit VIs-8.

Capability unit IVs-8

The soils in this unit occur in the basin, on alluvial fans, and on low terraces. They are moderately coarse textured to moderately fine textured and are shallow over a hardpan, a claypan, or both. Salts and alkali are present throughout the subsoil and affect 25 to 70 percent of the surface soil.

The soils in this unit are—

- (CdaA) Calhi loamy sand, shallow over hardpan variant, moderately saline-alkali, 0 to 1 percent slopes.

(DsA) Dinuba-El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes.
(DuA) Dinuba-El Peco loams, moderately saline-alkali, 0 to 1 percent slopes.
(FebA) Fresno and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes.
(FfbA) Fresno and El Peco loams, moderately saline-alkali, 0 to 1 percent slopes.
(FgbA) Fresno, El Peco, and Chino soils, moderately saline-alkali, 0 to 1 percent slopes.
(FhbA) Fresno, El Peco, and Lewis soils, moderately saline-alkali, 0 to 1 percent slopes.
(FkbA) Fresno, El Peco, and Pozo soils, moderately saline-alkali, 0 to 1 percent slopes.
(LwA) Lewis loam, moderately saline-alkali, 0 to 1 percent slopes.
(PtA) Pozo loam, moderately saline, 0 to 1 percent slopes.
(PmA) Pozo clay loam, moderately saline, 0 to 1 percent slopes.
(TsA) Traver, Fresno, and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are best suited to shallow-rooted crops that will tolerate moderate concentrations of salts and alkali. They are commonly used for grain and pasture.

Reclamation is very difficult. The same practices are required as for the soils in unit IIIs–8, but larger amounts of gypsum or sulfur and water are needed.

If used as range, these soils should be managed like those in unit VIs–8.

Capability unit VIe-1

The soils of this unit occur on rolling to steep areas in the uplands and are underlain by basic rock or mica schist. They are generally rocky, medium textured, and moderately deep to deep over bedrock. The moisture-holding capacity and inherent fertility are moderate.

The soils in this unit are—

(CkD) Coarsegold rocky loam, 15 to 30 percent slopes.
(TkC) Trabuco rocky loam, 8 to 15 percent slopes.
(ThE) Trabuco loam, 15 to 45 percent slopes.

Use and management.—These soils are best suited to grazing. Selected areas are suitable for reseeding with grasses and legumes.

Proper use of the range, particularly proper stocking, is essential for maximum production and erosion control. If range has been properly grazed, the vegetation has a patchy appearance at the end of the grazing season. Livestock should be kept off the range in spring until the grass is at least 4 inches high. About 2 inches of stubble should be left at the end of the grazing period. Adequate water should be provided, and salt should be so placed as to improve distribution of livestock. Cross fencing is essential to obtain proper distribution of livestock and use of forage.

Fertilizer increases the quantity and quality of forage and lengthens the grazing season. Grasses respond to nitrogen, and legumes respond to phosphorus and sulfur. Removing brush and scrub trees from selected sites increases production and improves the plant cover.

The condition of the annual grasses shows whether the range has been well managed. The following is a guide for determining when the range is producing at maximum.

1. The plant cover is—
   a. Approximately 70 percent desirable plants, such as soft chess, wild oats, burclover, filaree, and small amounts of perennial grasses.
   b. Approximately 20 percent less desirable plants, such as ripgut brome, fescues, bluegrass, lupines, and mouse barley.
   c. Approximately 10 percent undesirable plants, such as nitgrass, fiddleneck, tarweed, and popcornflower.
2. The vegetation covers 60 to 75 percent of the surface.
3. There is little or no evidence of erosion.
4. Litter and residue are abundant, and there is partly decomposed vegetation on the ground.
5. Untouched or partly grazed plants are evident, and the range has a patchy appearance at the end of the grazing season.

Capability unit VIe-4

The soils in this unit occupy sloping to hilly areas on terraces, and on the uplands. They were derived from old granitic alluvium or residuum from granitic bedrock. The elevation ranges from 500 to 3,500 feet. The vegetation consists of blue oaks, live oaks, Digger pines, and annual grasses and herbs.

These soils are moderately coarse textured and are moderately deep to deep over bedrock. On some, rock outcrops are common. Permeability is moderately rapid to moderately slow. The moisture-holding capacity and natural fertility are moderate to low.

The soils in this unit are—

(AaD) Ahwahnee and Auberry coarse sandy loams, 15 to 30 percent slopes.
(AbD) Ahwahnee and Auberry rocky coarse sandy loams, 8 to 30 percent slopes.
(AbB) Ahwahnee and Auberry rocky coarse sandy loams, 3 to 8 percent slopes.
(AdD) Ahwahnee and Vista coarse sandy loams, 15 to 30 percent slopes.
(AeB) Ahwahnee and Vista rocky coarse sandy loams, 3 to 8 percent slopes.
(AeD) Ahwahnee and Vista rocky coarse sandy loams, 8 to 30 percent slopes.
(HoD) Holland sandy loam, 15 to 30 percent slopes.
(SnB) Sesame rocky sandy loam, 3 to 8 percent slopes.
(SkC) Sesame rocky loam, 8 to 15 percent slopes.
(WnD) Whitney sandy loam, 15 to 30 percent slopes, eroded.

Use and management.—These soils are best suited to grazing. The Holland soil is also well suited to timber.

Proper use of the range, particularly proper stocking, is essential for maximum production and erosion control. If range has been properly grazed, the vegetation has a patchy appearance at the end of the grazing season. The vegetation should be at least 4 inches high before grazing is allowed, and approximately 2 inches of stubble should remain at the end of the grazing period. Adequate watering places should be provided over the range, and salt should be so placed as to improve distribution of grazing.

Fertilizer increases the quantity and quality of forage and lengthens the grazing season. Fertility studies have shown a nitrogen deficiency for grasses and phosphorus and sulfur deficiencies for legumes.

Removing brush and scrub trees from selected sites increases production and improves plant cover. Reseeding after clearing is desirable. Areas that have been overgrazed or cultivated should also be reseeded to suitable grasses and legumes.

Cross fencing is essential to obtain proper distribution of livestock and use of forage.

The condition of the range shows whether it has been well managed. The following is a guide for determining whether the range is producing at maximum.

1. The plant cover is—
   a. Approximately 70 percent desirable plants, such as soft chess, wild oats, burclover, filaree, and small amounts of perennial grasses.
   b. Approximately 20 percent less desirable plants, such as ripgut brome, fescues, annual bluegrass, mouse barley, and lupines.
   c. Approximately 10 percent undesirable plants, such as nitgrass, fiddleneck, tarweed, and popcornflower.
2. The vegetation covers 55 to 70 percent of the surface.
3. There is little or no evidence of erosion.
4. Litter and residue are abundant, and there is partly decomposed vegetation on the ground.
5. Untouched or partly grazed plants are evident, and the range has a patchy appearance at the end of the grazing season.

Capability unit VIs–6

The soils in this unit occupy recent alluvial fans, flood plains, and basin areas. They are very rapidly permeable, somewhat excessively drained, and low in moisture-holding capacity. Some are underlain by a silty substratum at moderate depths. Salts and alkali are present throughout the subsoil and affect more than 70 percent of the surface soil.

The soils in this unit are—

(CacA) Cajon loamy sand, strongly saline-alkali, 0 to 1 percent slopes.
(CccA) Calhi loamy sand, moderately deep and deep over silt, strongly saline-alkali, 0 to 3 percent slopes.

Use and management.—These soils are used mainly for range. The vegetation consists of saltgrass, pickleweed, alkali sacaton, jackass clover, and other salt- and alkali-tolerant plants. Large areas have little or almost none.

Capability unit VIs–8

The soils in this unit occupy areas in the basin, on the alluvial fans, and on low terraces. They are moderately coarse textured to moderately fine textured and are typically shallow to moderately deep over a hardpan, a claypan, or both. They are strongly saline-alkali. Salts and alkali are present throughout the subsoil and affect more than 70 percent of the surface soil.

The soils in this unit are—

(ByA) Buchenau fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes.
(EdA) El Peco-Dinuba fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes.
(FecA) Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes.
(FfcA) Fresno and El Peco loams, strongly saline-alkali, 0 to 1 percent slopes.
(FhcA) Fresno, El Peco, and Lewis soils, strongly saline-alkali, 0 to 1 percent slopes.
(PvA) Pozo loam, strongly saline, 0 to 1 percent slopes.
(PnA) Pozo clay loam, strongly saline, 0 to 1 percent slopes.
(TtA) Traver, Fresno, and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are used mainly for range. The vegetation consists of saltgrass, alkali sacaton, jackass clover, and other alkali-tolerant plants. Large areas have little or almost no vegetation.

Capability unit VIIe–1

The soils in this unit occur on very steep upland areas underlain by basic rocks or mica schist. They are usually rocky, medium textured, and moderately deep to deep over bedrock. The moisture-holding capacity and natural fertility are moderate.

The soils in this unit are—

(ChF) Coarsegold loam, 45 to 75 percent slopes.
(CkF) Coarsegold rocky loam, 30 to 75 percent slopes.
(TkF) Trabuco rocky loam, 45 to 75 percent slopes.

Use and management.—These soils are best suited to grazing. In general, the management practices discussed under unit VIe–1 apply. Reseeding and fertilizing, however, are not practical, and, because of the very steep slopes, more residue is needed to protect the soils from erosion. About 3 to 4 inches of stubble should be left at the end of the grazing season.

The following is a guide for determining whether the range is producing at maximum.

1. The plant cover is—
   a. Approximately 70 percent desirable plants, such as clover, filaree, and some perennial grasses.
   b. Approximately 20 percent less desirable plants, such as ripgut brome, fescues, bluegrass, lupines, and mouse barley.
   c. Approximately 10 percent undesirable plants, such as nitgrass, tarweed, fiddleneck, and popcornflower.
2. The vegetation covers 60 to 75 percent of the surface.
3. There is little or no evidence of erosion.
4. Litter and residue are abundant.
5. Untouched and partly grazed plants are evident, and the range has a patchy appearance at the end of the grazing season.

Capability unit VIIe–3

The soils in this unit occur on gently to steeply sloping upland areas. They are shallow to very shallow. The fertility and water-holding capacity are low.

The soils in this unit are—

(DbD) Daulton loam, 8 to 30 percent slopes.
(DaD) Daulton fine sandy loam, 8 to 30 percent slopes.
(DaB) Daulton fine sandy loam, 3 to 8 percent slopes.
(DaE) Daulton fine sandy loam, 30 to 45 percent slopes.
(DcB) Daulton rocky fine sandy loam, 3 to 8 percent slopes.
(DcE) Daulton rocky fine sandy loam, 30 to 45 percent slopes.
(WaB) Whiterock rocky fine sandy loam, 3 to 8 percent slopes.
(WaE) Whiterock rocky fine sandy loam, 30 to 45 percent slopes.
(WbD) Whiterock very rocky fine sandy loam, 8 to 30 percent slopes.

Use and management.—These soils are suited only to grazing. Yields are low because of droughtiness, shallowness, and low fertility. Reseeding and fertilizing are not practical.

The following is a guide for determining whether the range is producing at maximum.

1. The plant cover is—
   a. Approximately 70 percent desirable plants, such as soft chess, burclover, and filaree.
   b. Approximately 20 percent less desirable plants, such as ripgut brome, red brome, fescues, mouse barley, and annual lupines.
   c. Approximately 10 percent undesirable plants, such as fiddleneck, popcornflower, tarweed, and nitgrass.
2. The vegetation covers 60 to 75 percent of the surface.
3. There is little or no active erosion.
4. There is partly decomposed vegetation on the ground.
5. Untouched or partially grazed plants are evident, and the range has a patchy appearance at the end of the grazing season.

Capability unit VIIe-4

The soils in this unit occur on hilly to steep uplands. Their parent material was derived from granitic rocks. They are moderately deep to deep over bedrock. Rock outcrops are common. The moisture-holding capacity and inherent fertility are moderate.

The soils in this unit are—

(AbE) Ahwahnee and Auberry rocky coarse sandy loams, 30 to 45 percent slopes.
(AcD) Ahwahnee and Auberry very rocky coarse sandy loams, 15 to 30 percent slopes.
(AcF) Ahwahnee and Auberry very rocky coarse sandy loams, 30 to 75 percent slopes.
(AeE) Ahwahnee and Vista rocky coarse sandy loams, 30 to 45 percent slopes.
(ArD) Ahwahnee and Vista very rocky coarse sandy loams, 15 to 30 percent slopes.
(ArF) Ahwahnee and Vista very rocky coarse sandy loams, 30 to 75 percent slopes.
(HoE) Holland sandy loam, 30 to 45 percent slopes.
(HrE) Holland rocky sandy loam, 30 to 45 percent slopes.
(TgF) Tollhouse rocky coarse sandy loam, 30 to 75 percent slopes.

Use and management.—These soils are suited to grazing. The Holland soils are also well suited to timber. In general, the range management practices discussed under unit VIe-4 apply. Reseeding and fertilizing, however, are not practical, and more residue should be left to protect the soils from erosion. About 3 to 4 inches of stubble should be left on the range at the end of the grazing season.

The guide for determining the condition of the range is the same as for unit VIe-4.

Capability unit VIIe-9

The soils in this unit are on gently sloping to hilly uplands. They are rocky, stony, or gravelly, shallow to very shallow sandy loams and loams.

The soils in this unit are—

(HkB) Hideaway very stony loam, 0 to 8 percent slopes.
(HkD) Hideaway very stony loam, 15 to 30 percent slopes.
(HsB) Hornitos gravelly sandy loam, 3 to 8 percent slopes.
(HsD) Hornitos gravelly sandy loam, 8 to 30 percent slopes.
(HvD) Hornitos very rocky sandy loam, 8 to 30 percent slopes.
(RmB) Rocklin rocky sandy loam, pumiceous variant, 3 to 8 percent slopes.
(RmD) Rocklin rocky sandy loam, pumiceous variant, 8 to 30 percent slopes.

Use and management. —These soils are used for range, but they produce little forage.

Capability unit VIIIs-1

This unit consists of the areas not suited to commercial production of plants.

The miscellaneous land types in this class are—

(Gp) Gravel pits.
(Rh) Riverwash.
(Rk) Rock land, Hornitos soil material.
(Tf) Terrace escarpments.

Use and management.—These land types should be managed so as to increase their value as wildlife habitats, as parts of watersheds, and as recreational areas. Some may be sources of material used in highway and other construction. The areas that have plant cover should be protected from fire.

Other Soil Groupings and Ratings [6]

The nature of a large number of soils is more easily remembered if soils that have similar properties are grouped. Table 2 shows how the soils in the Madera Area are grouped by kind of profile, by natural land type, and according to the Storie index ratings and grades. An explanation of the groupings and of the rating and grading factors follows.

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[6] This subsection prepared by R. EARL STORIE, professor of soils, University of California, Berkeley.

TABLE 2.—*Soil profile groups, natural land types, and Storie index*

[Soil profile groups explained in text, p.82; natural land types explained in text, p.82 and in table 3; Storie index ratings and grades explained in text, p.82]

Map symbol	Soil	Soil profile group	Natural land type	Storie index					
				Rating factors				Index rating	Grade
				Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)		
AaC	Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes	VII	E_1	75	90	85	100	57	3
AaD	Ahwahnee and Auberry coarse sandy loams, 15 to 30 percent slopes		E_1					47	
AbD	Ahwahnee and Auberry rocky coarse sandy loams, 8 to 30 percent slopes	VII	E_4	75	60	80	90	32	4
AbE	Ahwahnee and Auberry rocky coarse sandy loams, 30 to 45 percent slopes	VII	E_{12}	60	60	30	80	9	6
AbB	Ahwahnee and Auberry rocky coarse sandy loams, 3 to 8 percent slopes	VII	E_4	75	60	95	100	42	3
AcD	Ahwahnee and Auberry very rocky coarse sandy loams, 15 to 30 percent slopes	VII	E_{12}	60	40	70	90	15	5
AcF	Ahwahnee and Auberry very rocky coarse sandy loams, 30 to 75 percent slopes	VII	E_{17}	55	40	45	90	9	6
AdC	Ahwahnee and Vista coarse sandy loams, 8 to 15 percent slopes	VII	E_1	60	90	90	100	49	3
AdD	Ahwahnee and Vista coarse sandy loams, 15 to 30 percent slopes	VII	E_1	60	90	70	100	39	4
AdB	Ahwahnee and Vista coarse sandy loams, 3 to 8 percent slopes	VII	E_1	60	90	95	100	51	3
AeD	Ahwahnee and Vista rocky coarse sandy loams, 8 to 30 percent slopes	VII	E_4	60	60	80	90	25	4
AeB	Ahwahnee and Vista rocky coarse sandy loams, 3 to 8 percent slopes	VII	E_4	70	60	95	100	39	4
AeE	Ahwahnee and Vista rocky coarse sandy loams, 30 to 45 percent slopes	VII	E_{12}	60	60	40	80	11	5
ArD	Ahwahnee and Vista very rocky coarse sandy loams, 15 to 30 percent slopes	VII	E_{12}	50	40	70	90	13	5
ArF	Ahwahnee and Vista very rocky coarse sandy loams, 30 to 75 percent slopes	VII	E_{12}	45	40	50	90	8	6
AsA	Alamo clay, 0 to 1 percent slopes	V	C_{14}	30	60	100	70	13	5
AtB	Atwater loamy sand, 3 to 8 percent slopes	II	A_5	95	80	90	100	68	2
AtA	Atwater loamy sand, 0 to 3 percent slopes	II	A_5	95	80	100	100	76	2
AwB	Atwater loamy sand, moderately deep and deep over hardpan, 3 to 8 percent slopes	II	A_{11}	90	80	90	100	65	2
AwA	Atwater loamy sand, moderately deep and deep over hardpan, 0 to 3 percent slopes	II	A_{11}	90	80	100	100	72	2
BeA	Bear Creek loam, 0 to 3 percent slopes	III	A_2	90	100	100	80	72	2
BfA	Borden fine sandy loam, 0 to 1 percent slopes	III	A_2	85	100	100	100	85	1
BkA	Borden fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	III	A_{2-2s}	85	100	100	80	68	2
BmA	Borden loam, 0 to 1 percent slopes	III	A_2	85	100	100	100	85	1
BoA	Borden loam, slightly saline-alkali, 0 to 1 percent slopes	III	A_{2-2s}	85	100	100	80	68	2
BzA	Buchenau loam, 0 to 3 percent slopes	V	C_{13}	30	100	100	95	28	4
BuA	Buchenau fine sandy loam, 0 to 3 percent slopes	V	C_{13}	30	100	100	95	28	4
BvA	Buchenau fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes	V	C_{13-2s}	30	100	100	70	21	4
ByA	Buchenau fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes	V	C_{13-2a}	30	100	100	19	6	6
CaA	Cajon loamy sand, 0 to 1 percent slopes	I	A_5	90	80	100	90	64	2
CaaA	Cajon loamy sand, slightly saline-alkali, 0 to 1 percent slopes	I	A_{5-2s}	90	80	100	75	54	3
CabA	Cajon loamy sand, moderately saline-alkali, 0 to 1 percent slopes	I	A_{5-2m}	100	80	100	40	32	4
CacA	Cajon loamy sand, strongly saline-alkali, 0 to 1 percent slopes	I	A_{5-2a}	100	80	100	20	16	5
CbaB	Calhi loamy sand, slightly alkali, 0 to 8 percent slopes	II	A_{5-2s}	90	80	90	70	45	3
CbbB	Calhi loamy sand, moderately alkali, 0 to 8 percent slopes	II	A_{5-2m}	90	80	90	40	26	4
CcaA	Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 0 to 3 percent slopes	II	A_{11-2s}	90	80	100	70	50	3

TABLE 2.—*Soil profile groups, natural land types, and Storie index*—Continued

Map symbol	Soil	Soil profile group	Natural land type	Storie index: Rating factors: Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)	Index rating	Grade
CcaB	Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 3 to 8 percent slopes	II	A_{11-2s}	90	80	90	70	45	3
CcbA	Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 0 to 3 percent slopes	II	A_{11-2m}	90	80	100	40	29	4
CcbB	Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 3 to 8 percent slopes	II	A_{11-2m}	90	80	90	40	26	4
CccA	Calhi loamy sand, moderately deep and deep over silt, strongly saline-alkali, 0 to 3 percent slopes	II	A_{11-2a}	90	80	100	20	14	5
CdaA	Calhi loamy sand, shallow over hardpan variant, moderately saline-alkali, 0 to 1 percent slopes	II	B_{15-2m}	30	80	100	36	9	6
CgA	Chino loam, 0 to 1 percent slopes	II	B_1	95	100	100	100	95	1
CgaA	Chino loam, slightly saline-alkali, 0 to 1 percent slopes	II	B_{1-2s}	95	100	100	80	76	2
CgbA	Chino loam, moderately saline-alkali, 0 to 1 percent slopes	II	B_{1-2m}	95	100	100	60	57	3
CgcA	Chino loam, strongly saline-alkali, 0 to 1 percent slopes	II	B_{1-2a}	95	100	100	30	28	4
CfA	Chino fine sandy loam, 0 to 1 percent slopes	II	B_1	95	100	100	100	95	1
CfaA	Chino fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	II	B_{1-2s}	95	100	100	80	76	2
CfbA	Chino fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes	II	B_{1-2m}	95	100	100	40	38	4
CeA	Chino clay loam, 0 to 1 percent slopes	II	B_1	95	85	100	95	77	2
CeaA	Chino clay loam, slightly saline-alkali, 0 to 1 percent slopes	II	B_{1-2s}	95	85	100	66	54	3
CebA	Chino clay loam, moderately saline-alkali, 0 to 1 percent slopes	II	B_{1-2m}	95	85	100	40	32	4
ChD	Coarsegold loam, 8 to 30 percent slopes	VII	E_1	75	100	80	90	54	3
ChF	Coarsegold loam, 45 to 75 percent slopes	VII	E_9	75	100	25	100	19	5
CkD	Coarsegold rocky loam, 15 to 30 percent slopes	VII	E_{12}	70	80	70	100	33	4
CkF	Coarsegold rocky loam, 30 to 75 percent slopes	VII	E_{12}	70	80	20	100	11	5
CmA	Columbia fine sandy loam, 0 to 1 percent slopes	I	A_1	100	100	100	90	90	1
CmtA	Columbia fine sandy loam, moderately deep and deep over Temple soils, 0 to 1 percent slopes	I	A_2	100	100	100	80	80	1
CmdA	Columbia fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes	I	A_9	90	100	100	90	81	1
CrB	Columbia soils, channeled, 0 to 8 percent slopes	I	A_{5-5ch}	90	50	100	70	32	4
CoA	Columbia loamy sand, 0 to 1 percent slopes	I	A_5	90	80	100	100	72	2
CotA	Columbia loamy sand, over Temple soils, 0 to 1 percent slopes	I	A_6	100	80	100	90	72	2
CpA	Columbia sandy loam, 0 to 1 percent slopes	I	A_1	100	95	100	100	95	1
CpdA	Columbia sandy loam, moderately deep over sand, 0 to 1 percent slopes	I	A_1	90	95	100	100	86	1
CuB	Cometa sandy loams, 3 to 8 percent slopes	IV	D_9	50	95	90	100	43	3
CuC	Cometa sandy loams, 8 to 15 percent slopes	IV	D_9	50	95	85	100	40	3
CuA	Cometa sandy loams, 0 to 3 percent slopes	IV	D_9	50	95	100	100	48	3
CsB	Cometa gravelly sandy loam, 3 to 8 percent slopes	IV	D_{12}	50	70	90	100	32	4
CtB	Cometa loam, 3 to 8 percent slopes	IV	D_9	50	100	90	100	45	3
CwB	Cometa-Whitney sandy loams, 3 to 8 percent slopes	IV	D_9	55	100	90	100	51	3
CwC	Cometa-Whitney sandy loams, 8 to 15 percent slopes	IV	D_9	55	100	80	100	43	3
CyA	Corning gravelly loam, 0 to 3 percent slopes	IV	D_{12}	60	70	100	100	42	3
CyB	Corning gravelly loam, 3 to 8 percent slopes	IV	D_{12}	60	70	90	100	36	4
DbD	Daulton loam, 8 to 30 percent slopes	VIII	E_5	40	100	80	100	32	4
DaD	Daulton fine sandy loam, 8 to 30 percent slopes	VIII	E_5	40	100	80	100	32	4
DaB	Daulton fine sandy loam, 3 to 8 percent slopes	VIII	E_5	40	100	90	100	36	4
DaE	Daulton fine sandy loam, 30 to 45 percent slopes	VIII	E_{13}	40	100	45	100	18	5
DcB	Daulton rocky fine sandy loam, 3 to 8 percent slopes	VIII	E_8	35	80	90	100	25	4
DcE	Daulton rocky fine sandy loam, 30 to 45 percent slopes	VIII	E_{16}	35	80	45	100	12	5
DeB	Delhi sand, 3 to 8 percent slopes	I	A_5	90	80	90	100	65	2
DeA	Delhi sand, 0 to 3 percent slopes	I	A_5	90	80	100	100	72	2

TABLE 2.—*Soil profile groups, natural land types, and Storie index*—Continued

Map symbol	Soil	Soil profile group	Natural land type	Storie index: Rating factors: Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)	Index rating	Grade
DfA	Delhi sand, moderately deep and deep over hardpan, 0 to 3 percent slopes	I	A_{11}	90	80	100	100	72	2
DpA	Dinuba-El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes	II, V	A_{2-2s}	90	100	100	70	63	2
DsA	Dinuba-El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes	II, V	A_{2-2m}	90	100	100	40	36	4
DmA	Dinuba fine sandy loam, 0 to 1 percent slopes	II, V	A_2	90	100	100	100	90	1
DoA	Dinuba loam, 0 to 1 percent slopes	II	A_2	90	100	100	100	90	1
DtA	Dinuba-El Peco loams, slightly saline-alkali, 0 to 1 percent slopes	II, V	A_{2-2s}	90	100	100	70	63	2
DuA	Dinuba-El Peco loams, moderately saline-alkali, 0 to 1 percent slopes	II, V	A_{2-2m}	90	100	100	40	36	4
EdA	El Peco-Dinuba fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes	V, II	A_{9-2a}	90	100	100	20	18	5
FbA	Foster loams, 0 to 1 percent slopes	I	A_1	100	100	100	100	100	1
FbaA	Foster loams, slightly saline-alkali, 0 to 1 percent slopes	I	A_{1-2s}	100	100	100	85	81	1
FbbA	Foster loams, moderately saline-alkali, 0 to 1 percent slopes	I	A_{1-2m}	100	100	100	60	60	2
FbcA	Foster loams, strongly saline-alkali, 0 to 1 percent slopes	I	A_{1-2a}	100	100	100	30	30	4
FbdA	Foster loams, sandy substratum, 0 to 1 percent slopes	I	A_1	90	100	100	100	90	1
FbeA	Foster loams, moderately deep and deep over Temple soils, 0 to 1 percent slopes	I	A_2	90	100	100	100	90	1
FcbA	Foster loams, moderately deep and deep over Temple soils, moderately saline-alkali, 0 to 1 percent slopes	I	A_{2-2m}	90	100	100	60	54	3
FaA	Foster clay loam, 0 to 1 percent slopes	I	A_1	100	85	100	100	85	1
FaaA	Foster clay loam, slightly saline-alkali, 0 to 1 percent slopes	I	A_{1-2s}	100	85	100	85	72	2
FabA	Foster clay loam, moderately saline-alkali, 0 to 1 percent slopes	I	A_{1-2m}	100	85	100	60	51	3
FacA	Foster clay loam, strongly saline-alkali, 0 to 1 percent slopes	I	A_{1-2a}	100	85	100	30	26	4
FdcA	Foster-Chino loams, strongly saline-alkali, 0 to 1 percent slopes	I, II	A_{1-2a}	98	100	100	30	29	4
FecA	Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes	V	B_{13-2a}	30	100	100	18	5	6
FfcA	Fresno and El Peco loams, strongly saline-alkali, 0 to 1 percent slopes	V	B_{13-2a}	30	100	100	18	5	6
FebA	Fresno and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes	V	B_{13-2m}	30	100	100	36	11	5
FfbA	Fresno and El Peco loams, moderately saline-alkali, 0 to 1 percent slopes	V	B_{13-2m}	30	100	100	36	11	5
FeaA	Fresno and El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes	V	B_{13-2s}	30	100	100	63	19	5
FfaA	Fresno and El Peco loams, slightly saline-alkali, 0 to 1 percent slopes	V	B_{13-2s}	30	100	100	63	19	5
FgaA	Fresno, El Peco, and Chino soils, slightly saline-alkali, 0 to 1 percent slopes	V	B_{13-2s}	60	95	100	70	40	3
FgbA	Fresno, El Peco, and Chino soils, moderately saline-alkali, 0 to 1 percent slopes	V	B_{13-2m}	60	95	100	40	23	4
FhbA	Fresno, El Peco, and Lewis soils, moderately saline-alkali, 0 to 1 percent slopes	V	B_{13-2m}	30	100	100	32	10	5
FhcA	Fresno, El Peco, and Lewis soils, strongly saline-alkali, 0 to 1 percent slopes	V	B_{13-2a}	30	100	100	16	5	6
FkaA	Fresno, El Peco, and Pozo soils, slightly saline-alkali, 0 to 1 percent slopes	V	B_{13-2s}	30	100	100	63	19	5
FkbA	Fresno, El Peco, and Pozo soils, moderately saline-alkali, 0 to 1 percent slopes	V	B_{13-2m}	30	100	100	36	11	5
GaA	Grangeville fine sandy loam, 0 to 1 percent slopes	I	A_1	100	100	100	100	100	1

TABLE 2.—*Soil profile groups, natural land types, and Storie index*—Continued

Map symbol	Soil	Soil profile group	Natural land type	Storie index: Rating factors: Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)	Index rating	Grade
GbA	Grangeville fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	I	A_{1-2s}	100	100	100	79	79	2
GmA	Grangeville sandy loam, 0 to 1 percent slopes	I	A_1	100	95	100	100	95	1
GnA	Grangeville sandy loam, slightly saline-alkali, 0 to 1 percent slopes	I	A_{1-2s}	100	95	100	80	76	2
GcA	Grangeville fine sandy loam, over Traver soils, 0 to 1 percent slopes	I	A_{1-2s}	100	100	100	90	90	1
GdA	Grangeville fine sandy loam, over Traver soils, slightly saline-alkali, 0 to 1 percent slopes	I	A_{1-2s}	100	100	100	70	70	2
GeA	Grangeville fine sandy loam, moderately deep and deep over Temple soils, 0 to 1 percent slopes	I	A_2	100	100	100	100	100	1
GfA	Grangeville fine sandy loam, deep over hardpan, 0 to 1 percent slopes	I	A_9	70	100	100	100	70	2
GhA	Grangeville fine sandy loam, deep over alkali hardpan, 0 to 1 percent slopes	I	A_9	70	100	100	90	63	2
GkA	Grangeville fine sandy loam, deep over alkali hardpan, slightly saline-alkali, 0 to 1 percent slopes	I	A_{9-2s}	70	100	100	70	49	3
Gp	Gravel pits	I	A_{14}	----	----	----	----	5	6
GrA	Greenfield coarse sandy loam, 0 to 3 percent slopes	II	A_1	95	90	100	100	87	1
GrB	Greenfield coarse sandy loam, 3 to 8 percent slopes	II	A_1	95	90	100	100	81	1
GuB	Greenfield sandy loam, 3 to 8 percent slopes	II	A_1	95	90	90	100	77	2
GuA	Greenfield sandy loam, 0 to 3 percent slopes	II	A_1	95	90	100	100	86	1
GvA	Greenfield sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes	II	A_9	86	90	90	100	70	2
GvB	Greenfield sandy loam, moderately deep and deep over hardpan, 3 to 8 percent slopes	II	A_9	86	90	100	90	70	2
GsA	Greenfield fine sandy loam, 0 to 3 percent slopes	II	A_1	95	100	100	100	95	1
GsB	Greenfield fine sandy loam, 3 to 8 percent slopes	II	A_1	95	100	95	100	86	1
HaA	Hanford fine sandy loam, 0 to 1 percent slopes	I	A_1	100	100	100	100	100	1
HbA	Hanford fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes	I	A_9	70	100	100	100	70	2
HfA	Hanford sandy loam, 0 to 3 percent slopes	I	A_1	100	95	100	100	95	1
HhA	Hanford sandy loam, moderately deep over sand, 0 to 3 percent slopes	I	A_1	80	95	100	100	76	2
HgA	Hanford sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes	I	A_9	70	95	100	100	67	2
HeB	Hanford gravelly sandy loam, 3 to 8 percent slopes	I	A_7	90	70	90	100	57	3
HdA	Hanford (Ripperdan) fine sandy loam, moderatley deep and deep over silt, 0 to 3 percent slopes	II	A_2	90	100	100	100	90	1
HcA	Hanford (Ripperdan) fine sandy loam, shallow variant, 0 to 3 percent slopes	II	A_9	50	100	100	85	42	3
HkB	Hideaway very stony loam, 0 to 8 percent slopes	VII	E_8	20	70	100	100	14	5
HkD	Hideaway very stony loam, 15 to 30 percent slopes	VII	E_8	20	70	70	100	10	5
HmA	Hildreth sandy clay, 0 to 3 percent slopes	III	A_4	80	60	100	85	40	3
HnB	Hildreth-San Joaquin complex, 0 to 8 percent slopes	III, V	A_4, C_{13}	60	70	90	90	34	4
HoD	Holland sandy loam, 15 to 30 percent slopes	VII	E_1	80	95	60	100	46	3
HoE	Holland sandy loam, 30 to 45 percent slopes	VII	E_9	70	95	30	90	17	5
HrE	Holland rocky sandy loam, 30 to 45 percent slopes	VII	E_{12}	65	70	30	90	13	5
HsB	Hornitos gravelly sandy loam, 3 to 8 percent slopes	VIII	E_8	50	50	90	100	22	4
HsD	Hornitos gravelly sandy loam, 8 to 30 percent slopes	VIII	E_8	50	50	80	100	20	4
HvD	Hornitos very rocky sandy loam, 8 to 30 percent slopes	VIII	E_{16}	20	50	80	100	8	6
JyA	Jesbel gravelly clay loam, 0 to 3 percent slopes	V	C_{16}	30	85	100	100	28	4
JeA	Jesbel clay, 0 to 3 percent slopes	V	C_{14}	30	70	100	100	21	4
JgB	Jesbel gravelly clay, 3 to 8 percent slopes	V	C_{14}	30	70	90	100	19	5
LeA	Lewis loam, slightly saline-alkali, 0 to 1 percent slopes	V	B_{13-2s}	30	100	100	56	17	5
LwA	Lewis loam, moderately saline-alkali, 0 to 1 percent slopes	V	B_{13-2m}	30	100	100	32	10	5
MaA	Madera fine sandy loam, 0 to 3 percent slopes	V	C_{13}	30	100	100	95	28	4

TABLE 2.—*Soil profile groups, natural land types, and Storie index*—Continued

Map symbol	Soil	Soil profile group	Natural land type	Storie index					
				Rating factors				Index rating	Grade
				Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)		
MdA	Madera-Lewis complex, slightly saline-alkali, 0 to 1 percent slopes	V	C_{13-2s}	30	100	100	85	26	4
MbA	Madera loam, 0 to 3 percent slopes	V	C_{13}	30	90	100	95	25	4
McA	Madera-Alamo complex, 0 to 1 percent slopes	V	C_{13}	30	80	100	72	17	5
MoA	Marguerite loam, 0 to 3 percent slopes	II	A_1	95	100	100	100	95	1
MrA	Marguerite loam, slightly saline-alkali, 0 to 3 percent slopes	II	A_{1-2s}	95	100	100	70	66	2
MsA	Marguerite loam, moderately saline-alkali, 0 to 3 percent slopes	II	A_{1-2m}	95	100	100	40	38	4
MmA	Marguerite clay loam, 0 to 3 percent slopes	II	A_1	95	85	100	100	81	1
MnA	Marguerite clay loam, moderately saline-alkali, 0 to 3 percent slopes	II	A_{1-2m}	95	85	100	40	32	4
MtB	Montpellier coarse sandy loam, 3 to 8 percent slopes	IV	D_9	50	95	90	100	43	3
MtC	Montpellier coarse sandy loam, 8 to 15 percent slopes	IV	D_9	50	95	85	100	40	3
PbA	Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	II	A_{1-2s}	95	100	100	80	76	2
PaA	Pachappa fine sandy loam, 0 to 1 percent slopes	II	A_1	95	100	100	100	95	1
PcA	Pachappa sandy loam, 0 to 1 percent slopes	II	A_1	95	95	100	100	90	1
PdA	Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes	II	A_{1-2s}	95	95	100	80	72	2
PeA	Pachappa sandy loam, moderately deep and deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes	II	A_{9-2s}	90	95	100	70	60	2
PfA	Porterville clay, 0 to 3 percent slopes	III	C_4	90	60	100	100	54	3
PfB	Porterville clay, 3 to 8 percent slopes	III	C_4	90	60	90	100	48	3
PgB	Porterville rocky clay, 3 to 8 percent slopes	III	C_8	80	60	90	100	43	3
PoA	Pozo loam, 0 to 1 percent slopes	V	B_{13}	30	100	100	95	28	4
PsA	Pozo loam, slightly saline, 0 to 1 percent slopes	V	B_{13-2s}	30	100	100	80	24	4
PtA	Pozo loam, moderately saline, 0 to 1 percent slopes	V	B_{13-2m}	30	100	100	57	17	5
PvA	Pozo loam, strongly saline, 0 to 1 percent slopes	V	B_{13-2a}	30	100	100	28	9	6
PhA	Pozo clay loam, 0 to 1 percent slopes	V	B_{13}	30	85	100	95	24	4
PkA	Pozo clay loam, slightly saline, 0 to 1 percent slopes	V	B_{13-2s}	30	85	100	80	21	4
PmA	Pozo clay loam, moderately saline, 0 to 1 percent slopes	V	B_{13-2m}	30	85	100	57	15	5
PnA	Pozo clay loam, strongly saline, 0 to 1 percent slopes	V	B_{13-2a}	30	85	100	28	7	6
RaA	Ramona sandy loam, 0 to 3 percent slopes	III	C_2	85	95	100	100	81	1
RaB	Ramona sandy loam, 3 to 8 percent slopes	III	C_2	85	95	90	100	73	2
RbA	Ramona sandy loam, deep over hardpan, 0 to 3 percent slopes	III	C_2	70	95	100	100	66	2
RcA	Raynor clay, 0 to 3 percent slopes	IX	E_2	90	60	100	100	54	3
RcB	Raynor clay, 3 to 8 percent slopes	IX	E_2	90	60	90	100	48	3
RdA	Redding gravelly loam, 0 to 3 percent slopes	V	D_{28}	25	70	100	100	18	5
RdC	Redding gravelly loam, 3 to 15 percent slopes	V	D_{28}	25	70	90	100	16	5
RfC	Redding gravelly sandy loam, 3 to 15 percent slopes	V	D_{28}	25	60	90	100	14	5
RgC	Redding-Raynor complex, 3 to 15 percent slopes	V	D_{28}, E_2	60	60	90	100	32	4
Rh	Riverwash	I	A_{14}	----	----	----	----	5	6
Rk	Rock land, Hornitos soil material	VIII	E_{17}	----	----	----	----	5	6
RmB	Rocklin rocky sandy loam, pumiceous variant, 3 to 8 percent slopes	VI	D_{28}	50	95	90	100	43	3
RmD	Rocklin rocky sandy loam, pumiceous variant, 8 to 30 percent slopes	VI	D_{32}	50	95	80	100	38	4
RtA	Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes	III	B_{2-2a}	95	100	100	27	26	4
RsA	Rossi silt loam, moderately saline-alkali, 0 to 1 percent slopes	III	B_{2-2m}	95	100	100	54	51	3
RrA	Rossi silt loam, slightly saline-alkali, 0 to 1 percent slopes	III	B_{2-2s}	95	100	100	76	73	2
RoA	Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes	III	B_{2-2s}	95	85	100	76	62	2

TABLE 2.—*Soil profile groups, natural land types, and Storie index*—Continued

Map symbol	Soil	Soil profile group	Natural land type	Storie index: Rating factors: Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)	Index rating	Grade
RpA	Rossi clay loam, strongly saline-alkali, 0 to 1 percent slopes	III	B_{2-2a}	95	85	100	27	22	4
SaA	San Joaquin sandy loams, 0 to 3 percent slopes	V	C_{13}	30	100	100	90	27	4
SbA	San Joaquin-Alamo complex, 0 to 3 percent slopes	V	C_{13}, C_{14}	30	80	100	72	17	5
ScB	San Joaquin-Whitney sandy loams, 0 to 8 percent slopes	V	C_{13}, E_{1}	60	100	90	100	54	3
SyB	Sesame sandy loam, 3 to 8 percent slopes	VII	E_{1}	60	95	90	100	51	3
SnB	Sesame rocky sandy loam, 3 to 8 percent slopes	VII	E_{4}	45	80	90	100	32	4
SeB	Sesame loam, 3 to 8 percent slopes	VII	E_{1}	50	100	90	100	45	3
SeC	Sesame loam, 8 to 15 percent slopes	VII	E_{1}	50	100	85	100	43	3
SkC	Sesame rocky loam, 8 to 15 percent slopes	VII	E_{4}	45	80	85	100	31	4
TdA	Temple loam, 0 to 1 percent slopes	II	B_{1}	95	100	100	95	90	1
TbA	Temple clay loam, 0 to 1 percent slopes	II	B_{1}	95	85	100	95	77	2
TaA	Temple clay, 0 to 1 percent slopes	II	B_{3}	95	60	100	95	54	3
TeA	Temple loam, slightly saline, 0 to 1 percent slopes	II	B_{1-2s}	95	100	100	80	77	2
TcA	Temple clay loam, slightly saline, 0 to 1 percent slopes	II	B_{1-2s}	95	85	100	80	65	2
Tf	Terrace escarpments	--------	D_{33}	--------	--------	--------	--------	1 to 25	--------
TgF	Tollhouse rocky coarse sandy loam, 30 to 75 percent slopes	VII	E_{16}	50	80	40	100	16	5
TkC	Trabuco rocky loam, 8 to 15 percent slopes	VII	E_{4}	70	70	85	100	42	3
TkF	Trabuco rocky loam, 45 to 75 percent slopes	VII	E_{12}	70	70	25	80	9	6
ThE	Trabuco loam, 15 to 45 percent slopes	VII	E_{9}	75	100	60	70	31	4
ToA	Traver loam, strongly saline-alkali, 0 to 1 percent slopes	II	B_{1-2a}	95	100	100	20	19	5
TmA	Traver loam, slightly saline-alkali, 0 to 1 percent slopes	II	B_{1-2s}	95	100	100	70	66	2
TnA	Traver loam, moderately saline-alkali, 0 to 1 percent slopes	II	B_{1-2m}	95	100	100	40	38	4
TpA	Traver-Chino complex, slightly saline-alkali, 0 to 1 percent slopes	II	B_{1-2s}	95	100	100	70	66	2
TrA	Traver-Chino complex, moderately saline-alkali, 0 to 1 percent slopes	II	B_{1-2m}	95	100	100	40	38	4
TsA	Traver, Fresno, and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes	II, V	B_{13-2m}	60	100	100	40	24	4
TtA	Traver, Fresno, and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes	II, V	B_{13-2a}	60	100	100	20	12	5
TuB	Trigo fine sandy loam, 3 to 8 percent slopes	IX	E_{5}	40	100	90	80	29	4
TuC	Trigo fine sandy loam, 8 to 15 percent slopes	IX	E_{5}	40	100	85	80	27	4
TvB	Trigo-Cometa sandy loams, 3 to 8 percent slopes	IX	E_{5}	40	100	90	95	34	4
TwA	Tujunga loamy sand, 0 to 3 percent slopes	I	A_{5}	90	80	100	80	56	3
TwB	Tujunga loamy sand, 3 to 8 percent slopes	I	A_{5}	90	80	90	80	49	3
TxA	Tujunga loamy sand, moderately deep and deep over hardpan, 0 to 3 percent slopes	I	A_{11}	70	80	100	80	45	3
TzB	Tujunga and Hanford soils, channeled, 0 to 8 percent slopes	I	A_{5-5ch}	90	50	100	70	32	4
TyA	Tujunga loamy sand, moderately deep and deep over silt, 0 to 3 percent slopes	I	A_{11}	90	80	100	100	72	2
VaA	Visalia fine sandy loam, 0 to 1 percent slopes	I	A_{1}	100	100	100	100	100	1
VdA	Visalia sandy loam, 0 to 3 percent slopes	I	A_{1}	100	95	100	100	95	1
VnA	Visalia sandy loam, moderately deep over sand, 0 to 3 percent slopes	I	A_{1}	70	95	100	100	66	2
VsB	Vista-Sesame complex, 3 to 8 percent slopes	VII	E_{1}	60	90	90	100	49	3
WaB	Whiterock rocky fine sandy loam, 3 to 8 percent slopes	VIII	E_{8}	20	70	85	100	12	5
WaE	Whiterock rocky fine sandy loam, 30 to 45 percent slopes	VIII	E_{16}	20	70	45	100	6	6
WbD	Whiterock very rocky fine sandy loam, 8 to 30 percent slopes	VIII	E_{8}	20	60	80	100	10	5
WfB	Whitney fine sandy loam, 3 to 8 percent slopes	IX	E_{1}	70	100	90	90	57	
WfC	Whitney fine sandy loam, 8 to 15 percent slopes	IX	E_{1}	70	100	85	90	54	33

TABLE 2.—*Soil profile groups, natural land types, and Storie index*—Continued

Map symbol	Soil	Soil profile group	Natural land type	Storie index: Rating factors: Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)	Index rating	Grade
WmA	Whitney loam, 0 to 3 percent slopes	IX	E_1	70	100	100	100	70	2
WmB	Whitney loam, 3 to 8 percent slopes	IX	E_1	70	100	90	100	63	2
WmC	Whitney loam, 8 to 15 percent slopes	IX	E_1	70	100	85	100	60	2
WnD	Whitney sandy loam, 15 to 30 percent slopes, eroded	IX	E_{1-3m}	60	95	70	60	24	4
WtB	Whitney-Trigo fine sandy loams, 3 to 8 percent slopes	IX	E_1	50	100	90	95	43	3
WrB	Whitney and Rocklin sandy loams, 3 to 8 percent slopes	IX, VI	E_1	60	95	90	100	51	3
WrC	Whitney and Rocklin sandy loams, 8 to 15 percent slopes	IX, VI	E_1	60	95	85	100	48	3
WoC	Whitney and Rocklin gravelly sandy loams, 3 to 15 percent slopes	IX, VI	E_4	60	70	85	100	36	4
WxA	Wunjey very fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes	I	B_{1-2a}	100	100	100	20	20	4
WvA	Wunjey very fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes	I	B_{1-2m}	100	100	100	40	40	3
WuA	Wunjey very fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	I	B_{1-2s}	100	100	100	79	79	2
WyB	Wunjey very fine sandy loam, strongly saline-alkali, channeled, 1 to 8 percent slopes	I	$B_{1-2a-5ch}$	100	100	100	14	14	5
ZaB	Zaca clay, 3 to 8 percent slopes	IX	E_2	90	60	90	100	48	3

Soil profile groups

Soil profile groups are based on (1) position, (2) degree to which profile development is expressed, and (3) nature of underlying material.

Nine profile groups are recognized in the Madera Area (see table 2). Group I consists of recent alluvial and wind-reworked soils that have no horizon differentiation. The next five groups have increasing amounts of clay in the subsoil, as follows: Group II soils have weakly expressed B horizons, and group III soils have moderately expressed horizons. Group IV soils have strongly expressed claypan subsoils, and group V soils have hardpan subsoils. Group VI soils have claypans underlain by partly consolidated substrata.

In groups VII, VIII, and IX are soils of the uplands. The group number indicates the nature of the underlying rock, as follows: Group VII soils are underlain by hard igneous rocks; group VIII soils, by hard sedimentary rocks; and group IX soils, by relatively soft rocks of all kinds.

Natural land types

The explanation of the symbols in this column is given in Real Property Appraisal Memorandum, Part IV, Rural Appraisal (pages 8 through 31), issued November 20, 1940, by the State Board of Equalization, Division of Assessment Standards, Sacramento, Calif. The column is included for the benefit of appraisers using this classification for tax appraisal purposes.

Storie index ratings and soil grades

The Storie index ratings (see table 2) provide a comparative evaluation of the general suitability of the soils for agriculture (*7*).[7] They are based on four factors that represent the inherent characteristics and qualities of the soils. Each factor is evaluated separately in terms of percentage of ideal, or 100 percent.

Factor A—Profile characteristics. Factor A expresses relative favorability of the profile for the growth of plant roots. Soils that have a deep, friable profile are rated 100 percent. Those that have a clay layer or a hardpan or are shallow over bedrock are rated less than 100 percent. The actual rating depends upon the extent to which root penetration is limited.

Factor B—Texture of the surface soil. Factor B is rated according to the texture of the surface soil, which is important in determining how easily the soil can be worked and how easily crops can be established. The moderately coarse or medium textures—fine sandy loam, loam, and silt loam—are the most favorable and are rated 100 percent. The coarser and finer textures are rated less than 100 percent.

[7] Italic numbers in parentheses refer to Literature Cited, p. 151.

Factor C—Slope. Factor C is particularly important if the soils are irrigated. Smooth, very gently sloping soils are rated 100 percent. Stronger slopes are rated less than 100 percent.

Factor X—Other conditions. Factor X is used to evaluate any limitations on the use of the soils, including imperfect or poor drainage, salts or alkali, erosion, low natural fertility, or unfavorable microrelief. If more than one limitation exists, the values for each are multiplied together to get the rating for the X factor.

The index is obtained by multiplying together the values of the four factors. A×B×C×X=Storie index. Soil properties and qualities alone are considered. Land values, climate, location, markets, and other economic factors are not taken into account.

The soils are arranged in grades according to their suitability for general intensive agriculture, as shown by their Storie index ratings. There are six grades, each representing a range in index ratings, as follows:

	Range in index ratings
Grade 1	80 to 100.
Grade 2	60 to 79.
Grade 3	40 to 59.
Grade 4	20 to 39.
Grade 5	10 to 19.
Grade 6	Less than 10.

Grade 1 soils and grade 2 soils are suitable for a fairly wide range of crops and have few special management needs.

Grade 3 soils are suited to few crops or to special crops.

Grade 4 soils have a narrow range of agricultural possibilities. If used for crops they are exacting in management requirements.

Grade 5 soils are generally suited only to range.

Grade 6 soils are generally nonagricultural; they furnish less grazing than grade 5 soils.

Yield Predictions and Management Practices

The yield estimates in this report are based on observations made by the soil scientists who surveyed the Area, on information furnished by farmers in the Area, and by State and Federal farm advisory people in the Extension Service, Soil Conservation Service, and Agricultural Experiment Station. Federal and county census data were also reviewed and considered. More information was available for some soils than for others. If little or no information was available, yield estimates were made by comparison with similar soils.

Table 3 gives the yields of the principal crops grown in the Area, under three levels of management identified as A, B, and C. The management levels have the following general definitions:

A. Common, or average, management. That level of management most commonly used by the farmers of the Area.

B. Good management. That level of management used by farmers who apply more advanced, but not all of the best possible, practices now known.

C. Optimum management. That level of management, actually applied or not, that experience, field trials, and research findings up to the present indicate would give the highest returns.

Several important limitations should be kept in mind when using the yield estimates in table 3. First, the figures are estimates, or predictions. Second, the figures are averages that may be expected over a period of years. In any given year, the yield may be considerably higher or lower than the average. Third, there is considerable variation within some soils—as for example, variations due to salts and alkali—and this fact was considered in making the estimates.

The information on yields and management practices provided in this part of the report will be most useful and helpful immediately upon the release of the report. New developments in crop breeding, control of insects and diseases, fertilizers, tillage, irrigation, and drainage will make obsolete much of the information on management, although the yields obtained may not change greatly. Newer and better practices can always be substituted, and the State and Federal farm advisory services are always ready to provide the latest information available.

Estimates of yields are of most use when the management practices under which such yields can be produced are specified. Tables 4 through 15 show, for each crop and for the soils of each capability unit, the combination of practices that will produce the yields given in table 3 for each of the three defined levels of management—common (or average), good, and optimum. Tables 4 through 15 are useful only in relation to table 3. To use them, it is necessary to find in table 3 the crop, the name of the soil, the capability classification of the soil, the level of management, and the estimated yield, and then to look at the appropriate one of tables 4 through 15 to learn the details of management. For example: Atwater loamy sand, 0 to 3 percent slopes (AtA) will, it is estimated, produce 5 tons of alfalfa per acre under common management (level A). This soil is in capability unit IIe-4. To find the combination of practices that will produce this amount of alfalfa, the reader can refer to table 4 and look in column A under subhead 3.

TABLE 3.—*Estimated average acre yields of*

[A denotes average management; B, good management; and C, optimum management. The three levels of management are defined in is not suited. Details of each level of

Capability unit	Map symbol	Soil	Irrigated crops: Alfalfa (Tons/acre) A	B	C	Cotton (Bales/acre) A	B	C	Sorghum (grain) (100 lb./acre) A	B	C
IVe-1	AaC	Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes.	--	--	--	--	--	--	--	--	--
VIe-4	AaD	Ahwahnee and Auberry coarse sandy loams, 15 to 30 percent slopes.	--	--	--	--	--	--	--	--	--
VIe-4	AbD	Ahwahnee and Auberry rocky coarse sandy loams, 8 to 30 percent slopes.	--	--	--	--	--	--	--	--	--
VIIe-4	AbE	Ahwahnee and Auberry rocky coarse sandy loams, 30 to 45 percent slopes.	--	--	--	--	--	--	--	--	--
VIe-4	AbB	Ahwahnee and Auberry rocky coarse sandy loams, 3 to 8 percent slopes.	--	--	--	--	--	--	--	--	--
VIIe-4	AcD	Ahwahnee and Auberry very rocky coarse sandy loams, 15 to 30 percent slopes.	--	--	--	--	--	--	--	--	--
VIIe-4	AcF	Ahwahnee and Auberry very rocky coarse sandy loams, 30 to 75 percent slopes.	--	--	--	--	--	--	--	--	--
IVe-1	AdC	Ahwahnee and Vista coarse sandy loams, 8 to 15 percent slopes.	--	--	--	--	--	--	--	--	--
VIe-4	AdD	Ahwahnee and Vista coarse sandy loams, 15 to 30 percent slopes.	--	--	--	--	--	--	--	--	--
IIIe-1	AdB	Ahwahnee and Vista coarse sandy loams, 3 to 8 percent slopes.	--	--	--	--	--	--	--	--	--
VIe-4	AeB	Ahwahnee and Vista rocky coarse sandy loams, 3 to 8 percent slopes.	--	--	--	--	--	--	--	--	--
VIe-4	AeD	Ahwahnee and Vista rocky coarse sandy loams, 8 to 30 percent slopes.	--	--	--	--	--	--	--	--	--
VIIe-4	AeE	Ahwahnee and Vista rocky coarse sandy loams, 30 to 45 percent slopes.	--	--	--	--	--	--	--	--	--
VIIe-4	ArD	Ahwahnee and Vista very rocky coarse sandy loams, 15 to 30 percent slopes.	--	--	--	--	--	--	--	--	--
VIIe-4	ArF	Ahwahnee and Vista very rocky coarse sandy loams, 30 to 75 percent slopes.	--	--	--	--	--	--	--	--	--
IIIw-5	AsA	Alamo clay, 0 to 1 percent slopes	--	--	--	--	--	--	--	--	--
IIe-4	AtB	Atwater loamy sand, 3 to 8 percent slopes	--	--	--	--	--	--	--	--	--
IIe-4	AtA	Atwater loamy sand, 0 to 3 percent slopes	5	7	9	1. 50	2. 00	2. 50	25	45	55
IIIe-4	AwB	Atwater loamy sand, moderately deep and deep over hardpan, 3 to 8 percent slopes.	--	--	--	--	--	--	--	--	--
IIIe-4	AwA	Atwater loamy sand, moderately deep and deep over hardpan, 0 to 3 percent slopes.	5	7	9	1. 50	2. 00	2. 50	25	45	56
IIs-3	BeA	Bear Creek loam, 0 to 3 percent slopes	--	--	--	--	--	--	--	--	--
IIs-7	BfA	Borden fine sandy loam, 0 to 1 percent slopes	5	7	9	1. 25	1. 75	2. 25	20	40	50
IIIs-6	BkA	Borden fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	25	35
IIs-7	BmA	Borden loam, 0 to 1 percent slopes	5	7	9	1. 25	1. 75	2. 25	20	40	50
IIIs-6	BoA	Borden loam, slightly saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	25	35
IIIs-3	BzA	Buchenau loam, 0 to 3 percent slopes	--	--	--	--	--	--	--	--	--
IIIs-3	BuA	Buchenau fine sandy loam, 0 to 3 percent slopes	--	--	--	--	--	--	--	--	--
IIIs-8	BvA	Buchenau fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes.	--	--	--	--	--	--	--	--	--
VIs-8	ByA	Buchenau fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes.	--	--	--	--	--	--	--	--	--
IIIe-4	CaA	Cajon loamy sand, 0 to 1 percent slopes	4	5	7	1. 25	1. 50	1. 75	15	25	35
IIIe-4	CaaA	Cajon loamy sand, slightly saline-alkali, 0 to 1 percent slopes.	4	5	7	1. 25	1. 50	1. 75	15	25	35
IVs-4	CabA	Cajon loamy sand, moderately saline-alkali, 0 to 1 percent slopes.	--	--	--	--	--	--	--	--	--
VIs-6	CacA	Cajon loamy sand, strongly saline-alkali, 0 to 1 percent slopes.	--	--	--	--	--	--	--	--	--
IIIe-4	CbaB	Calhi loamy sand, slightly alkali, 0 to 8 percent slopes.	--	--	--	--	--	--	--	--	--
IVs-4	CbbB	Calhi loamy sand, moderately alkali, 0 to 8 percent slopes.	--	--	--	--	--	--	--	--	--

[1] With adequate drainage.

principal crops under three levels of management

the text, p. 83. No estimates are given for soils on which the particular crop is not generally grown or for soils to which the crop management are given in tables 4 through 15]

Irrigated crops—continued																					Dryland crops					
Corn (grain) (100 lb./acre)			Corn (silage) (Tons/acre)			Barley (grain) (100 lb./acre)			Sugar beets (Tons/acre)			Potatoes (100 lb./acre)			Grapes (Tons/acre)			Pasture (Lb. beef/acre/yr.)			Dryfarmed barley (100 lb./acre)			Dryland range (Lb. beef/acre/yr.)		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	40	100	180
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	30	70	150
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	25	50	100
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----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	30	70	150
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	10	20	50
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5	10	30
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	40	100	180
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	30	70	150
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	50	120	200
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	30	70	150
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	25	50	100
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	10	20	50
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	10	20	50
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5	10	30
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	2	4	[1] 10	----	40	100
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	8	10	12	----	20	150
30	40	50	15	20	25	15	20	25	----	----	----	----	----	----	1.5	2.5	3.0	300	500	700	10	12	14	----	25	75
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	8	10	12	----	20	150
30	40	50	15	20	25	15	20	25	----	----	----	----	----	----	1.5	2.5	3.0	300	500	700	10	12	14	----	25	175
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	11	13	15	----	30	200
30	50	60	15	25	30	16	25	34	14	18	22	----	----	----	----	----	----	300	500	700	11	13	15	----	30	200
25	40	50	12	20	25	13	22	30	12	16	20	----	----	----	----	----	----	250	450	650	10	12	14	----	25	170
30	50	60	15	25	30	16	25	34	14	18	22	----	----	----	----	----	----	300	500	700	11	13	15	----	30	200
25	40	50	12	20	25	13	22	30	12	16	20	----	----	----	----	----	----	250	450	650	10	12	14	----	25	175
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	11	13	15	----	30	200
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	11	13	15	----	30	200
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	10	12	14	----	25	170
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	15	70
20	30	40	10	15	20	12	20	25	----	----	----	----	----	----	----	----	----	200	300	400	----	----	----	----	----	10
20	30	40	10	15	20	12	20	25	----	----	----	----	----	----	----	----	----	200	300	400	----	----	----	----	----	10
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	150	250	350	----	----	----	----	----	5
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	<5
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TABLE 3.—*Estimated average acre yields of principal*

Capability unit	Map symbol	Soil	Irrigated crops								
			Alfalfa (Tons/acre)			Cotton (Bales/acre)			Sorghum (grain) (100 lb./acre)		
			A	B	C	A	B	C	A	B	C
IIIe–4	CcaA	Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 0 to 3 percent slopes.	------	------	------	------	------	------	------	------	------
IIIe–4	CcaB	Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 3 to 8 percent slopes.	------	------	------	------	------	------	------	------	------
IVs–4	CcbA	Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 0 to 3 percent slopes.	------	------	------	------	------	------	------	------	------
IVs–4	CcbB	Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 3 to 8 percent slopes.	------	------	------	------	------	------	------	------	------
VIs–6	CccA	Calhi loamy sand, moderately deep and deep over silt, strongly saline-alkali, 0 to 3 percent slopes.	------	------	------	------	------	------	------	------	------
IVs–8	CdaA	Calhi loamy sand, shallow over hardpan variant, moderately saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IIw–2	CgA	Chino loam, 0 to 1 percent slopes	6	8	10	1. 75	2. 25	3. 00	30	50	60
IIs–6	CgaA	Chino loam, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 50	2. 00	2. 50	25	40	50
IIIs–6	CgbA	Chino loam, moderately saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 25	1. 75	2. 00	15	30	40
IVw–6	CgcA	Chino loam, strongly saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IIw–2	CfA	Chino fine sandy loam, 0 to 1 percent slopes	6	8	10	1. 75	2. 25	3. 00	30	50	60
IIs–6	CfaA	Chino fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 50	2. 00	2. 50	25	40	50
IIIs–6	CfbA	Chino fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 25	1. 75	2. 00	15	30	40
IIw–2	CeA	Chino clay loam, 0 to 1 percent slopes	6	8	10	1. 75	2. 25	3. 00	30	50	60
IIs–6	CeaA	Chino clay loam, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 50	2. 00	2. 50	25	40	50
IIIs–6	CebA	Chino clay loam, moderately saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 25	1. 75	2. 00	15	30	40
IVe–1	ChD	Coarsegold loam, 8 to 30 percent slopes	------	------	------	------	------	------	------	------	------
VIIe–1	ChF	Coarsegold loam, 45 to 75 percent slopes	------	------	------	------	------	------	------	------	------
VIe–1	CkD	Coarsegold rocky loam, 15 to 30 percent slopes	------	------	------	------	------	------	------	------	------
VIIe–1	CkF	Coarsegold rocky loam, 30 to 75 percent slopes	------	------	------	------	------	------	------	------	------
IIw–2	CmA	Columbia fine sandy loam, 0 to 1 percent slopes	6	8	10	1. 75	2. 25	3. 00	30	50	60
IIw–7	CmtA	Columbia fine sandy loam, moderately deep and deep over Temple soils, 0 to 1 percent slopes.	5	7	9	1. 50	2. 00	2. 75	25	45	55
IIs–3	CmdA	Columbia fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes.	5	7	9	1. 50	2. 00	2. 75	25	45	55
IIIe–4	CrB	Columbia soils, channeled, 0 to 8 percent slopes	------	------	------	------	------	------	------	------	------
IIIs–3	CoA	Columbia loamy sand, 0 to 1 percent slopes	4	6	8	1. 25	1. 75	2. 50	20	40	50
IIw–7	CotA	Columbia loamy sand, over Temple soils, 0 to 1 percent slopes.	4	6	8	1. 25	1. 75	2. 50	20	40	50
IIw–2	CpA	Columbia sandy loam, 0 to 1 percent slopes	5	7	9	1. 50.	2. 00	2. 75	25	45	55
IIw–2	CpdA	Columbia sandy loam, moderately deep over sand, 0 to 1 percent slopes.	4	6	8	1. 25	1. 75	2. 50	20	40	55
IVe–3	CuB	Cometa sandy loams, 3 to 8 percent slopes	------	------	------	------	------	------	------	------	------
IVe–3	CuC	Cometa sandy loams, 8 to 15 percent slopes	------	------	------	------	------	------	------	------	------
IVs–3	CuA	Cometa sandy loams, 0 to 3 percent slopes	------	------	------	------	------	------	------	------	------
IVe–3	CsB	Cometa gravelly sandy loam, 3 to 8 percent slopes.	------	------	------	------	------	------	------	------	------
IVe–3	CtB	Cometa loam, 3 to 8 percent slopes	------	------	------	------	------	------	------	------	------
IVe–3	CwB	Cometa-Whitney sandy loams, 3 to 8 percent slopes.	------	------	------	------	------	------	------	------	------
IVe–3	CwC	Cometa-Whitney sandy loams, 8 to 15 percent slopes.	------	------	------	------	------	------	------	------	------
IVs–3	CyA	Corning gravelly loam, 0 to 3 percent slopes	------	------	------	------	------	------	------	------	------
IVe–3	CyB	Corning gravelly loam, 3 to 8 percent slopes	------	------	------	------	------	------	------	------	------
VIIe–3	DbD	Daulton loam, 8 to 30 percent slopes	------	------	------	------	------	------	------	------	------
VIIe–3	DaD	Daulton fine sandy loam, 8 to 30 percent slopes	------	------	------	------	------	------	------	------	------
VIIe–3	DaB	Daulton fine sandy loam, 3 to 8 percent slopes	------	------	------	------	------	------	------	------	------
VIIe–3	DaE	Daulton fine sandy loam, 30 to 45 percent slopes	------	------	------	------	------	------	------	------	------

crops under three levels of management—Continued

Irrigated crops—continued																					Dryland crops					
Corn (grain) (100 lb./acre)			Corn (silage) (Tons/acre)			Barley (grain) (100 lb./acre)			Sugar beets (Tons/acre)			Potatoes (100 lb./acre)			Grapes (Tons/acre)			Pasture (Lb. beef/acre/yr.)			Dryfarmed barley (100 lb./acre)			Dryland range (Lb. beef/acre/yr.)		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
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40	50	60	20	25	30	25	35	45	18	23	26	----	----	----	----	----	----	350	600	800	----	----	----	----	----	40
30	40	50	15	20	25	20	30	40	14	18	22	----	----	----	----	----	----	300	550	750	----	----	----	----	----	30
20	30	40	10	15	20	15	25	30	----	----	----	----	----	----	----	----	----	250	500	650	----	----	----	----	----	20
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40	50	60	20	25	30	25	35	45	18	23	26	----	----	----	----	----	----	350	600	800	----	----	----	----	----	40
30	40	50	15	20	25	20	30	40	14	18	22	----	----	----	----	----	----	300	550	750	----	----	----	----	----	30
20	30	40	10	15	20	15	25	30	----	----	----	----	----	----	----	----	----	250	500	650	----	----	----	----	----	20
40	50	60	20	25	30	25	35	45	18	23	26	----	----	----	----	----	----	350	600	800	----	----	----	----	----	40
30	40	50	15	20	25	20	30	40	14	18	22	----	----	----	----	----	----	300	550	750	----	----	----	----	----	30
20	30	40	10	15	20	15	25	30	----	----	----	----	----	----	----	----	----	250	500	650	----	----	----	----	----	20
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40	50	60	20	25	30	25	35	45	18	22	26	----	----	----	----	----	----	350	600	800	----	----	----	----	----	40
30	40	50	15	20	25	16	25	34	16	20	24	----	----	----	----	----	----	350	600	800	----	----	----	----	----	40
30	40	50	15	20	25	16	25	34	16	20	24	----	----	----	----	----	----	----	----	----	----	----	----	----	----	40
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25	35	45	12	17	22	13	22	30	----	----	----	----	----	----	----	----	----	200	300	400	----	----	----	----	----	20
25	35	45	12	17	22	13	22	30	----	----	----	----	----	----	----	----	----	250	400	550	----	----	----	----	----	25
30	40	50	15	20	25	16	25	34	16	20	24	----	----	----	----	----	----	300	550	750	----	----	----	----	----	30
25	35	45	12	17	22	13	22	30	12	15	20	----	----	----	----	----	----	250	450	650	----	----	----	----	----	25
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TABLE 3.—*Estimated average acre yields of principal*

Capability unit	Map symbol	Soil	Irrigated crops: Alfalfa (Tons/acre) A	Alfalfa B	Alfalfa C	Cotton (Bales/acre) A	Cotton B	Cotton C	Sorghum (grain) (100 lb./acre) A	Sorghum B	Sorghum C
VIIe-3	DcB	Daulton rocky fine sandy loam, 3 to 8 percent slopes.	------	------	------	------	------	------	------	------	------
VIIe-3	DcE	Daulton rocky fine sandy loam, 30 to 45 percent slopes.	------	------	------	------	------	------	------	------	------
IVe-4	DeB	Delhi sand, 3 to 8 percent slopes	------	------	------	------	------	------	------	------	------
IVe-4	DeA	Delhi sand, 0 to 3 percent slopes	4	5	7	1. 25	1. 50	1. 75	15	25	35
IVe-4	DfA	Delhi sand, moderately deep and deep over hardpan, 0 to 3 percent slopes.	4	5	7	1. 25	1. 50	1. 75	15	25	35
IIIs-8	DpA	Dinuba-El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 25	1. 75	2. 25	18	25	30
IVs-8	DsA	Dinuba-El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	2. 00	15	20	25
IIIs-3	DmA	Dinuba fine sandy loam, 0 to 1 percent slopes	6	8	10	1. 25	1. 75	2. 50	20	30	40
IIIs-3	DoA	Dinuba loam, 0 to 1 percent slopes	6	8	10	1. 25	1. 75	2. 50	20	30	40
IIIs-8	DtA	Dinuba-El Peco loams, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 25	1. 75	2. 25	18	25	30
IVs-8	DuA	Dinuba-El Peco loams, moderately saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	2. 00	15	20	25
VIs-8	EdA	El Peco-Dinuba fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IIw-2	FbA	Foster loams, 0 to 1 percent slopes	6	8	10	1. 25	1. 75	2. 50	25	40	60
IIs-6	FbaA	Foster loams, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 25	1. 75	2. 25	20	35	50
IIIs-6	FbbA	Foster loams, moderately saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	30	40
IVw-6	FbcA	Foster loams, strongly saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IIw-2	FbdA	Foster loams, sandy substratum, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	30	40
IIw-7	FbeA	Foster loams, moderately deep and deep over Temple soils, 0 to 1 percent slopes.	5	7	9	1. 25	1. 75	2. 25	20	35	50
IIIs-6	FcbA	Foster loams, moderately deep and deep over Temple soils, moderately saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	30	40
IIw-2	FaA	Foster clay loam, 0 to 1 percent slopes	6	8	10	1. 25	1. 75	2. 50	25	40	60
IIs-6	FaaA	Foster clay loam, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 25	1. 75	2. 25	20	35	50
IIIs-6	FabA	Foster clay loam, moderately saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	30	40
IVw-6	FacA	Foster clay loam, strongly saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IVw-6	FdcA	Foster-Chino loams, strongly saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
VIs-8	FecA	Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
VIs-8	FfcA	Fresno and El Peco loams, strongly saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IVs-8	FebA	Fresno and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IVs-8	FfbA	Fresno and El Peco loams, moderately saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IIIs-8	FeaA	Fresno and El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	20	30
IIIs-8	FfaA	Fresno and El Peco loams, slightly saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	20	30
IIIs-8	FgaA	Fresno, El Peco, and Chino soils, slightly saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	20	30
IVs-8	FgbA	Fresno, El Peco, and Chino soils, moderately saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IVs-8	FhbA	Fresno, El Peco, and Lewis soils, moderately saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
VIs-8	FhcA	Fresno, El Peco, and Lewis soils, strongly saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IIIs-8	FkaA	Fresno, El Peco, and Pozo soils, slightly saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	20	30
IVs-8	FkbA	Fresno, El Peco, and Pozo soils, moderately saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------

crops under three levels of management—Continued

Irrigated crops—continued																					Dryland crops					
Corn (grain) (100 lb./acre)			Corn (silage) (Tons/acre)			Barley (grain) (100 lb./acre)			Sugar beets (Tons/acre)			Potatoes (100 lb./acre)			Grapes (Tons/acre)			Pasture (Lb. beef/acre/yr.)			Dryfarmed barley (100 lb./acre)			Dryland range (Lb. beef/acre/yr.)		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
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20	30	40	10	15	20	12	20	25	----	----	----	125	150	200	----	----	----	----	----	----	4	5	6	----	15	90
20	30	40	10	15	20	12	20	25	----	----	----	125	150	200	----	----	----	----	----	----	4	5	6	----	15	100
30	40	50	15	20	25	15	25	35	12	16	20	----	----	----	2. 0	2. 5	3. 0	300	500	700	----	----	----	----	----	25
20	30	40	10	15	20	12	20	25	----	----	----	----	----	----	----	----	----	250	450	550	----	----	----	----	----	20
40	50	60	20	25	30	20	30	40	15	20	25	200	250	300	2. 0	3. 0	3. 5	350	600	800	----	----	----	----	----	30
40	50	60	20	25	30	20	30	40	15	20	25	200	250	300	2. 0	3. 0	3. 5	350	600	800	----	----	----	----	----	30
30	40	50	15	20	25	15	25	35	12	16	20	----	----	----	1. 5	2. 5	3. 0	300	500	700	----	----	----	----	----	25
20	30	40	10	15	20	12	20	25	----	----	----	----	----	----	----	----	----	250	450	550	----	----	----	----	----	20
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40	50	60	20	25	30	25	35	45	18	23	26	----	----	----	----	----	----	350	600	800	----	----	----	----	----	40
30	40	50	15	20	25	20	30	40	14	18	22	----	----	----	----	----	----	300	550	750	----	----	----	----	----	35
20	30	40	10	15	20	15	25	30	----	----	----	----	----	----	----	----	----	250	500	650	----	----	----	----	----	30
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20	30	40	10	15	20	15	25	30	12	16	20	----	----	----	----	----	----	250	450	600	----	----	----	----	----	35
30	40	50	15	20	25	20	30	40	14	18	22	----	----	----	----	----	----	350	600	800	----	----	----	----	----	40
20	30	40	10	15	20	15	25	30	----	----	----	----	----	----	----	----	----	250	500	650	----	----	----	----	----	30
40	50	60	20	25	30	25	35	45	18	23	26	----	----	----	----	----	----	350	600	800	----	----	----	----	----	40
30	40	50	15	20	25	20	30	40	14	18	22	----	----	----	----	----	----	300	550	750	----	----	----	----	----	35
20	30	40	10	15	20	15	25	30	----	----	----	----	----	----	----	----	----	250	500	650	----	----	----	----	----	30
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20	30	40	10	15	20	15	20	25	----	----	----	----	----	----	----	----	----	300	500	700	----	----	----	----	----	20
20	30	40	10	15	20	15	20	25	----	----	----	----	----	----	----	----	----	300	500	700	----	----	----	----	----	20
20	30	40	10	15	20	15	20	25	----	----	----	----	----	----	----	----	----	300	500	700	----	----	----	----	----	15
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20	30	40	10	15	20	15	20	25	----	----	----	----	----	----	----	----	----	300	500	700	----	----	----	----	----	20
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TABLE 3.—*Estimated average acre yields of principal*

Capability unit	Map symbol	Soil	Irrigated crops								
			Alfalfa (Tons/acre)			Cotton (Bales/acre)			Sorghum (grain) (100 lb./acre)		
			A	B	C	A	B	C	A	B	C
I–1	GaA	Grangeville fine sandy loam, 0 to 1 percent slopes	8	10	12	1. 75	2. 25	3. 00	30	50	65
IIs–6	GbA	Grangeville fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.	6	8	10	1. 25	1. 75	2. 50	20	40	55
I–1	GmA	Grangeville sandy loam, 0 to 1 percent slopes	7	9	11	1. 50	2. 00	2. 75	25	45	60
IIs–6	GnA	Grangeville sandy loam, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 25	1. 75	2. 25	20	40	55
IIs–6	GcA	Grangeville fine sandy loam, over Traver soils, 0 to 1 percent slopes.	6	8	10	1. 25	1. 75	2. 50	20	40	55
IIs–6	GdA	Grangeville fine sandy loam, over Traver soils, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 25	1. 75	2. 25	20	40	55
IIw–7	GeA	Grangeville fine sandy loam, moderately deep and deep over Temple soils, 0 to 1 percent slopes.	6	8	10	1. 25	1. 75	2. 50	20	40	55
IIs–3	GfA	Grangeville fine sandy loam, deep over hardpan, 0 to 1 percent slopes.	6	8	10	1. 25	1. 75	2. 50	20	40	55
IIs–3	GhA	Grangeville fine sandy loam, deep over alkali hardpan, 0 to 1 percent slopes.	6	8	10	1. 25	1. 75	2. 50	20	40	55
IIs–3	GkA	Grangeville fine sandy loam, deep over alkali hardpan, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 25	1. 75	2. 25	20	40	55
VIIIs–1	Gp	Gravel pits	------	------	------	------	------	------	------	------	------
I–1	GrA	Greenfield coarse sandy loam, 0 to 3 percent slopes.	6	8	10	1. 25	1. 75	2. 50	20	40	55
IIe–1	GrB	Greenfield coarse sandy loam, 3 to 8 percent slopes.	5	7	9	1. 25	1. 75	2. 25	20	40	55
IIe–1	GuB	Greenfield sandy loam, 3 to 8 percent slopes	5	7	9	1. 25	1. 75	2. 25	20	40	55
I–1	GuA	Greenfield sandy loam, 0 to 3 percent slopes	7	9	11	1. 50	2. 00	2. 75	25	45	60
IIs–3	GvA	Greenfield sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes.	5	7	9	1. 25	1. 75	2. 25	20	40	55
IIs–3	GvB	Greenfield sandy loam, moderately deep and deep over hardpan, 3 to 8 percent slopes.	5	7	9	1. 25	1. 75	2. 25	20	40	55
I–1	GsA	Greenfield fine sandy loam, 0 to 3 percent slopes	8	10	12	1. 75	2. 25	3. 00	30	50	65
IIe–1	GsB	Greenfield fine sandy loam, 3 to 8 percent slopes	6	8	10	1. 25	1. 75	2. 50	20	40	55
I–1	HaA	Hanford fine sandy loam, 0 to 1 percent slopes	8	10	12	1. 75	2. 25	3. 00	30	50	65
IIIs–3	HbA	Hanford fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes.	6	8	10	1. 25	1. 75	2. 50	20	40	55
I–1	HfA	Hanford sandy loam, 0 to 3 percent slopes	7	9	11	1. 50	2. 00	2. 75	25	45	60
IIIe–4	HhA	Hanford sandy loam, moderately deep over sand, 0 to 3 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	25	35
IIIs–3	HgA	Hanford sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes.	5	7	9	1. 25	1. 75	2. 50	20	40	55
IIe–1	HeB	Hanford gravelly sandy loam, 3 to 8 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	25	35
IIIs–3	HdA	Hanford (Ripperdan) fine sandy loam, moderately deep and deep over silt, 0 to 3 percent slopes.	6	8	10	1. 25	1. 75	2. 50	------	------	------
IIIs–3	HcA	Hanford (Ripperdan) fine sandy loam, shallow variant, 0 to 3 percent slopes.	4	5	6	. 75	1. 00	1. 25	------	------	------
VIIe–9	HkB	Hideaway very stony loam, 0 to 8 percent slopes	------	------	------	------	------	------	------	------	------
VIIe–9	HkD	Hideaway very stony loam, 15 to 30 percent slopes.	------	------	------	------	------	------	------	------	------
IIIw–5	HmA	Hildreth sandy clay, 0 to 3 percent slopes	------	------	------	------	------	------	------	------	------
IIIw–5	HnB	Hildreth-San Joaquin complex, 0 to 8 percent slopes.	------	------	------	------	------	------	------	------	------
VIe–4	HoD	Holland sandy loam, 15 to 30 percent slopes	------	------	------	------	------	------	------	------	------
VIIe–4	HoE	Holland sandy loam, 30 to 45 percent slopes	------	------	------	------	------	------	------	------	------
VIIe–4	HrE	Holland rocky sandy loam, 30 to 45 percent slopes.	------	------	------	------	------	------	------	------	------
VIIe–9	HsB	Hornitos gravelly sandy loam, 3 to 8 percent slopes.	------	------	------	------	------	------	------	------	------
VIIe–9	HsD	Hornitos gravelly sandy loam, 8 to 30 percent slopes.	------	------	------	------	------	------	------	------	------
VIIe–9	HvD	Hornitos very rocky sandy loam, 8 to 30 percent slopes.	------	------	------	------	------	------	------	------	------
IVs–3	JyA	Jesbel gravelly clay loam, 0 to 3 percent slopes	------	------	------	------	------	------	------	------	------
IIIs–5	JeA	Jesbel clay, 0 to 3 percent slopes	------	------	------	------	------	------	------	------	------
IIIs–5	JgB	Jesbel gravelly clay, 3 to 8 percent slopes	------	------	------	------	------	------	------	------	------

crops under three levels of management—Continued

Irrigated crops—continued																					Dryland crops					
Corn (grain) (100 lb./acre)			Corn (silage) (Tons/acre)			Barley (grain) (100 lb./acre)			Sugar beets (Tons/acre)			Potatoes (100 lb./acre)			Grapes (Tons/acre)			Pasture (Lb. beef/acre/yr.)			Dryfarmed barley (100 lb./acre)			Dryland range (Lb. beef/acre/yr.)		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
40	60	80	20	30	40	25	35	45	20	25	30	250	300	400	2.0	3.0	3.5	350	600	800	----	----	----	----	----	30
30	50	70	15	25	35	20	28	40	18	22	26	----	----	----	1.5	2.5	3.0	300	550	750	----	----	----	----	----	25
35	55	75	18	28	38	22	32	42	19	24	28	225	275	350	1.5	2.5	3.0	300	550	750	----	----	----	----	----	25
30	50	65	15	25	33	16	25	34	14	18	22	----	----	----	1.0	2.0	2.5	300	550	750	----	----	----	----	----	25
30	50	70	15	25	35	20	28	40	18	22	26	200	250	300	1.5	2.5	3.0	350	600	800	----	----	----	----	----	30
30	50	65	15	25	33	16	25	34	14	18	22	----	----	----	1.0	2.0	2.5	300	550	750	----	----	----	----	----	25
30	50	70	15	25	35	20	28	40	18	22	26	200	250	300	1.5	2.5	3.0	350	600	800	----	----	----	----	----	30
30	50	70	15	25	35	20	28	40	18	22	26	200	250	300	1.5	2.5	3.0	350	600	800	----	----	----	----	----	30
30	50	70	15	25	35	20	28	40	18	22	26	200	250	300	1.0	2.0	2.5	300	550	750	----	----	----	----	----	30
30	50	65	15	25	33	16	25	34	14	18	22	----	----	----	----	----	----	300	550	750	----	----	----	----	----	25
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30	50	70	15	25	35	20	28	40	18	22	26	200	250	300	1.5	2.5	3.0	300	550	750	11	13	15	----	25	170
30	50	65	15	25	33	16	25	34	----	----	----	----	----	----	----	----	----	300	550	750	10	12	14	----	20	150
30	50	65	15	25	33	16	25	34	----	----	----	----	----	----	----	----	----	300	550	750	10	12	14	----	25	180
35	55	75	18	28	38	22	32	42	19	24	28	225	275	350	1.5	2.5	3.0	300	550	750	11	13	15	----	20	170
30	50	65	15	25	33	16	25	34	14	18	22	175	225	275	1.5	2.5	3.0	350	600	800	11	13	15	----	25	180
30	50	65	15	25	33	16	25	34	----	----	----	----	----	----	----	----	----	300	550	750	10	12	14	----	20	170
40	60	80	20	30	40	25	35	45	20	25	30	250	300	400	2.0	3.0	3.5	350	600	800	11	13	15	----	30	200
30	50	70	15	25	35	20	28	40	----	----	----	----	----	----	----	----	----	300	550	750	----	----	----	----	25	180
40	60	80	20	30	40	25	35	45	20	25	30	250	300	400	2.0	3.0	3.5	350	600	800	----	----	----	----	----	30
30	50	70	15	25	35	20	28	40	18	22	26	200	250	300	2.0	3.0	3.5	350	600	800	----	----	----	----	----	30
35	55	75	18	28	38	22	32	42	19	24	28	225	275	350	1.5	2.5	3.0	300	550	750	----	----	----	----	----	25
25	40	55	12	20	28	13	22	30	12	16	20	150	200	250	1.0	1.5	2.0	250	450	650	----	----	----	----	----	15
30	50	65	15	25	33	16	25	34	14	18	22	175	225	275	1.5	2.5	3.0	300	550	750	----	----	----	----	----	20
25	40	55	12	20	28	13	22	30	----	----	----	----	----	----	----	----	----	300	500	700	----	----	----	----	----	15
30	50	70	15	25	35	20	32	40	----	----	----	200	250	300	2.0	3.0	4.0	350	600	800	----	----	----	----	----	30
20	30	40	10	15	20	13	18	22	----	----	----	100	125	150	.5	1.0	1.5	200	300	400	----	----	----	----	----	30
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TABLE 3.—*Estimated average acre yields of principal*

Capability unit	Map symbol	Soil	Irrigated crops								
			Alfalfa (Tons/acre)			Cotton (Bales/acre)			Sorghum (grain) (100 lb./acre)		
			A	B	C	A	B	C	A	B	C
IIIs–8	LeA	Lewis loam, slightly saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	20	30
IVs–8	LwA	Lewis loam, moderately saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IVs–3	MaA	Madera fine sandy loam, 0 to 3 percent slopes	4	6	8	1. 00	1. 50	2. 50	20	25	30
IVs–3	MdA	Madera-Lewis complex, slightly saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 00	1. 50	2. 25	18	23	30
IVs–3	MbA	Madera loam, 0 to 3 percent slopes	4	6	8	1. 00	1. 50	2. 50	20	25	30
IVs–3	McA	Madera-Alamo complex, 0 to 1 percent slopes	------	------	------	------	------	------	------	------	------
I–1	MoA	Marguerite loam, 0 to 3 percent slopes	------	------	------	------	------	------	------	------	------
IIs–6	MrA	Marguerite loam, slightly saline-alkali, 0 to 3 percent slopes.	------	------	------	------	------	------	------	------	------
IIIs–6	MsA	Marguerite loam, moderately saline-alkali, 0 to 3 percent slopes.	------	------	------	------	------	------	------	------	------
I–1	MmA	Marguerite clay loam, 0 to 3 percent slopes	------	------	------	------	------	------	------	------	------
IIIs–6	MnA	Marguerite clay loam, moderately saline-alkali, 0 to 3 percent slopes.	------	------	------	------	------	------	------	------	------
IVe–3	MtB	Montpellier coarse sandy loam, 3 to 8 percent slopes.	------	------	------	------	------	------	------	------	------
IVe–3	MtC	Montpellier coarse sandy loam, 8 to 15 percent slopes.	------	------	------	------	------	------	------	------	------
IIs–6	PbA	Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 50	2. 00	2. 75	20	35	55
I–1	PaA	Pachappa fine sandy loam, 0 to 1 percent slopes	6	8	10	1. 75	2. 25	3. 00	25	40	60
I–1	PcA	Pachappa sandy loam, 0 to 1 percent slopes	6	8	10	1. 75	2. 25	3. 00	25	40	60
IIs–6	PdA	Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 50	2. 00	2. 75	20	35	55
IIIs–8	PeA	Pachappa sandy loam, moderately deep and deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 50	2. 00	2. 75	20	35	55
IIIs–5	PfA	Porterville clay, 0 to 3 percent slopes	------	------	------	------	------	------	------	------	------
IIIs–5	PfB	Porterville clay, 3 to 8 percent slopes	------	------	------	------	------	------	------	------	------
IIIs–5	PgB	Porterville rocky clay, 3 to 8 percent slopes	------	------	------	------	------	------	------	------	------
IIIs–3	PoA	Pozo loam, 0 to 1 percent slopes	4	6	8	1. 00	1. 50	2. 00	30	40	50
IIIs–8	PsA	Pozo loam, slightly saline, 0 to 1 percent slopes	4	5	7	1. 00	1. 25	1. 75	25	35	45
IVs–8	PtA	Pozo loam, moderately saline, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
VIs–8	PvA	Pozo loam, strongly saline, 0 to 1 percent slopes	------	------	------	------	------	------	------	------	------
IIIs–3	PhA	Pozo clay loam, 0 to 1 percent slopes	4	6	8	1. 00	1. 50	2. 00	30	40	50
IIIs–8	PkA	Pozo clay loam, slightly saline, 0 to 1 percent slopes.	4	5	7	1. 00	1. 25	1. 75	25	35	45
IVs–8	PmA	Pozo clay loam, moderately saline, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
VIs–8	PnA	Pozo clay loam, strongly saline, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IIs–7	RaA	Ramona sandy loam, 0 to 3 percent slopes	4	6	8	1. 25	1. 50	1. 75	20	25	30
IIIe–1	RaB	Ramona sandy loam, 3 to 8 percent slopes	------	------	------	------	------	------	------	------	------
IIs–7	RbA	Ramona sandy loam, deep over hardpan, 0 to 3 percent slopes.	4	6	8	1. 25	1. 50	1. 75	20	25	30
IIIs–5	RcA	Raynor clay, 0 to 3 percent slopes	------	------	------	------	------	------	------	------	------
IIIs–5	RcB	Raynor clay, 3 to 8 percent slopes	------	------	------	------	------	------	------	------	------
IVs–3	RdA	Redding gravelly loam, 0 to 3 percent slopes	------	------	------	------	------	------	------	------	------
IVe–3	RdC	Redding gravelly loam, 3 to 15 percent slopes	------	------	------	------	------	------	------	------	------
IVe–3	RfC	Redding gravelly sandy loam, 3 to 15 percent slopes.	------	------	------	------	------	------	------	------	------
IVe–3	RgC	Redding-Raynor complex, 3 to 15 percent slopes	------	------	------	------	------	------	------	------	------
VIIIs–1	Rh	Riverwash	------	------	------	------	------	------	------	------	------
VIIIs–1	Rk	Rock land, Hornitos soil material	------	------	------	------	------	------	------	------	------
VIIe–9	RmB	Rocklin rocky sandy loam, pumiceous variant, 3 to 8 percent slopes.	------	------	------	------	------	------	------	------	------
VIIe–9	RmD	Rocklin rocky sandy loam, pumiceous variant, 8 to 30 percent slopes.	------	------	------	------	------	------	------	------	------
IVw–6	RtA	Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IVw–6	RsA	Rossi silt loam, moderately saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------

crops under three levels of management—Continued

Irrigated crops—continued																					Dryland crops					
Corn (grain) (100 lb./acre)			Corn (silage) (Tons/acre)			Barley (grain) (100 lb./acre)			Sugar beets (Tons/acre)			Potatoes (100 lb./acre)			Grapes (Tons/acre)			Pasture (Lb. beef/acre/yr.)			Dryfarmed barley (100 lb./acre)			Dryland range (Lb. beef/acre/yr.)		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
20	30	40	10	15	20	15	20	25	----	----	----	----	----	----	----	----	----	300	500	700	----	----	----	----	----	20
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30	40	50	15	20	25	20	30	40	----	----	----	----	----	----	1.5	2.0	2.5	350	600	800	10	12	14	----	30	200
28	38	48	13	18	23	18	28	35	----	----	----	----	----	----	----	----	----	300	550	750	9	11	12	----	25	180
30	40	50	15	20	25	20	30	40	----	----	----	----	----	----	1.5	2.0	2.5	300	600	800	10	12	14	----	30	200
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----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	8	10	12	----	20	150
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35	45	55	15	20	25	15	25	35	12	18	22	----	----	----	1.5	2.5	3.0	300	550	750	----	----	----	----	----	25
40	50	60	20	25	30	20	30	40	15	20	25	200	250	300	2.0	3.0	3.5	350	600	800	----	----	----	----	----	30
40	50	60	20	25	30	20	30	40	15	20	25	200	250	300	2.0	3.0	3.5	350	600	800	----	----	----	----	----	30
35	45	55	15	20	25	15	25	35	12	18	22	----	----	----	1.5	2.5	3.0	300	550	750	----	----	----	----	----	25
35	45	55	15	20	25	15	25	35	12	18	22	----	----	----	1.5	2.5	3.0	300	550	750	----	----	----	----	----	25
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30	40	50	15	20	25	20	30	40	----	----	----	----	----	----	----	----	----	300	500	700	----	----	----	----	----	30
25	35	45	12	16	20	18	24	32	----	----	----	----	----	----	----	----	----	250	450	650	----	----	----	----	----	25
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30	40	50	15	20	25	20	30	40	----	----	----	----	----	----	----	----	----	300	500	700	----	----	----	----	----	30
25	35	45	12	16	20	18	24	32	----	----	----	----	----	----	----	----	----	250	450	650	----	----	----	----	----	25
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30	40	50	15	20	25	20	30	40	----	----	----	----	----	----	----	----	----	350	600	800	10	12	14	----	30	200
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30	40	50	15	20	25	20	30	40	----	----	----	----	----	----	----	----	----	350	600	800	10	12	14	----	30	200
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TABLE 3.—*Estimated average acre yields of principal*

Capability unit	Map symbol	Soil	Irrigated crops								
			Alfalfa (Tons/acre)			Cotton (Bales/acre)			Sorghum (grain) (100 lb./acre)		
			A	B	C	A	B	C	A	B	C
IIIs-6	RrA	Rossi silt loam, slightly saline-alkali, 0 to 1 percent slopes.	---	---	---	---	---	---	---	---	---
IIIs-6	RoA	Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes.	---	---	---	---	---	---	---	---	---
IVw-6	RpA	Rossi clay loam, strongly saline-alkali, 0 to 1 percent slopes.	---	---	---	---	---	---	---	---	---
IVs-3	SaA	San Joaquin sandy loams, 0 to 3 percent slopes	4	6	8	1. 00	1. 50	1. 75	15	20	30
IVs-3	SbA	San Joaquin-Alamo complex, 0 to 3 percent slopes	---	---	---	---	---	---	---	---	---
IVe-3	ScB	San Joaquin-Whitney sandy loams, 0 to 8 percent slopes.	---	---	---	---	---	---	---	---	---
IIIe-1	SyB	Sesame sandy loam, 3 to 8 percent slopes	---	---	---	---	---	---	---	---	---
VIe-4	SnB	Sesame rocky sandy loam, 3 to 8 percent slopes	---	---	---	---	---	---	---	---	---
IIIe-1	SeB	Sesame loam, 3 to 8 percent slopes	---	---	---	---	---	---	---	---	---
IVe-1	SeC	Sesame loam, 8 to 15 percent slopes	---	---	---	---	---	---	---	---	---
VIe-4	SkC	Sesame rocky loam, 8 to 15 percent slopes	---	---	---	---	---	---	---	---	---
IIw-2	TdA	Temple loam, 0 to 1 percent slopes	6	8	10	1. 75	2. 25	3. 00	30	50	60
IIw-2	TbA	Temple clay loam, 0 to 1 percent slopes	6	8	10	1. 75	2. 25	3. 00	30	50	60
IIw-2	TaA	Temple clay, 0 to 1 percent slopes	5	7	9	1. 50	2. 00	2. 50	25	40	50
IIs-6	TeA	Temple loam, slightly saline, 0 to 1 percent slopes	5	7	9	1. 50	2. 00	2. 50	25	40	50
IIs-6	TcA	Temple clay loam, slightly saline, 0 to 1 percent slopes.	5	7	9	1. 50	2. 00	2. 50	25	40	50
VIIIs-1	Tf	Terrace escarpments	---	---	---	---	---	---	---	---	---
VIIe-4	TgF	Tollhouse rocky coarse sandy loam, 30 to 75 percent slopes.	---	---	---	---	---	---	---	---	---
VIe-1	TkC	Trabuco rocky loam, 8 to 15 percent slopes	---	---	---	---	---	---	---	---	---
VIIe-1	TkF	Trabuco rocky loam, 45 to 75 percent slopes	---	---	---	---	---	---	---	---	---
VIe-1	ThE	Trabuco loam, 15 to 45 percent slopes	---	---	---	---	---	---	---	---	---
IVs-6	ToA	Traver loam, strongly saline-alkali, 0 to 1 percent slopes.	---	---	---	---	---	---	---	---	---
IIs-6	TmA	Traver loam, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 00	1. 50	1. 75	25	30	35
IIIs-6	TnA	Traver loam, moderately saline-alkali, 0 to 1 percent slopes.	4	5	7	. 75	1. 25	1. 50	---	---	---
IIs-6	TpA	Traver-Chino complex, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 00	1. 50	1. 75	25	30	35
IIIs-6	TrA	Traver-Chino complex, moderately saline-alkali, 0 to 1 percent slopes.	4	5	7	. 75	1. 25	1. 50	---	---	---
IVs-8	TsA	Traver, Fresno, and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes.	4	5	7	. 75	1. 25	1. 50	---	---	---
VIs-8	TtA	Traver, Fresno, and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes.	---	---	---	---	---	---	---	---	---
IVe-3	TuB	Trigo fine sandy loam, 3 to 8 percent slopes	---	---	---	---	---	---	---	---	---
IVe-3	TuC	Trigo fine sandy loam, 8 to 15 percent slopes	---	---	---	---	---	---	---	---	---
IVe-3	TvB	Trigo-Cometa sandy loams, 3 to 8 percent slopes	---	---	---	---	---	---	---	---	---
IIIe-4	TwA	Tujunga loamy sand, 0 to 3 percent slopes	4	5	7	1. 25	1. 50	1. 75	---	---	---
IIIe-4	TwB	Tujunga loamy sand, 3 to 8 percent slopes	---	---	---	---	---	---	---	---	---
IIIe-4	TxA	Tujunga loamy sand, moderately deep and deep over hardpan, 0 to 3 percent slopes.	4	6	8	1. 25	1. 50	1. 75	---	---	---
IIIe-4	TzB	Tujunga and Hanford soils, channeled, 0 to 8 percent slopes.	---	---	---	---	---	---	---	---	---
IIIe-4	TyA	Tujunga loamy sand, moderately deep and deep over silt, 0 to 3 percent slopes.	4	6	8	1. 25	1. 50	1. 75	---	---	---
I-1	VaA	Visalia fine sandy loam, 0 to 1 percent slopes	8	10	12	1. 75	2. 25	3. 00	30	50	65
I-1	VdA	Visalia sandy loam, 0 to 3 percent slopes	7	9	11	1. 50	2. 00	2. 75	25	45	60
IIIe-4	VnA	Visalia sandy loam, moderately deep over sand, 0 to 3 percent slopes.	4	6	8	1. 00	1. 50	1. 75	15	25	35
IIIe-1	VsB	Vista-Sesame complex, 3 to 8 percent slopes	---	---	---	---	---	---	---	---	---
VIIe-3	WaB	Whiterock rocky fine sandy loam, 3 to 8 percent slopes.	---	---	---	---	---	---	---	---	---
VIIe-3	WaE	Whiterock rocky fine sandy loam, 30 to 45 percent slopes.	---	---	---	---	---	---	---	---	---
VIIe-3	WbD	Whiterock very rocky fine sandy loam, 8 to 30 percent slopes.	---	---	---	---	---	---	---	---	---
IIIe-1	WfB	Whitney fine sandy loam, 3 to 8 percent slopes	---	---	---	---	---	---	---	---	---
IVe-1	WfC	Whitney fine sandy loam, 8 to 15 percent slopes	---	---	---	---	---	---	---	---	---

crops under three levels of management—Continued

Irrigated crops—continued																					Dryland crops					
Corn (grain) (100 lb./acre)			Corn (silage) (Tons/acre)			Barley (grain) (100 lb./acre)			Sugar beets (Tons/acre)			Potatoes (100 lb./acre)			Grapes (Tons/acre)			Pasture (Lb. beef/acre/yr.)			Dryfarmed barley (100 lb./acre)			Dryland range (Lb. beef/acre/yr.)		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
																		250	500	650						20
																		250	500	650						20
																										10
20	30	40	10	15	20	15	20	25							1.5	2.0	2.5	350	600	800	10	12	14		30	200
																		250	500	600	9	11	12		25	150
																					10	12	14		25	150
																					10	12	14		25	170
																									20	150
																					10	12	14		25	180
																					9	11	13		20	150
																									15	120
40	50	60	20	25	30	25	35	45	18	23	26							350	600	800						40
40	50	60	20	25	30	25	35	45	18	23	26							350	600	800						40
30	40	50	15	20	25	20	30	40	14	18	22							300	550	750						40
30	40	50	15	20	25	20	30	40	14	18	22							300	550	750						35
30	40	50	15	20	25	20	30	40	14	18	22							300	550	750						35
																								<5		
																								25	50	100
																								10	20	50
																								25	50	100
																										10
20	30	40	10	15	20	20	25	30	15	18	22							300	550	750						20
						15	20	25										200	400	600						15
20	30	40	10	15	20	20	25	30	15	18	22							300	550	750						25
						15	20	25										250	500	700						20
						15	20	25										200	400	600						15
																										10
																					6	8	10		15	80
																					5	6	8		10	50
																					6	8	10		20	120
20	30	40	10	15	20	12	20	25				125	150	200	.5	1.0	1.5	200	300	400						10
20	35	45	10	18	23	12	20	25				125	150	200	.5	1.0	1.5	200	300	400						15
																										10
20	35	45	10	18	23	12	20	25				125	150	200	.5	1.0	1.5	200	300	400						15
40	60	80	20	30	40	25	35	45	20	25	30	250	300	400	2.0	3.0	3.5	350	600	800						35
35	55	75	18	28	38	22	32	42	19	24	28	225	275	350	1.5	2.5	3.0	300	550	750						30
25	40	55	12	20	28	13	22	30	12	15	20	150	200	250	1.0	1.5	2.0	250	450	650						20
																								50	120	200
																								5	10	15
																								<5		
																								<5		
																					10	12	14		25	180
																					8	10	12		20	150

587105—62——7

TABLE 3.—*Estimated average acre yields of principal*

Capability unit	Map symbol	Soil	Irrigated crops: Alfalfa (Tons/acre) A	Alfalfa B	Alfalfa C	Cotton (Bales/acre) A	Cotton B	Cotton C	Sorghum (grain) (100 lb./acre) A	Sorghum B	Sorghum C
IIIe-1	WmA	Whitney loam, 0 to 3 percent slopes	------	------	------	------	------	------	------	------	------
IIIe-1	WmB	Whitney loam, 3 to 8 percent slopes	------	------	------	------	------	------	------	------	------
IVe-1	WmC	Whitney loam, 8 to 15 percent slopes	------	------	------	------	------	------	------	------	------
VIe-4	WnD	Whitney sandy loam, 15 to 30 percent slopes, eroded.	------	------	------	------	------	------	------	------	------
IIIe-1	WtB	Whitney-Trigo fine sandy loams, 3 to 8 percent slopes.	------	------	------	------	------	------	------	------	------
IIIe-1	WrB	Whitney and Rocklin sandy loams, 3 to 8 percent slopes.	------	------	------	------	------	------	------	------	------
IVe-1	WrC	Whitney and Rocklin sandy loams, 8 to 15 percent slopes.	------	------	------	------	------	------	------	------	------
IVe-1	WoC	Whitney and Rocklin gravelly sandy loams, 3 to 15 percent slopes.	------	------	------	------	------	------	------	------	------
IVs-6	WxA	Wunjey very fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes.	------	------	------	------	------	------	------	------	------
IIIs-6	WvA	Wunjey very fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes.	4	6	8	1. 25	1. 75	2. 00	15	30	40
IIs-6	WuA	Wunjey very fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.	5	7	9	1. 50	2. 00	2. 50	20	40	55
IVs-6	WyB	Wunjey very fine sandy loam, strongly saline-alkali, channeled, 1 to 8 percent slopes.	------	------	------	------	------	------	------	------	------
IIIs-5	ZaB	Zaca clay, 3 to 8 percent slopes	------	------	------	------	------	------	------	------	------

crops under three levels of management—Continued

Irrigated crops—continued																					Dryland crops					
Corn (grain) (100 lb./acre)			Corn (silage) (Tons/acre)			Barley (grain) (100 lb./acre)			Sugar beets (Tons/acre)			Potatoes (100 lb./acre)			Grapes (Tons/acre)			Pasture (Lb. beef/acre/yr.)			Dryfarmed barley (100 lb./acre)			Dryland range (Lb. beef/acre/yr.)		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11	13	15	--	30	200
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	12	14	--	25	180
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8	10	12	--	20	150
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15	120
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	11	13	--	20	150
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	12	14	--	25	170
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8	10	12	--	20	150
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	11	13	--	20	150
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10
20	30	40	10	15	20	15	20	25	--	--	--	--	--	--	--	--	--	200	400	600	--	--	--	--	--	15
30	40	50	15	20	25	20	25	30	14	18	22	--	--	--	--	--	--	300	550	750	--	--	--	--	--	20
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TABLE 4.—*Irrigated alfalfa*

1.—Capability units I–1, IIw–7, IIs–3, IIs–6, IIs–7, IIIs–3, IIIs–6, IIIs–8, and IVs–3

Practice	Management level		
	A	B	C
Rotation	Alfalfa, alfalfa, alfalfa, cotton, cotton, and sorghum, corn, or black-eye beans.	Alfalfa, alfalfa, alfalfa, cotton, cotton, and sorghum, corn, or black-eye beans.	Alfalfa, alfalfa, alfalfa, cotton, cotton, and sorghum, corn or black-eye beans.
Seedbed preparation	Shallow. Rotary-chop cotton stalks, disk, plow, disk, border, disk and harrow between borders, ringroll parallel to borders to cover seed.	Deep. Disk crop residues, chisel to depth of 14 to 16 inches, disk, border, disk and harrow between borders, apply 30 pounds nitrogen on nonleguminous crop residues, ringroll at right angles to borders to cover seed.	Deep. Disk crop residues, chisel to depth of 14 to 16 inches, disk, border, disk and harrow between borders, apply 30 pounds nitrogen on nonleguminous crop residues, ringroll at right angles to borders to cover seed. Land plane when necessary before bordering.
Fertilization	None.	200 pounds superphosphate (40 pounds P_2O_5 and 18 pounds sulfur) per acre per year, broadcast each winter.	400 pounds superphosphate (80 pounds P_2O_5 and 36 pounds sulfur) per acre per year, broadcast each winter.
Seeding:			
Variety	Lahontan.	Lahontan.	Lahontan.
Rate	25 pounds per acre, broadcast.	25 pounds per acre, broadcast.	25 pounds per acre, broadcast.
Date	Oct. 1 to March 1.	Oct. 1 to April 1.	Oct. 1 to April 1.
Irrigation:			
Method	Flood in checks.	Flood in checks; pre-irrigate if necessary.	Flood in checks; pre-irrigate if necessary.
Schedule	Early May to mid-October, 13 irrigations, usually every 10 days between cuttings and after final cutting, 4 inches per irrigation.	Early May to mid-October, 10 irrigations, usually every 15 days between cuttings and after final cutting, 4 inches per irrigation.	Early May to mid-October, 10 irrigations, usually every 15 days between cuttings and after final cutting, 4 inches per irrigation.
Amount of water	4.5 acre-feet.	3.5 acre-feet.	3.5 acre-feet.
Cutting schedule	6 cuttings, beginning early in May and ending in the middle of October.	6 cuttings, beginning early in May and ending in the middle of October.	6 cuttings, beginning early in May and ending in the middle of October.
Cutting state	0.1 bloom.	0.1 bloom.	0.1 bloom.
Insect control	5 or 6 sprayings, usually at rate of 1 or 2 per cutting, from July through September, for spotted alfalfa aphid.	5 or 6 sprayings, usually at rate of 1 or 2 per cutting, from July through September, for spotted alfalfa aphid; spray for alfalfa butterfly as necessary.	5 or 6 sprayings, usually at rate of 1 or 2 per cutting, from July through September, for spotted alfalfa aphid; spray for alfalfa butterfly as necessary.
Nematode control	None.	None.	None (some residual benefits from treatment for cotton).
Drainage	None. Water pools at end of check, killing from 100 to 400 feet of stand. Grade not uniform to ends of checks.	Excess water at end of check removed by drains or pumped back into system for recirculation. Grade not uniform to drains.	Excess water at end of check removed by drains or pumped back into system for recirculation. Grade uniform to drains.

2.—Capability unit IIe–1

Conservation practices	Contour application of irrigation water (or irrigation by sprinkler).	Contour application of irrigation water (or irrigation by sprinkler).	Contour application of irrigation water (or irrigation by sprinkler).
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

TABLE 4.—*Irrigated alfalfa*—Continued

3.—Capability units IIe–4, IIIe–4, IVe–4, and IVs–4

Practice	Management level		
	A	B	C
Rotation	Alfalfa, alfalfa, alfalfa, cotton, and sorghum, corn, or barley.	Alfalfa, alfalfa, alfalfa, cotton, and sorghum, corn, or barley.	Alfalfa, alfalfa, alfalfa, cotton, and sorghum, corn, or barley.
Irrigation schedule	Early May to mid-October, 18 irrigations, 3 inches per irrigation, usually every 7 or 8 days, between cuttings and after final cutting.	Early May to mid-October, 14 irrigations, 3 inches per irrigation, usually every 10 days, between cuttings and after final cutting.	Early May to mid-October, 14 irrigations, 3 inches per irrigation, usually every 10 days between cuttings and after final cutting.
Conservation practices	Limit irrigation runs to 600 feet on 0 to 3 percent slopes: sprinkler irrigation on 3 to 8 percent slopes.	Limit irrigation runs to 600 feet on 0 to 3 percent slopes: sprinkler irrigation on 3 to 8 percent slopes.	Limit irrigation runs to 600 feet on 0 to 3 percent slopes; sprinkler irrigation on 3 to 8 percent slopes.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

4.—Capability unit IIw–2

Conservation practices	None.	Open drains, as needed, to control high water table.	Open drains, as needed, to control high water table.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

5.—Capability units IVw–6, IVs–6, IVs–8, VIs–6, and VIs–8

Alluvial-fan and basin soils poorly suited to or unsuited to alfalfa because of moderate to strong concentrations of salts or alkali or both.

6.—Capability units IIIe–1, IIIw–5, IIIs–5, IVe–1, IVe–3, VIe–1, VIe–4, VIIe–1, VIIe–3, VIIe–4, VIIe–9, and VIIIs–1

Terrace and upland soils poorly suited to or unsuited to alfalfa because of slope, restricted rooting depth, stones or rocks, lack of irrigation water, or other reasons.

TABLE 5.—*Irrigated cotton*

1.—Capability units I-1, IIw-7, IIs-3, IIs-6, IIs-7, IIIs-3, IIIs-6, IIIs-8, and IVs-3

Practice	Management level		
	A	B	C
Rotation	Alfalfa, alfalfa, alfalfa, cotton, cotton, and sorghum, corn, or black-eye beans.	Alfalfa, alfalfa, alfalfa, cotton, cotton, and sorghum, corn, or black-eye beans.	Alfalfa, alfalfa, alfalfa, cotton, cotton, and sorghum, corn, or black-eye beans.
Seedbed	Flat. Seed planted in slight depressions.	Furrowed out (before pre-irrigation). Plant on top of bed.	Furrowed out (before pre-irrigation). Plant on top of bed.
Seedbed preparation	Shallow. First year: disk, plow, disk twice to maximum depth of 9 inches. Second year: rotary chop cotton stalks, disk, plow, disk twice to maximum depth of 9 inches.	Deep. First year: disk, plow, disk twice. Second year: disk, chisel to depth of 14 to 16 inches, disk twice.	Deep. First year: disk, plow, disk twice. Second year: disk, chisel to depth of 14 to 16 inches, disk twice.
Fertilization	First year after alfalfa: none. Second year: 40 pounds nitrogen at planting, 6 or 7 inches to side of seed; or apply before first irrigation.	First year after alfalfa: none. Second year: 40 to 80 pounds nitrogen, 6 or 7 inches to side of seed; or apply before first irrigation.	First year after alfalfa: none. Second year: 80 to 100 pounds nitrogen, 6 or 7 inches to side of seed; or apply before first irrigation.
Seeding:			
Variety	Acala 4-42 (green tag).	Acala 4-42 (green tag).	Acala 4-42 (green tag).
Kind of seed	Regular (mechanically delinted).	Regular (mechanically delinted).	Regular (mechanically delinted).
Rate	30 pounds (drilled).	20 pounds (drilled) for hand chop; 30 pounds for mechanical chop.	20 pounds (drilled) for hand chop; 30 pounds for mechanical chop.
Date	April 1 to April 15.	April 15 (optimum).	April 15 (optimum).
Density	38 to 40 inches between rows; 6 to 12 inches between plants.	38 to 40 inches between rows; 4 to 8 inches between plants.	38 to 40 inches between rows; 3 to 6 inches between plants.
Cultivation:			
Chop	Mechanically or by hand at 4-6 leaf stage; thin stand to between 15,000 and 30,000 plants per acre.	Mechanically or by hand at 4-6 leaf stage; thin stand to between 20,000 and 40,000 plants per acre.	Mechanically or by hand at 4-6 leaf stage; very little need to chop; thin to between 30,000 and 60,000 plants per acre.
Mechanical	6 times between the time the plants are first visible and the time they become too tall (about July 15).	4 times between the time the plants are first visible and the time they become too tall (about July 15).	4 times, including once late in the season (about July 31) with high-clearance equipment.
Row profile	Cultivation shovels do not bring furrow to point; efficiency of machine harvesting reduced.	Furrow brought to point by use of broad shovels and rod attachments; row nematode fumigation possible; labor and equipment costs reduced.	Furrow brought to point by use of broad shovels and rod attachments; row nematode fumigation possible; chemical weed control possible; labor and equipment costs reduced.
Irrigation:			
Pre-irrigation	Shallow (to depth of 2 to 3 feet) any time up to April 1.	Deep (to depth of 3 to 5 feet) any time up to April 1.	Deep (to minimum depth of 5 feet) any time up to April 1.
Regular	June 1: 2 or 3 inches. June 1 to Aug. 30: 9 irrigations, 3 inches per irrigation, every 8 to 10 days. Sept. 1 to Oct. 1: 1 or 2 irrigations if unseasonably warm.	June 1: 2 or 3 inches. June 1 to Aug. 30: 9 irrigations, 3 inches per irrigation, every 8 to 10 days.	June 15: 2 or 3 inches. By Aug. 30: 6 irrigations, 4 inches per irrigation, at intervals of more than 10 days.
Amount	36 inches.	38 to 40 inches.	38 to 40 inches.
Insect control	1 dusting for bollworms and lygus bugs in July or August; 1 dusting for spider mites.	1 dusting for bollworms and lygus bugs in July or August; 1 dusting for spider mites. Or, dusting on recommendation of farm advisory groups.	Weekly inspection, and application of appropriate controls as needed.
Nematode control	None.	None.	As needed, up to 1 week prior to planting.

TABLE 5.—*Irrigated cotton*—Continued

Practice	Management level		
	A	B	C
Harvest:			
Defoliation	Generally too early for proper effect; grade usually lowered; advice generally needed as to proper timing.	Generally effectively done; grade not lowered; advice needed as to timing.	Generally properly and effectively done; limited assistance needed on occasion.
Picking:			
First	October 1 to Nov. 15; generally by hand; lower bolls mostly.	Oct. 1 to Nov. 15; generally by machine; greater speed generally compensates for field loss and lowering of grade.	Oct. 1 to Nov. 15; generally by machine; field loss and lowering of grade minimized by better knowledge of machine operation.
Second	Nov. 15 to March 1, generally by hand.	Nov. 15 to Feb. 1, generally by machine.	Nov. 15 to Feb. 1, generally by machine.
2.—Capability unit IIe-1			
Conservation practices	Contour planting; contour or sprinkler irrigation.	Contour planting; contour or sprinkler irrigation.	Contour planting; contour or sprinkler irrigation.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.
3.—Capability units IIe-4, IIIe-4, IVe-4, and IVs-4			
Rotation	Alfalfa, alfalfa, alfalfa, cotton, and sorghum, corn, or barley.	Alfalfa, alfalfa, alfalfa, cotton, and sorghum, corn, or barley.	Alfalfa, alfalfa, alfalfa, cotton, and sorghum, corn, or barley.
Irrigation:			
Regular	June 1: 2 to 3 inches. June 1 to Aug. 30: 12 irrigations, 3 inches per irrigation, every 7 days. Sept. 1 to Oct. 1: 1 or 2 irrigations if unseasonably warm.	June 1: 2 to 3 inches. June 1 to Aug. 30: 12 irrigations, 3 inches per irrigation, every 7 days.	June 1: 2 to 3 inches. June 1 to Aug. 30: 12 irrigations, 3 inches per irrigation, every 7 days.
Fertilization	60 pounds nitrogen.	60 to 100 pounds nitrogen: 30 to 50 pounds at planting, 30 to 50 pounds by July 1.	100 to 120 pounds nitrogen: 50 to 60 pounds at planting, 50 to 60 pounds by July 1.
Conservation practices	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; sprinkler irrigation on 3 to 8 percent slopes.	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; sprinkler irrigation on 3 to 8 percent slopes.	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; sprinkler irrigation on 3 to 8 percent slopes.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.
4.—Capability unit IIw-2			
Conservation practices	None.	Open drains, as needed, to control high water table.	Open drains, as needed, to control high water table.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.
5.—Capability units IVw-6, IVs-6, IVs-8, VIs-6, and VIs-8			
Alluvial-fan and basin soils not suited to cotton because of moderate to strong concentrations of salts or alkali or both.			
6.—Capability units IIIe-1, IIIw-5, IIIs-5, IVe-1, IVe-3, VIe-1, VIe-4, VIIe-1, VIIe-3, VIIe-4, VIIe-9, and VIIIs-1			
Terrace and upland soils poorly suited to or unsuited to cotton because of slope, shallow root zone, stones or rocks, lack of irrigation water, or other reasons.			

TABLE 6.—*Irrigated sorghum for grain*

1.—Capability units I-1, IIw-7, IIs-3, IIs-6, IIs-7, IIIs-3, IIIs-6, IIIs-8, and IVs-3

Practice	Management level		
	A	B	C
Rotation	Alfalfa, alfalfa, alfalfa, cotton, cotton, sorghum.	Alfalfa, alfalfa, alfalfa, cotton, cotton, sorghum.	Alfalfa, alfalfa, alfalfa, cotton, cotton, sorghum.
Seedbed	Flat. Plant in slight depressions.	Flat. Plant in slight depressions.	Flat. Plant in slight depressions.
Seedbed preparation	Shallow. Disk crop residues, plow, disk twice to maximum depth of 9 inches.	Deep. Disk crop residues, chisel to depth of 14 to 16 inches, disk twice.	Deep. Disk crop residues, chisel to depth of 14 to 16 inches, disk twice.
Fertilization	None.	40 pounds nitrogen, 6 inches to side of seed at planting; or applied before first irrigation.	100 to 120 pounds nitrogen, 6 inches to side of seed at planting; or applied before first irrigation.
Seeding:			
Variety	Double dwarf 38.	Double dwarf 38.	Double dwarf 38.
Rate	4 to 6 pounds per acre.	4 to 6 pounds per acre.	4 to 6 pounds per acre.
Date	April 1, or as soon thereafter as possible.	April 1 to May 15.	April 1 to May 15.
Density	36 to 40 inches between rows, 2 to 3 inches between plants. 50,000 to 80,000 plants per acre.	30 to 40 inches between rows, 2 to 3 inches between plants. 50,000 to 80,000 plants per acre.	30 to 40 inches between rows, 2 to 3 inches between plants. 50,000 to 80,000 plants per acre.
Cultivation, mechanical	3 times.	3 times.	3 times.
Irrigation:			
Pre-irrigation	Shallow, (to depth of 2 to 3 feet) any time up to March 15, or 2 weeks before planting.	Deep (to depth of 3 to 5 feet) any time up to March 15, or 2 weeks before planting.	Deep (to depth of 3 to 5 feet) any time up to March 15, or 2 weeks before planting.
Regular	Early in June, 3 times in July, once in August, total 5 times; 4 inches per irrigation.	Early in June, 3 times in July, once in August, total 5 times; 4 inches per irrigation.	Early in June, 3 times in July, once in August, total 5 times; 4 inches per irrigation.
Amount	2 acre-feet.	2 acre-feet.	2 acre-feet.
Insect control	None.	Aphid control if bad infestation.	Aphid control if bad infestation.
Nematode control	None.	None.	None.
Harvest	By combine, as early as possible, about Sept. 15, at about 15 percent moisture.	By combine, as early as possible, about Sept. 15, at about 15 percent moisture.	By combine, as early as possible, about Sept. 15, at about 15 percent moisture.

2.—Capability unit IIe-1

Conservation practices	Contour planting and contour irrigation.	Contour planting and contour irrigation.	Contour planting and contour irrigation.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

TABLE 6.—*Irrigated sorghum for grain*—Continued

3.—Capability units IIe-4, IIIe-4, IVe-4, and IVs-4

Practice	Management level		
	A	B	C
Rotation	Alfalfa, alfalfa, alfalfa, cotton, sorghum.	Alfalfa, alfalfa, alfalfa, cotton, sorghum.	Alfalfa, alfalfa, alfalfa, cotton, sorghum.
Fertilization	None.	40 pounds nitrogen: 20 pounds at planting, 6 inches to side, or before first irrigation; 20 pounds by July 1.	100 to 120 pounds nitrogen: 50 to 60 pounds at planting, 6 inches to side, or before first irrigation; 50 to 60 pounds by July 1.
Irrigation:			
Regular	Smaller and more frequent applications: 7 times, 3 inches per irrigation.	Smaller and more frequent applications: 7 times, 3 inches per irrigation.	Smaller and more frequent applications: 7 times, 3 inches per irrigation.
Conservation practices	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; contour application on 3 to 8 percent slopes.	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; contour application on 3 to 8 percent slopes.	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; contour application on 3 to 8 percent slopes.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.
4.—Capability unit IIw-2			
Conservation practices	None.	Open drains, as needed, to control high water table.	Open drains, as needed, to control high water table.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.
5.—Capability units IVw-6, IVs-6, IVs-8, VIs-6, and VIs-8			
Alluvial-fan and basin soils poorly suited to or not suited to sorghum because of moderate to strong concentrations of salts or alkali or both.			
6.—Capability units IIIe-1, IIIw-5, IIIs-5, IVe-1, IVe-3, VIe-1, VIe-4, VIIe-1, VIIe-3, VIIe-4, VIIe-9, and VIIIs-1			
Terrace and upland soils poorly suited to or not suited to sorghum because of slope, shallowness, stones or rocks, lack of irrigation wate, or other reasons.			

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TABLE 7.—*Irrigated corn for grain*

1.—Capability units I–1, IIw–7, IIs–3, IIs–6, IIs–7, IIIs–3, IIIs–6, IIIs–8, and IVs–3

Practice	Management level		
	A	B	C
Rotation	Alfalfa, alfalfa, alfalfa, cotton, cotton, corn.	Alfalfa, alfalfa, alfalfa, cotton, cotton, corn.	Alfalfa, alfalfa, alfalfa, cotton, cotton, corn.
Seedbed	Flat. Plant in slight depressions.	Flat. Plant in slight depressions.	Flat. Plant in slight depressions.
Seedbed preparation	Shallow. Disk crop residues, plow, disk twice to maximum depth of 9 inches.	Deep. Disk crop residues, chisel to depth of 14 to 16 inches, disk twice.	Deep. Disk crop residues, chisel to depth of 14 to 16 inches, disk twice.
Fertilization	80 pounds nitrogen at planting, 4 to 5 inches to side of seed; or applied before first irrigation.	120 pounds nitrogen at planting, 4 to 5 inches to side of seed; or applied before first irrigation.	150 pounds nitrogen at planting, 4 to 5 inches to side of seed; or applied before first irrigation.
Seeding:			
Variety	An adapted hybrid.	An adapted hybrid.	An adapted hybrid.
Rate	8 to 10 pounds per acre.	8 to 10 pounds per acre.	8 to 10 pounds per acre.
Date	April 1 or as soon thereafter as possible.	April 1 to May 15.	April 1 to May 15.
Density	36 to 40 inches between rows, 8 to 12 inches between plants, 13,000 to 20,000 plants per acre.	36 to 40 inches between rows, 8 to 12 inches between plants, 13,000 to 20,000 plants per acre.	36 to 40 inches between rows, 6 to 8 inches between plants, 20,000 to 26,000 plants per acre.
Cultivation, mechanical	3 times.	3 times.	3 times.
Irrigation:			
Pre-irrigation	Shallow (to depth of 2 to 3 feet) any time up to 2 weeks before planting.	Deep (to depth of 3 to 5 feet) any time up to 2 weeks before planting.	Deep (to depth of 3 to 5 feet) any time up to 2 weeks before planting.
Regular	May 15 to Sept. 1, at 10-day intervals, 10 irrigations, 4 inches per irrigation.	May 15 to Sept. 1, at 10-day intervals, 10 irrigations, 4 inches per irrigation. Irrigate more frequently in tasseling and silking period, to complete pollination.	May 15 to Sept. 1, at 10-day intervals, 10 irrigations, 4 inches per irrigation. Irrigate more frequently in tasseling and silking period, to complete pollination.
Amount	3.5 acre-feet.	3.5 acre-feet.	3.5 acre-feet.
Insect and nematode control	None.	None.	None.
Harvest	Harvest by Oct. 1, using cornpicker, and store for shelling. Pick at 25 percent moisture. If using picker-sheller, pick at 15 percent moisture.	Harvest by Oct. 1, using cornpicker, and store for shelling. Pick at 25 percent moisture. If using picker-sheller, pick at 15 percent moisture.	Harvest by Oct. 1, using cornpicker, and store for shelling. Pick at 25 percent moisture. If using picker-sheller, pick at 15 percent moisture.

2.—Capability unit IIe–1

Conservation practices	Contour planting and contour irrigation.	Contour planting and contour irrigation.	Contour planting and contour irrigation.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

TABLE 7.—*Irrigated corn for grain*—Continued

3.—Capability units IIe-4, IIIe-4, IVe-4, and IVs-4

Practice	Management level		
	A	B	C
Rotation	Alfalfa, alfalfa, alfalfa, cotton, corn.	Alfalfa, alfalfa, alfalfa, cotton, corn.	Alfalfa, alfalfa, alfalfa, cotton, corn.
Fertilization	Same as for group 1, above.	120 pounds nitrogen; 60 pounds at planting, 4 to 5 inches to side of seed, or before first irrigation; 60 pounds by July 1.	150 pounds nitrogen; 75 pounds at planting, 4 to 5 inches to side of seed, or before first irrigation; 75 pounds by July 1.
Irrigation:			
Regular	May 15 to Sept. 1, at 7-day intervals, 13 irrigations, 3 inches per irrigation.	May 15 to Sept. 1, at 7-day intervals, 13 irrigations, 3 inches per irrigation. More frequent in tasseling and silking period.	May 15 to Sept. 1, at 7-day intervals, 13 irrigations, 3 inches per irrigation. More frequent in tasseling and silking period.
Conservation practices	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; contour irrigation on 3 to 8 percent slopes.	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; contour irrigation on 3 to 8 percent slopes.	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; contour irrigation on 3 to 8 percent slopes.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

4.—Capability unit IIw-2

Practice	A	B	C
Conservation practices	None.	Open drains, as needed, to control high water table.	Open drains, as needed, to control high water table.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

5.—Capability units IVw-6, IVs-6, IVs-8, VIs-6, and VIs-8

Alluvial-fan and basin soils not suited to corn because of moderate to strong concentrations of salts or alkali or both.

6.—Capability units IIIe-1, IIIw-5, IIIs-5, IVe-1, IVe-3, VIe-1, VIe-4, VIIe-1, VIIe-3, VIIe-4, VIIe-9, and VIIIs-1

Terrace and upland soils poorly suited to or unsuited to corn because of slope, shallowness, rocks or stones, lack of irrigation water, or other reasons.

TABLE 8.—*Irrigated corn for silage*

1.—Capability units I-1, IIw-7, IIs-3, IIs-6, IIs-7, IIIs-3, IIIs-6, IIIs-8, and IVs-3

Practice	Management level		
	A	B	C
Rotation	Irrigated barley, corn. Or, potatoes, corn.	Irrigated barley, corn. Or, potatoes, corn.	Irrigated barley, corn. Or, potatoes, corn.
Seedbed	Flat. Plant in slight depressions.	Flat. Plant in slight depressions.	Flat. Plant in slight depressions.
Seedbed preparation	Shallow. Disk crop residues, plow, disk twice to maximum depth of 9 inches.	Deep. Disk crop residues, chisel to depth of 14 to 16 inches, disk twice.	Deep. Disk crop residues, chisel to depth of 14 to 16 inches, disk twice.
Fertilization	80 pounds nitrogen at planting, 4 to 5 inches to side of seed; or applied before first irrigation.	120 pounds nitrogen at planting, 4 to 5 inches to side of seed; or applied before first irrigation.	150 pounds nitrogen at planting, 4 to 5 inches to side of seed; or applied before first irrigation.
Seeding:			
Variety	Any adapted 90-day hybrid.	Any adapted 90-day hybrid.	Any adapted 90-day hybrid.
Rate	10 to 12 pounds per acre.	10 to 12 pounds per acre.	10 to 12 pounds per acre.
Date	July 1 to 15.	July 1 to 15.	July 1 to 15.
Density	36 to 40 inches between rows, 6 to 8 inches between plants, 20,000 to 26,000 plants per acre.	36 to 40 inches between rows, 6 to 8 inches between plants, 20,000 to 26,000 plants per acre.	36 to 40 inches between rows, 6 to 8 inches between plants, 20,000 to 26,000 plants per acre.
Cultivation	2 times.	2 times.	2 times.
Irrigation:			
Pre-irrigation	Shallow (to depth of 2 to 3 feet) any time up to 2 weeks before planting.	Deep (to depth of 3 to 5 feet) any time up to 2 weeks before planting.	Deep (to depth of 3 to 5 feet) any time up to 2 weeks before planting.
Regular	July 15 to Oct. 1, every 10 days, 7 irrigations, 4 inches per irrigation.	July 15 to Oct. 1, every 10 days, 7 irrigations, 4 inches per irrigation.	July 15 to Oct. 1, every 10 days, 7 irrigations, 4 inches per irrigation.
Amount	2.5 acre-feet.	2.5 acre-feet.	2.5 acre-feet.
Insect and nematode control	None.	None.	None.
Harvest	Field chop when kernels are in late dough or well-dented stage (about Oct. 1), about 65 to 70 percent moisture.	Field chop when kernels are in late dough or well-dented stage (about Oct. 1), about 65 to 70 percent moisture.	Field chop when kernels are in late dough or well-dented stage (about Oct. 1), about 65 to 70 percent moisture.

2.—Capability unit IIe-1

Conservation practices	Planting and irrigating on the contour.	Planting and irrigating on the contour.	Planting and irrigating on the contour.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

TABLE 8.—*Irrigated corn for silage*—Continued

3.—Capability units IIe–4, IIIe–4, IVe–4, and IVs–4

Practice	Management level		
	A	B	C
Rotation	Alfalfa, alfalfa, alfalfa, cotton, corn.	Alfalfa, alfalfa, alfalfa, cotton, corn.	Alfalfa, alfalfa, alfalfa, cotton, corn.
Fertilization	80 pounds nitrogen at planting, 4 to 5 inches to side of seed; or applied before first irrigation.	120 pounds nitrogen: 60 pounds at planting, 4 to 5 inches to side of seed, or applied before first irrigation; and 60 pounds up to Aug. 15.	150 lbs nitrogen: 75 pounds at planting, 4 to 5 inches to side of seed, or applied before first irrigation; and 75 pounds up to Aug. 15.
Irrigation:			
Regular	May 15 to Sept. 1, at 7-day intervals, 13 irrigations, 3 inches per irrigation.	May 15 to Sept. 1, at 7-day intervals, 13 irrigations, 3 inches per irrigation.	May 15 to Sept. 1, at 7-day intervals, 13 irrigations, 3 inches per irrigation.
Conservation practices	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; contour application on 3 to 8 percent slopes.	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; contour application on 3 to 8 percent slopes.	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; contour application on 3 to 8 percent slopes.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.
4.—Capability unit IIw–2			
Conservation practices	None.	Open drains, as needed, to control high water table.	Open drains, as needed, to control high water table.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.
5.—Capability units IVw–6, IVs–6, IVs–8, VIs–6, and VIs–8			
Alluvial-fan and basin soils poorly suited to or unsuited to corn because of moderate to strong concentrations of salts or alkali or both.			
6.—Capability units IIIe–1, IIIw–5, IIIs–5, IVe–1, IVe–3, VIe–1, VIe–4, VIIe–1, VIIe–3, VIIe–4, VIIe–9, and VIIIs–1			
Terrace and upland soils poorly suited to or unsuited to corn because of slope, shallowness, rocks or stones, lack of irrigation water, or other reasons.			

TABLE 9 —*Irrigated barley for grain*

1.—Capability units I–1, IIe–1, IIe–4, IIw–2, IIw–7, IIs–3, IIs–6, IIs–7, IIIe–4, IIIs–3, IIIs–6, IIIs–8, IVe–4, IVs–3, IVs–4 and IVs–8

Practice	Management level		
	A	B	C
Rotation	Barley, corn. Or, barley, blackeye beans.	Barley, corn. Or, barley, blackeye beans.	Barley, corn. Or, barley, blackeye beans.
Seedbed preparation	Disk crop residues, make temporary border, pre-irrigate, remove border, disk and harrow, plant flat.	Disk crop residues, make temporary border, pre-irrigate, remove border, disk and harrow, plant flat.	Disk crop residues, make temporary border, pre-irrigate, remove border, disk and harrow, plant flat.
Fertilization	None.	40 to 80 pounds nitrogen at planting. Less nitrogen is needed after legumes than after other crops.	40 to 80 pounds nitrogen (more following nonlegume and less following a legume) and 20 to 40 pounds P_2O_5 at planting. Less nitrogen is needed after legumes than after other crops.
Seeding:			
Variety	Atlas 46 or Arivat. California Mariout on saline-alkali soils or for late planting.	Atlas 46 or Arivat. California Mariout on saline-alkali soils or for late planting.	Atlas 46 or Arivat. California Mariout on saline-alkali soils or for late planting.
Rate	90 pounds per acre, drilled or broadcast.	90 pounds per acre, drilled.	90 pounds per acre, drilled.
Date	Oct. 15 to Feb. 15.	Nov. 1 to Feb. 1.	Nov. 1 to Feb. 1.
Width rows	6 to 10 inches.	6 to 10 inches.	6 to 10 inches.
Irrigation:			
Preparation	As needed, moisten soil to depth of 2 or 3 feet.	As needed, moisten soil to depth of 2 or 3 feet.	As needed, moisten soil to depth of 2 or 3 feet.
Regular	2 irrigations, 6 inches per irrigation, between March 1 and May 15.	2 irrigations, 6 inches per irrigation, between March 1 and May 15.	2 irrigations, 6 inches per irrigation, between March 1 and May 15.
Amount	18 inches.	18 inches.	18 inches.
Insect and nematode control	None.	None.	None.
Drainage	None.	None.	None.
Harvest	By combine (bulk handling).	By combine (bulk handling).	By combine (bulk handling).

2.—Capability units IVw–6, IVs–6, VIs–6, and VIs–8

Alluvial-fan and basin soils poorly suited to or not suited to irrigated barley because of strong concentrations of salts or alkali or both.

3.—Capability units IIIe–1, IIIw–5, IIIs–5, IVe–1, IVe–3, VIe–1, VIe–4, VIIe–1, VIIe–3, VIIe–4, VIIe–9, and VIIIs–1

Terrace and upland soils poorly suited to or not suited to irrigated barley because of slope, shallowness, rocks, lack of irrigation water, or other reasons.

TABLE 10.—*Irrigated sugar beets*

1.—Capability units I-1, IIw-7, IIs-3, IIs-6, IIs-7, and IIIs-3

Practice	Management level		
	A	B	C
Rotation	Alfalfa, alfalfa, alfalfa, cotton, cotton, sugar beets. Or alfalfa, alfalfa, alfalfa, sugar beets, cotton, cotton.	Alfalfa, alfalfa, alfalfa, cotton, cotton, sugar beets. Or, alfalfa, alfalfa, alfalfa, sugar beets, cotton, cotton.	Alfalfa, alfalfa, alfalfa, cotton, cotton, sugar beets. Or, alfalfa, alfalfa, alfalfa, sugar beets, cotton, cotton.
Seedbed	Furrow out, plant on beds.	Furrow out, plant on beds.	Furrow out, plant on beds.
Seedbed preparation	Shallow. Disk, plow, disk twice to maximum depth of 9 inches.	Deep. Disk, chisel to depth of 14 to 16 inches, disk twice.	Deep. Disk, chisel to depth of 14 to 16 inches, disk twice.
Fertilization	150 pounds nitrogen, following thinning if dry fertilizer is used, prior to planting if liquid or gas is used.	150 pounds nitrogen, following thinning if dry fertilizer is used, prior to planting if liquid or gas is used.	150 pounds nitrogen, following thinning if dry fertilizer is used, prior to planting if liquid or gas is used. Additional nitrogen, either liquid or gas applied in water, according to needs indicated by petiole analysis, any time up to June 15.
Seeding:			
Variety	U.S. #22.	U.S. #22.	U.S. #22.
Amount	5 pounds per acre.	5 pounds per acre.	5 pounds per acre.
Date	March 1.	March 1.	March 1.
Density	East side of area: 1 row per bed, 30 inches between center of beds. West side of area: double rows 14 inches apart in beds, 40 inches between center of beds.	East side of area: 1 row per bed, 30 inches between center of beds. West side of area: double rows 14 inches apart in beds, 40 inches between center of beds.	East side of area: 1 row per bed, 30 inches between center of beds. West side of area: double rows 14 inches apart in beds, 40 inches between center of beds.
Cultivation	First cultivation as soon as plants emerge.	First cultivation as soon as plants emerge. Rotary weeder used to remove weeds from rows.	First cultivation as soon as plants emerge. Rotary weeder used to remove weeds from rows.
Thinning	By hand, 6-inch spacing in row.	Partial or complete mechanical thinning, depending on stand; may be followed by hand thinning.	Partial or complete mechanical thinning, depending on stand; may be followed by hand thinning.
Weeding	Hand hoed, generally twice as needed; 3 mechanical cultivations for weed control and furrowing out.	Hand hoed, generally twice as needed; 3 mechanical cultivations for weed control and furrowing out.	Hand hoed, generally twice as needed; 3 mechanical cultivations for weed control and furrowing out.
Nematode control	None.	As needed.	As needed.
Insect control	None.	None.	None.
Irrigation:			
Regular	May 1 to Aug. 15, 8 to 10 irrigations, 4 inches per irrigation, every 10 days.	May 1 to Aug. 15, 8 to 10 irrigations, 4 inches per irrigation, every 10 days.	May 1 to Aug. 15, 8 to 10 irrigations, 4 inches per irrigation, every 10 days.
Amount water	32 to 40 inches.	32 to 40 inches.	32 to 40 inches.
Harvest	By machine, between Aug. 20 and Oct. 15, as scheduled by factory.	By machine, between Aug. 20 and Oct. 15, as scheduled by factory.	By machine, between Aug. 20 and Oct. 15, as scheduled by factory. (Ideal time is when nitrogen in plant is at minimum and regrowth has just begun.)
Drainage	None; tail water not all removed.	Drains to remove tail water.	Drains to remove tail water.

TABLE 10.—*Irrigated sugar beets*—Continued

2.—Capability unit IIw-2

Practice	Management level		
	A	B	C
Conservation practices	None.	Open drains, as needed, to control high water table.	Open drains, as needed, to control high water table.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

3.—Capability units IIe-1, IIe-4, IIIe-4, IIIs-6, IIIs-8, IVe-4, IVw-6, IVs-4, IVs-6, IVs-8, VIs-6, and VIs-8

Alluvial-fan and basin soils poorly suited to or not suited to sugar beets because of slope, coarse texture, or moderate to strong concentration of salts or alkali or both.

4.—Capability units IIIe-1, IIIw-5, IIIs-5, IVe-1, IVe-3, IVs-3, VIe-1, VIe-4, VIIe-1, VIIe-3, VIIe-4, VIIe-9, and VIIIs-1

Terrace and upland soils poorly suited to or not suited to sugar beets because of slope, shallowness, stones or rocks, lack of irrigation water, or other reasons.

TABLE 11.—*Irrigated potatoes*

1.—Capability units I-1, IIs-3, and IIIs-3

Practice	Management level		
	A	B	C
Rotation	Alfalfa, alfalfa, alfalfa, potatoes, cotton, cotton, potatoes.	Alfalfa, alfalfa, alfalfa, potatoes, cotton, cotton, potatoes,	Alfalfa, alfalfa, alfalfa, potatoes, cotton, cotton, potatoes.
Seedbed	Prepared flat; seed placed near ground level and covered by disk hillers.	Prepared flat; seed placed near ground level and covered by disk hillers.	Prepared flat; seed placed near ground level and covered by disk hillers.
Seedbed preparation	Disk, chisel to depth of 14 to 16 inches, disk twice.	Disk, chisel to depth of 14 to 16 inches, disk twice.	Disk, chisel to depth of 14 to 16 inches, disk twice.
Fertilization	100 to 150 pounds nitrogen and 100 pounds P_2O_5 at planting.	100 to 150 pounds nitrogen and 100 pounds P_2O_5 at planting.	100 to 150 pounds nitrogen and 100 pounds P_2O_5 at planting. Potash as indicated by results of soil and petiole analysis, usually up to 200 pounds K_2O.
Seeding:			
Variety	White Rose.	White Rose.	White Rose.
Rate	15 to 20 sacks per acre.	15 to 20 sacks per acre.	15 to 20 sacks per acre.
Date	Feb. 15 to March 30.	Feb. 15 to March 30.	Feb. 15 to March 30.
Density	32 inches between rows, 6 inches between plants.	32 inches between rows, 6 inches between plants.	32 inches between rows, 6 inches between plants.
Cultivation	3 times for weed control, usually by end of May.	3 times for weed control, usually by end of May.	3 times for weed control, usually by end of May.

TABLE 11.—*Irrigated potatoes*—Continued

Practice	Management level A	Management level B	Management level C
Irrigation:			
Regular	Soil kept moist to depth of 2 or 3 feet by frequent, light applications.	Soil kept moist to depth of 2 or 3 feet by frequent, light applications. Trickle irrigation in warm weather, every other row every other day.	Soil kept moist to depth of 2 or 3 feet by frequent, light applications. Trickle irrigation in warm weather, every other row every other day.
Amount	3 acre-feet.	3 acre-feet.	3 acre-feet.
Insect control	None.	None.	None.
Nematode control	None.	Fumigation for nematodes and wireworms.	Fumigation for nematodes and wireworms.
Disease control	Treat seed.	Treat seed.	Treat seed.
Drainage	None; water pools at end of rows.	Excess tail water removed by surface drains.	Excess tail water removed by surface drains.
Harvest	June 25 to July 15. Machine digging, hand pickup for washing and grading.	June 25 to July 15. Machine digging, hand pickup for washing and grading.	June 25 to July 15. Machine digging and pickup.
2.—Capability units IIe–4, IIIe–4, and IVe–4			
Rotation	Alfalfa, alfalfa, alfalfa, potatoes, cotton.	Alfalfa, alfalfa, alfalfa, potatoes, cotton.	Alfalfa, alfalfa, alfalfa, potatoes, cotton.
Fertilization	Same as for group 1, above.	50 to 75 pounds nitrogen and 50 pounds P_2O_5 at planting; 50 to 75 pounds nitrogen by May 1.	50 to 75 pounds nitrogen and 50 pounds P_2O_5 at planting; 50 to 75 pounds nitrogen by May 1. 50 to 100 pounds potash in row with each application, as needed.
Conservation practices	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; sprinkler application on 3 to 8 percent slopes.	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; sprinkler irrigation on 3 to 8 percent slopes.	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; sprinkler irrigation on 3 to 8 percent slopes.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.
3.—Capability units IIe–1, IIw–2, IIw–7, IIs–6, IIs–7, IIIs–6, IIIs–8, IVw–6, IVs–4, IVs–6, IVs–8, VIs–6, and VIs–8			
Recent alluvial-fan, flood-plain, and basin soils poorly suited to or not suited to potatoes because of wetness, slopes, or slight to strong concentrations of salts or alkali or both.			
4.—Capability units IIIe–1, IIIw–5, IIIs–5, IVe–1, IVe–3, IVs–3, VIe–1, VIe–4, VIIe–1, VIIe–3, VIIe–4, VIIe–9, and VIIIs–1			
Terrace and upland soils very poorly suited to or not suited to potatoes because of slope, shallowness, rocks or stones, lack of irrigation water, or other reasons.			

TABLE 12.—*Grapes*

1.—Capability units I-1, IIs-3, IIs-6, IIs-7, and IIIs-3

Practice	Management level A	Management level B	Management level C
Variety	Thompson seedless (for raisins).	Thompson seedless (for raisins).	Thompson seedless (for raisins).
Fertilization	None.	None.	None.
Cover crop	Volunteer grass, weeds, or both.	Vetch and barley, or volunteer cover of grass and weeds.	Vetch and barley, or volunteer cover of grass and weeds; legumes predominant.
Manure	None.	None.	None.
Prunings	Shredded and disked into soil.	Shredded and disked into soil.	Shredded and disked into soil.
Cultivation	6 times, once after each irrigation.	6 times, once after each irrigation.	3 times, after every other irrigation (just frequently enough to prevent seeding of annual weeds).
Irrigation: Regular	6 irrigations, 6 inches per irrigation.	6 irrigations, 6 inches per irrigation, 1 irrigation after harvest.	6 irrigations, 6 inches per irrigation, 1 irrigation after harvest.
Amount	24 to 40 inches.	30 to 40 inches.	30 inches.
Harvest	Aug. 20 to Sept. 15; fruit placed on paper trays to sun-dry for 4 to 6 weeks.	Sept. 1 to 10, starting where fruit is ripest.	Sept. 1 to 10, starting where fruit is ripest.
2.—Capability units IIe-4, IIIe-4, and IVe-4			
Manure	None.	None.	10 to 15 tons barnyard manure, or 5 to 8 tons poultry manure.
Irrigation: Regular	Same as for group 1, above.	8 to 10 irrigations, 4 inches per irrigation.	8 to 10 irrigations, 4 inches per irrigation.
Conservation practices	Runs limited to 600 feet on 0 to 3 percent slopes.	Runs limited to 600 feet on 0 to 3 percent slopes.	Runs limited to 600 feet on 0 to 3 percent slopes.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.
3.—Capability units IIe-1, IIw-2, IIw-7, IIIs-6, IIIs-8, IVw-6, IVs-4, IVs-6, IVs-8, VIs-6, and VIs-8			
More recent alluvial-fan, flood-plain, and basin soils not suited to or rarely planted to grapes, largely because of drainage, slopes, hardpan, or slight to strong concentrations of salts or alkali or both.			
4.—Capability units IIIe-1, IIIw-5, IIIs-5, IVe-1, IVe-3, IVs-3, VIe-1, VIe-4, VIIe-1, VIIe-3, VIIe-4, VIIe-9, and VIIIs-1			
Terrace and upland soils not suited to grapes because of slope, shallowness, rocks or stones, lack of irrigation water, or other reasons.			

TABLE 13.—*Irrigated pasture*

1.—Capability units I-1, IIw-7, IIs-3, IIs-6, IIs-7, IIIs-3, and IIIs-8

Rotations	Management level		
	A	B	C
Seedbed preparation	Shallow. Disk crop residues, plow, disk, float, border, float, disk and harrow between borders, seed, cultipack parallel to borders to cover seed.	Deep. Disk crop residues, chisel to depth of 14 to 16 inches, disk, land plane, border, harrow between borders, float, cultipack at right angles to borders to cover seed.	Deep. Disk crop residues, chisel to depth of 14 to 16 inches, disk, land plane, border, harrow between borders, float, ringroll at right angles to borders to cover seed.
Fertilization	None.	400 pounds ammonium sulfate per acre at planting, broadcast, and 200 pounds each subsequent spring, in February.	1,000 pounds ammonium sulfate per year (⅓ in Sept., ⅓ in Feb., and ⅓ in June); 400 pounds superphosphate every 3 years, broadcast about Nov. 1.
Seeding:			
Mixture and amount	2 pounds alfalfa (Ranger or Buffalo), 1 pound ladino clover, 1 pound narrowleaf trefoil, 4 pounds orchardgrass (Akaroa strain), 4 pounds tall fescue, 2 pounds perennial rye, and 2 pounds annual rye.	2 pounds alfalfa (Ranger or Buffalo) 1 pound ladino clover, 1 pound narrowleaf trefoil, 4 pounds orchardgrass (Akaroa strain), 4 pounds tall fescue, 2 pounds perennial rye, and 2 pounds annual rye.	2 pounds alfalfa (Ranger or Buffalo), 1 pound ladino clover, 1 pound narrowleaf trefoil, 4 pounds orchardgrass (Akaroa strain), 4 pounds tall fescue, 2 pounds perennial rye, and 2 pounds annual rye.
Date	Fall-winter-spring (Oct. 1-April 1).	Fall (Sept. 15-Oct. 30) or winter (Feb. 15 to March 15).	Fall (Sept. 15 to Oct. 15).
Irrigation:			
Method	Flood in checks, pre-irrigate, and irrigate up if necessary.	Flood in checks, pre-irrigate, and irrigate up if necessary.	Flood in checks, pre-irrigate, and irrigate up if necessary.
Schedule	Every 10 days as needed, about May 1 to Oct. 1; 4 inches per irrigation, 15 irrigations.	Every 10 days as needed, about May 1 to Oct. 1; 4 inches per irrigation, 15 irrigations.	Every 10 days as needed, about May 1 to Oct. 1, following dung spreading; 4 inches per irrigation, 15 irrigations.
Amount	5 acre-feet.	5 acre-feet.	5 acre-feet.
Drainage	None; water pools at end of check killing from 100 to 300 feet of stand.	Drains to remove excess water at end of check; water pumped back into system for recirculation.	Drains to remove excess water at end of check; uniform grade to drain in each check; water pumped back into system for recirculation.
Grazing schedule:			
Rotation	2 or 3 fields, grazed 7 to 10 days in rotation; frequently grazed while being irrigated.	4 fields, grazed about 7 days in rotation, 21 days allowed for regrowth, not grazed while being irrigated.	5 permanent fields, each divided in half by an electric fence, 3-day grazing period per plot, 24 days allowed for regrowth; not grazed while being irrigated.
Season	Year round; maximum growth period April 15 to Oct. 1; number of livestock reduced for period Oct. 1 to April 15.	Year round; maximum growth period April 15 to Oct. 1; number of livestock reduced for period Oct. 1 to April 15.	Year round; maximum growth period April 15 to Oct. 1; number of livestock reduced for period Oct. 1 to April 15.
Clippings	None.	1 or 2 times per season.	4 times per season, following grazing period; cut to height of 6 to 8 inches.
Dung management	None.	Spread once per season with spike-tooth harrow or horse-drawn hayrake.	Spread 4 times per year, just before clipping, with spike-tooth harrow or horse-drawn hayrake.

TABLE 13.—*Irrigated pasture*—Continued

2.—Capability units IIIs-6 and IVs-8

Rotations	Management level A	Management level B	Management level C
Seeding: Mixture and amount	2 pounds alfalfa (Ranger), 2 pounds narrowleaf trefoil, 1 pound strawberry clover (Palestine strain), 3 pounds orchardgrass (Akaroa strain), 4 pounds tall fescue, 2 pounds dallisgrass, 2 pounds perennial rye.	2 pounds alfalfa (Ranger), 2 pounds narrowleaf trefoil, 1 pound strawberry clover (Palestine strain), 3 pounds orchardgrass (Akaroa strain), 4 pounds tall fescue, 2 pounds dallisgrass, 2 pounds perennial rye.	2 pounds alfalfa (Ranger), 2 pounds narrowleaf trefoil, 1 pound strawberry clover (Palestine strain), 3 pounds orchardgrass (Akaroa strain), 4 pounds tall fescue, 2 pounds dallisgrass, 2 pounds perennial rye.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

3.—Capability units IVw-6, IVs-6, VIs-6, and VIs-8

Rotations	A	B	C
Seeding: Mixture and amount	2 pounds alfalfa (Ranger), 2 pounds narrowleaf trefoil, 2 pounds strawberry clover (Palestine strain), 2 pounds sweetclover (yellow blossom), 2 pounds orchardgrass (Akaroa strain), 3 pounds tall fescue, 2 pounds dallisgrass, 3 pounds rhodesgrass, 2 pounds perennial rye. Replant spots with 5 pounds sweetclover (yellow blossom), 5 pounds dallisgrass, and 5 pounds rhodesgrass.	2 pounds alfalfa (Ranger), 2 pounds narrowleaf trefoil, 2 pounds strawberry clover (Palestine strain), 2 pounds sweetclover (yellow blossom), 2 pounds orchardgrass (Akaroa strain), 3 pounds tall fescue, 2 pounds dallisgrass, 3 pounds rhodesgrass, 2 pounds perennial rye. Replant spots with 5 pounds sweetclover (yellow blossom), 5 pounds dallisgrass, and 5 pounds rhodesgrass.	2 pounds alfalfa (Ranger), 2 pounds narrowleaf trefoil, 2 pounds strawberry clover (Palestine strain), 2 pounds sweetclover (yellow blossom), 2 pounds orchardgrass (Akaroa strain), 3 pounds tall fescue, 2 pounds dallisgrass, 3 pounds rhodesgrass, 2 pounds perennial rye. Replant spots with 5 pounds sweetclover (yellow blossom), 5 pounds dallisgrass, and 5 pounds rhodesgrass.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

4.—Capability units IIe-4, IIIe-4, IVe-4, IVs-3, and IVs-4

Rotations	A	B	C
Irrigation: Schedule	Every 7 days, 3 inches per irrigation, 20 irrigations during period May 1 to Oct. 1.	Every 7 days, 3 inches per irrigation, 20 irrigations during period May 1 to Oct. 1.	Every 7 days, 3 inches per irrigation, 20 irrigations during period May 1 to Oct. 1.
Conservation practices	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; contour or sprinkler irrigation on 3 to 8 percent slopes.	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; contour or sprinkler irrigation on 3 to 8 percent slopes.	Irrigation runs limited to 600 feet on 0 to 3 percent slopes; contour or sprinkler irrigation on 3 to 8 percent slopes.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

5.—Capability unit IIe-1

Rotations	A	B	C
Conservation practices	Contour or sprinkler irrigation.	Contour or sprinkler irrigation.	Contour or sprinkler irrigation.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

6.—Capability unit IIw-2

Rotations	A	B	C
Conservation practices	None.	Open drains, as needed, to control high water table.	Open drains, as needed, to control high water table.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.

7.—Capability units IIIe-1, IIIw-5, IIIs-5, IVe-1, IVe-3, VIe-1, VIe-4, VIIe-1, VIIe-3, VIIe-4, VIIe-9, and VIIIs-1

Terrace and upland soils poorly suited to or not suited to irrigated pasture because of slope, shallowness, stones or rocks, lack of irrigation water, or other reason.

TABLE 14.—*Dryfarmed barley*

1.—Capability units I-1, IIe-1, IIe-4, IIw-2, IIw-7, IIs-3, IIs-6, IIs-7, IIIe-1, IIIe-4, IIIw-5, IIIs-3, IIIs-5, IIIs-6, IIIs-8, IVe-1, IVe-3, IVe-4, IVs-3, IVs-4, and IVs-8

Practice	Management level		
	A	B	C
Rotation	Summer fallow, barley.	Summer fallow, barley.	Summer fallow, barley.
Seedbed preparation	Shallow. Disk stubble, weeds, and volunteer plants between Feb. 1 and March 31; disk 2 or 3 times for weed control, as needed, until fall.	Deep. Disk stubble in fall, chisel to depth of about 15 inches or deep plow to depth of 10 inches; disk 1 to 3 times for weed control, as needed, until fall.	Deep. Disk stubble in fall, chisel to depth of about 15 inches, or deep plow to depth of 10 inches; disk 1 to 3 times for weed control, as needed, until fall.
Fertilization	None.	None.	200 pounds superphosphate (40 pounds P_2O_5) per acre just before or at seeding. Then, if rainfall is normal or above, (approximately 6 inches) by Feb. 1, fly on 20 pounds nitrogen (nitrate, not ammonia form), or 100 pounds 13-39-0, or 300 pounds 3-16-0.
Seeding:			
Variety	Atlas 46 or Arivat.	Atlas 46 or Arivat.	Atlas 54.
Rate	75 to 90 pounds per acre.	75 to 90 pounds per acre.	45 to 50 pounds per acre.
Date	Oct. 15 to Nov. 15.	Nov. 1 to 20.	Nov. 1 to 20.
Width of rows	6 to 10 inches.	6 to 10 inches.	6 to 10 inches.
Planting	Gravity grain box on Stockton gang plow, with drag or harrow to cover seed.	Gravity grain box on Stockton gang plow, with drag or harrow to cover seed.	Brillion-type seeder.
Weed control	None.	2-4D applied by plane, for wild radish and mustard, as needed; apply before Mar. 15, when grain is 6 to 8 inches high.	2-4D applied by plane, for wild radish and mustard, as needed; apply before March 15, when grain is 6 to 8 inches high. Hand-pull individual plants if too few to spray.
Drainage	None.	None.	Level to remove small irregularities, and fill low spots where water stands.
Harvest	By combine (bulk handling).	By combine (bulk handling).	By combine (bulk handling).

2.—Capability units VIe-1, VIe-4, VIIe-1, VIIe-3, VIIe-4, VIIe-9, and VIIIs-1

Upland soils not suited to dryfarmed barley because of slope, shallowness, stones or rocks, or other reasons.

3.—Capability units IVw-6, IVs-6, VIs-6, and VIs-8

Alluvial-fan and basin soils not suited to dryfarmed barley because of strong concentrations of salts or alkali or both.

TABLE 15.—*Dryland range*

Practice	Management level		
	A	B	C
1.—Capability units IIIe-1, IIIs-5, IVe-1, VIe-1, and VIe-4			
Vegetative cover	Annual grasses and herbs, 1 to 10 percent annual legumes.	Annual grasses and herbs, 1 to 10 percent annual legumes.	Annual grasses and herbs, 1 to 10 percent annual legumes.
Brush removal	None.	By controlled burning, but only partially effective.	By controlled burning, 100 percent effective.
Tree removal: Bull (Digger) pine	None.	Killed with amine 2-4D.	Killed with amine 2-4D; controlled burning when trees have fallen.
Live oak	None.	Burned; sprouts not sprayed.	Trees cut and stumps painted with amine 2-4D.
Blue oak	None.	None.	Thin if more than one-third of surface area is shaded.
Fertilization	None.	400 pounds ammonium sulfate per acre every 2 or 3 years, broadcast by ground equipment.	400 pounds ammonium sulfate every year, broadcast by ground equipment.
Rotation of grazing	None.	Rotated twice each year; each pasture grazed at same time each year.	Rotated and season of grazing varied—early one year, late the next.
2.—Capability units VIIe-1, VIIe-3, VIIe-4, and VIIe-9			
Fertilization	None.	None.	None.
Removal of brush or trees	None.	Same as for group 1, above, if required.	Same as for group 1, above, if required.
All other practices	Same as for group 1, above.	Same as for group 1, above.	Same as for group 1, above.
3.—Capability units IIe-4, IIs-7, IIIw-5, IVe-3, IVe-4, and IVs-3			
Establishment of stand	Not applicable.	Same as for group 1, above.	Plant 10 pounds rose clover, burclover, and crimson clover in barley stubble in fall.
Fertilization	Not applicable.	None.	400 pounds superphosphate per acre every 2 years, and 200 pounds ammonium sulfate every year beginning with 3d year after seeding.
Removal of trees or brush	Not applicable.	None required.	None required.
All other practices	Not applicable.	Same as for group 1, above.	Same as for group 1, above.
4.—Capability unit I-1, IIe-1, IIw-2, IIw-7, IIs-3, IIs-6, IIIe-4, IIIs-3, IIIs-6, IIIs-8, IVw-6, IVs-4, IVs-6, IVs-8, VIs-6, and VIs-8			
Fertilization	Not applicable.	Not applicable.	None.
Rotation of grazing	Not applicable.	Not applicable.	None.
All other practices as required	Not applicable.	Not applicable.	Same as for group 1, above.

Soluble Salts and Alkali

Most soils in areas of low rainfall contain at least small quantities of soluble salts or alkali or both. In some soils these substances are highly concentrated and toxic to plants.

Nature and Amounts of Excess Salts and Alkali

Soluble salts in soils can be traced to several sources. Most of them had their origin in the decomposition of soil minerals and rocks through weathering processes. In humid regions, soluble substances are usually removed from the root zone by percolating rainfall. In arid regions, where the rainfall is low and evaporation is high, soluble salts remain in the root zone and often become a problem. In addition, many low-lying areas receive salt-charged runoff or ground water. The shallow percolation and surface evaporation of such waters usually increases the amount of soluble salts in or on the soils. In areas that have a high water table, water may rise by capillary action and bring dissolved salts with it. Soluble salts dissolve readily in water and may move in solution to any part of the soil profile.

The effect of soluble salts on soils and plants depends upon the amount and composition of the salts present. If the proportion of calcium and magnesium is high and the proportion of sodium is low, the salts do not have a harmful effect on soil structure, and the soils, for the most part, are fairly well aggregated, porous, and permeable. However, large amounts of soluble salts have a direct effect on plant growth. Soluble salts have a strong attraction for water, and plants have difficulty absorbing moisture. Consequently, saline soils need more water than nonsaline soils in order to produce similar yields. If the salt content becomes too high, water may even be withdrawn from plant roots, and the plants will wilt and may die. Some kinds of plants are more sensitive to salinity than others. Varieties and even strains may differ in sensitivity. Plants affected by excess salts usually are stunted and have burned leaf tips. Crops are usually inferior in quality to crops grown on salt-free soils. Strong concentrations of sodium also interfere with the calcium uptake of plants. A soil that contains excess soluble salts is called a *saline* soil.

When the proportion of sodium to calcium and magnesium salts in the soil is high (generally in excess of 50 percent), an exchange of sodium for calcium and magnesium occurs on the surface of the clay particles. Clay that has a high percentage of exchangeable sodium on the surface tends to be dispersed and to swell when wet. Pore space decreases, and consequently permeability and aeration decrease. A soil so affected is often described as "puddled." The particles are packed so closely together that movement of water, air, and plant roots is restricted. Soils that have 15 percent or more of sodium on the surface of the clay particles are usually strongly or very strongly alkaline (reaction pH 8.5 or higher) and are called *alkali* or *sodic* soils.

A soil that contains both excess soluble salts and alkali is described as *saline-alkali*. Depending on the amount of salts and alkali, the effect on plant growth may be severe and reclamation may be especially difficult or expensive.

Considerable variation in amounts of soluble salts and alkali may occur within short distances. Four general classes are recognized; free, slight, moderate, and strong.

Salinity classes represent the percentage of soluble salts on a dry soil weight basis. In the Madera Area, the limits of each class are as follows: Free, less than 0.2 percent; slight, 0.2 to 0.5 percent; moderate, 0.5 to 1.0 percent; and strong, more than 1.0 percent.

Alkali classes are based on relative effect on plant growth, as follows: Free, no significant effect; slight, slight effect; moderate, moderate effect; and strong, severe effect.

Guidelines for Reclamation of Saline and Alkali Soils

Field and laboratory determinations indicate that the concentrations of soluble salts and alkali are greatest in the nearly level soils on the lower alluvial fans and in the basin. Soils of 19 series are affected. Soil conditions vary so much it is not possible to make a general statement about the specific salts each soil contains nor about the practices needed to improve any particular soil. But some general guidelines can be given that should be helpful in dealing with the problem.

The key items to consider in planning a reclamation program are the following:

General soil drainage.—Adequate drainage is required to remove excess salts from the soil. Whatever the other conditions may be, improvement is likely only to that depth in the soil for which adequate drainage can be provided. The better the natural drainage, the more readily excess salts can be removed. If drainage is not adequate and no measures are taken to improve it, little change is likely.

Rate of internal drainage.—Many factors affect downward movement of water through the soil: texture, density, porosity, structure, and whether or not the soil shrinks and swells a good deal upon wetting and drying. The more rapid the rate of internal drainage, the more quickly excess salts can be removed and the sooner improvement can be obtained.

The presence or absence of restricting subsoil and substratum layers.—Uniform soils that have favorable drainage can generally be readily reclaimed. Dense, slowly permeable, fine textured, and, in places, cemented subsoil and substratum materials are common in the soils of the Madera Area. They make these soils extremely difficult to improve. Until something is done about these underlying materials, there are definite limits to the depth to which salts can be moved.

Amount of excess salts and alkali in the soil.—If general and internal drainage are adequate or are artificially improved, even severely affected soils can be readily improved by deep wetting alone. About all that is required in such cases is basin ponding of the surface soil and providing the necessary water.

Removing salts from soils that have restricting subsoil and substratum layers is by no means so easy, and improvement is usually confined to the upper soil layers.

Removing excess alkali is much more difficult and expensive than removing excess salts. A chemical change must take place in the soil. This is usually brought about by applying gypsum (calcium sulfate). A soil test will show how much gypsum to use. Upon solution, gypsum supplies the calcium to replace the excess sodium on the surface of the clay particles. Elemental sulfur can be used instead of gypsum, but sulfur takes longer to react. Before it can act, it must be changed to sulfate. This is done by microbes living in the soil. Much the same result is obtained either way, but time and cost differences must be considered.

Reclamation Practices

On the basis of the foregoing guidelines, the saline and alkali soils in the Madera Area can be placed in the following general groups.

Soils relatively easy to reclaim.—These soils are relatively uniform, and most of them have moderately rapid to moderately slow internal drainage. Some are poorly to imperfectly drained, but surface, open ditch, or tile drainage systems are easily installed and effective. In this group are the slightly to moderately affected members of the Cajon, Calhi, Chino, Foster, Marguerite, Temple, Traver, and Wunjey series, and the slightly affected members of the Dinuba, El Peco, Grangeville, Pachappa, and Pozo series. The principal practices required to improve these soils are deep wetting to remove the slight to moderate amounts of excess salts and, where necessary, the application of small to moderate amounts of gypsum or sulfur to correct alkali. For most of these soils, improvement should be relatively rapid and benefits should be quickly apparent.

Soils relatively difficult to reclaim.—In this group are the strongly affected members of the Cajon, Calhi, Chino, Foster, Traver, and Wunjey series. Also included are the moderately affected Dinuba, El Peco, and Pozo soils and the slightly affected Borden and Rossi soils, which are deep and have a hardpan or a moderate amount of clay in the subsoil and moderately slow to slow internal drainage.

Improving these soils is slower and more difficult than improving the soils in group 1. Moderate to large amounts of gypsum or sulfur may be necessary. Split applications of gypsum are often needed for the more strongly alkali areas—one application to treat the whole area and a second for the spots that need additional treatment.

Soils very difficult to reclaim.—In this group are the shallow hardpan and claypan soils that have slow to very slow internal drainage. Also included are some of the deep, moderately to strongly saline-alkali soils that have slow to moderately slow internal drainage. Concentrations of excess salts and alkali in these soils vary from slight to strong. The group includes the slightly and moderately affected Lewis soils, the moderately affected shallow variant Calhi, the slightly and strongly affected Buchenau, the moderately and strongly affected Rossi, the strongly affected Dinuba, El Peco, and Pozo soils, and the slightly to strongly affected Fresno soils. For most of these soils, anything more than a little improvement of the upper layers is unlikely unless something is done to break up the restrictive hardpan and claypan layers. In most cases, moderate to large amounts of gypsum or sulfur are required.

Salt- and Alkali-Tolerant Crops

Saline irrigation water, a high water table, slow internal drainage, or cropping while improvement is underway may make it impossible or undesirable to maintain a low level of salinity. Cropping with a certain amount of salinity is possible if salt-tolerant crops are grown.

Table 16 shows the relative salt tolerance of the common crops of the Area. The crops in each group are listed in order of decreasing salt tolerance, and the concentration of salts that each crop will tolerate is given in terms of electrical conductivity (EC x 10^3) values. The conductivity values given at the top and bottom of each list of crops represent the range within which a 50 percent decrease in yields can be expected, as compared to yields on nonsaline soils under comparable growing conditions.

For example, of the moderately tolerant forage crops, white sweetclover will tolerate salinity nearer to conductivity value 12 and tall meadow oatgrass will tolerate salinity nearer to conductivity value 4. Most of the data are based on field-plot trials in which crops were grown on soils that were artificially adjusted to various salinity levels.

TABLE 16.—*Salt tolerance of crops* [1]

ROW, FORAGE, AND GRAIN CROPS

Good	Moderate	Poor
Ec×10³=16	*Ec×10³=10*	*Ec×10³=4*
Barley (grain).	Rye (grain).	Field beans.
Sugar beets.	Wheat (grain).	
Rape.	Oats (grain).	
Cotton.	Rice.	
	Sorghum (grain).	
	Corn (field).	
	Flax.	
	Sunflowers.	
	Castor beans.	
Ec×10³=10	*Ec×10³=6*	

VEGETABLES

Good	Moderate	Poor
Ec×10³=12	*Ec×10³=10*	*Ec×10³=4*
Garden beets.	Tomatoes.	Radishes.
Kale.	Broccoli.	Celery.
Asparagus.	Cabbage.	Green beans.
Spinach.	Bell peppers.	
	Cauliflower.	
	Lettuce.	
	Sweet corn.	
	Potatoes (White Rose).	
	Carrots.	
	Onions.	
	Peas.	
	Squash.	
	Cucumbers.	
Ec×10³=10	*Ec×10³=4*	*Ec×10³=3*

[1] From DIAGNOSIS AND IMPROVEMENT OF SALINE AND ALKALI SOILS. Agricultural Handbook No. 60. U.S. Salinity Laboratory, Riverside, California (*11*).

TABLE 16.—*Salt tolerance of crops*—Continued

Good	Moderate	Poor
Pasture and Hay Crops		
Ec×10³=18 Alkali sacaton. Saltgrass. Bermudagrass. Rhodesgrass. Rescuegrass. Canada wild-rye. Western wheatgrass. Barley (hay). Birdsfoot trefoil.	*Ec×10³=12* White sweet-clover. Yellow sweet-clover. Perennial rye-grass. Mountain brome. Strawberry clover. Dallisgrass. Sudangrass. Hubam clover. Alfalfa (Calif. common). Tall fescue. Rye (hay). Wheat (hay). Oats (hay). Orchardgrass. Blue grama. Meadow fescue. Reed canary-grass. Big trefoil. Smooth brome. Tall meadow oatgrass.	*Ec×10³=4* White dutch clover. Meadow foxtail. Alsike clover. Red clover. Ladino clover. Burnet.
Ec×10³=12	*Ec×10³=4*	*Ec×10³=2*
Fruit Crops		
None.	Pomegranates. Figs. Olives. Grapes. Cantaloups.	Pears. Apples. Oranges. Grapefruit. Prunes. Plums. Almonds. Apricots. Peaches. Strawberries. Lemons.

Irrigation and Water Supply

The development of irrigation systems in Madera County began in the early days of settlement. The following excerpts are from an article that appeared in the Fresno Bee of December 3, 1949.

"The first water project was started in Madera County in 1860 when Isaac Friedman, a San Francisco capitalist, purchased 35 sections, including the present site of the City of Madera, and filed on water from the Fresno River. Friedman went broke in the wheat market, and the Fresno Dam and Canal Company took over his holdings, Madera then being a part of Fresno County.

"In 1888, the Madera Canal Company was formed and absorbed the Fresno Dam Company . . .

"In 1920 the Madera Irrigation District, first organized in 1888 began to function.

"In 1923, Charles A. Clark, Charles J. Emmert and his son, Keith Emmert, purchased the Madera Canal and Irrigation Company, including 113 miles of canals, capable of supplying 20,000 acres of land . . .

"The canal company recently has been purchased by the Madera Irrigation District."

Both ground water and water diverted from major streams and from Millerton Lake, a manmade reservoir on the San Joaquin River 20 miles east of Madera, are used for irrigation. The Friant-Madera Canal, which brings water from Millerton Lake, was completed in 1945. It helps to maintain a flow of water in many of the streams, and thus to build up the supply of ground water, and it also supplies water for direct irrigation. An extensive distribution system to serve most of the irrigable land below the canal is planned. Most of the irrigated land in the Area has been supplied by water from wells, but more will be served by surface water when the system for distributing water from Millerton Lake is completed. The water table has dropped steadily for the past several years, as a result of pumping. It is hoped that, with the further development of the canal system to use the impounded water, the rate of drop in the water table will be arrested.

In the Madera Area, three methods of irrigation are in general use: flooding the surface; distributing water through furrows, thus wetting only part of the surface; and sprinkling, which wets the whole surface much as rainfall does.

The method of irrigation used depends upon the crop to be grown, the texture of the soil, the topography, and in part upon the preference of the operator. Alfalfa, grain, and pasture are usually irrigated by flooding the surface between two border checks and then disposing of the excess water at the lower end of the checks. Rice is flooded in basin checks and the surface is kept under slowly moving water during the growing season. Furrow irrigation is used on row crops, such as cotton, sugar beets, corn, and truck crops, and also in most orchards and vineyards. Some orchards and vineyards are irrigated by basin checks. Overhead sprinkling is not extensively used but is becoming more common. It is particularly suitable for soils that are too steep or too shallow to be leveled and for sandy soils that have a high infiltration rate.

The type of soil, the crops to be raised, the cost of preparing the land for irrigation, the cost of the irrigation installation, and the amount of labor and power needed must be considered in choosing an irrigation method.

Most of the better soils are now being irrigated. If more water is made available, many of the shallow soils now used chiefly for dryfarmed grain and range pasture will probably be irrigated, and also the saline-alkali soils in the western part of the Area. Some of these saline-alkali soils are well suited to shallow-rooted crops, particularly irrigated pasture.

There are two irrigation districts in the Area. The south-central part of the valley is served by the Madera Irrigation District,[8] which was organized on January 2, 1920. The gross area of this district is 112,405 acres, of

[8] Information concerning irrigation districts was supplied by the California Department of Public Works, Division of Water Resources.

Figure 18.—A stock-water reservoir in the foothills.

which 79,700 acres was irrigated in 1949. The north-central part of the valley is served by the Chowchilla Water District, which was organized on February 7, 1949. The gross area of the northern district is 64,090 acres, of which 45,316 acres was irrigated in 1949.

In the valley, all the domestic water used is from wells; in the uplands, many springs have been developed.

In the terraces and foothills, a great many small, earth-filled dams have been built on intermittent streams to impound water for livestock (fig. 18). Stock water is also obtained from streams, springs, and natural and manmade lakes in the mountains, and by pumping ground water.

Formation and Classification of Soils

The soils of the Madera Area differ in fertility, physical and chemical properties, and productivity. These differences are the result of local differences in the environment under which the soils developed.

Formation of Soils

Soil is a natural body on the surface of the earth, in which plants grow, and it is composed of organic and mineral materials (*9*).

Soils differ, often within short distances, in appearance, composition, management requirements, and productivity. The factors that cause soils to differ are—

1. Parent material—the physical and chemical composition of the material from which the soil was formed.
2. Climate, principally rainfall and temperature.
3. Biological forces—the plant and animal life in and on the soil.
4. Relief.
5. Time, or the period the soil-forming forces have acted on the parent material.

These five factors work together in many different combinations, and the soils that result differ from place to place. The influence of each soil-forming factor on the soils in the Madera Area is described in a general way in the following sections.

Parent material

There are three main sources of parent material in the Madera Area: (1) alluvium, (2) weakly consolidated old alluvial sediments, and (3) hard bedrock. Figure 19 is an approximation of the distribution of geologic materials, but it is based only partly upon geologic studies and so cannot be termed a geologic map. The pattern shown is the result of a combination of soil information, topographic studies, and purely geological investigations reported by other workers.

The largest areas of soils are those developed from alluvial material washed from the Sierra Nevada since early Pleistocene times. This material ranges in character from clay deposited in the lower part of the basin through broad expanses of sandy deposits on fans to poorly sorted mixed gravelly material on fans.

The alluvial material can also be divided into several kinds depending upon the source rock. The dominant alluvium is that derived from granitic rocks and laid down by major streams that drain the higher parts of the Sierra Nevada. The larger of these minor streams drain areas made up mainly of metamorphosed rocks, such as slate and schist, with which some granitic rocks are mixed. The lesser of the minor streams deposit reworked materials of local origin. The very old, gravelly and cobbly alluvium from which the Corning and Redding soils formed was derived from a wide variety of igneous and metamorphic rocks and is considered to be mixed alluvium.

The weakly consolidated old alluvial material consists mainly of silt and fine sand of granitic origin and includes a small area of andesitic tuff.

Hard bedrock is extensive in the eastern part of the Area. It consists of (1) slate and schist of the Mariposa group in the lower foothills; (2) granite, largely classified as granodiorite, and (3) mica schist and basic igneous rocks associated with granitic rocks. A small area just north of the San Joaquin River is underlain by basalt.

The various kinds of parent material are described below:

Recent alluvium.—This material consists of relatively unweathered, predominantly granitic sediments deposited during the Recent geologic epoch on flood plains and fans. From it developed the Cajon, Columbia, Foster, Grangeville, Hanford, Hildreth, Tujunga, Visalia, and Wunjey soils.

Young alluvium.—This material was deposited earlier than the recent alluvium; it is flooded less frequently and receives less, and in places no, new material. Extensive deposits of stratified sandy and silty granitic sediments in the southwestern part of the Area appear to be semilacustrine and were probably deposited at a very late stage in the glacial history of the Sierra Nevada. The Calhi, Delhi, Dinuba, Greenfield, Pachappa, and Temple soils developed from predominantly granitic alluvium. The Marguerite soils developed from metasedimentary alluvium, and the Bear Creek soils developed from mixed local alluvium.

Saline-alkali basin sediments.—This material is probably of the same origin and age as the predominantly granitic young alluvium, but it has been modified by the water table. From it developed the Chino, El Peco,

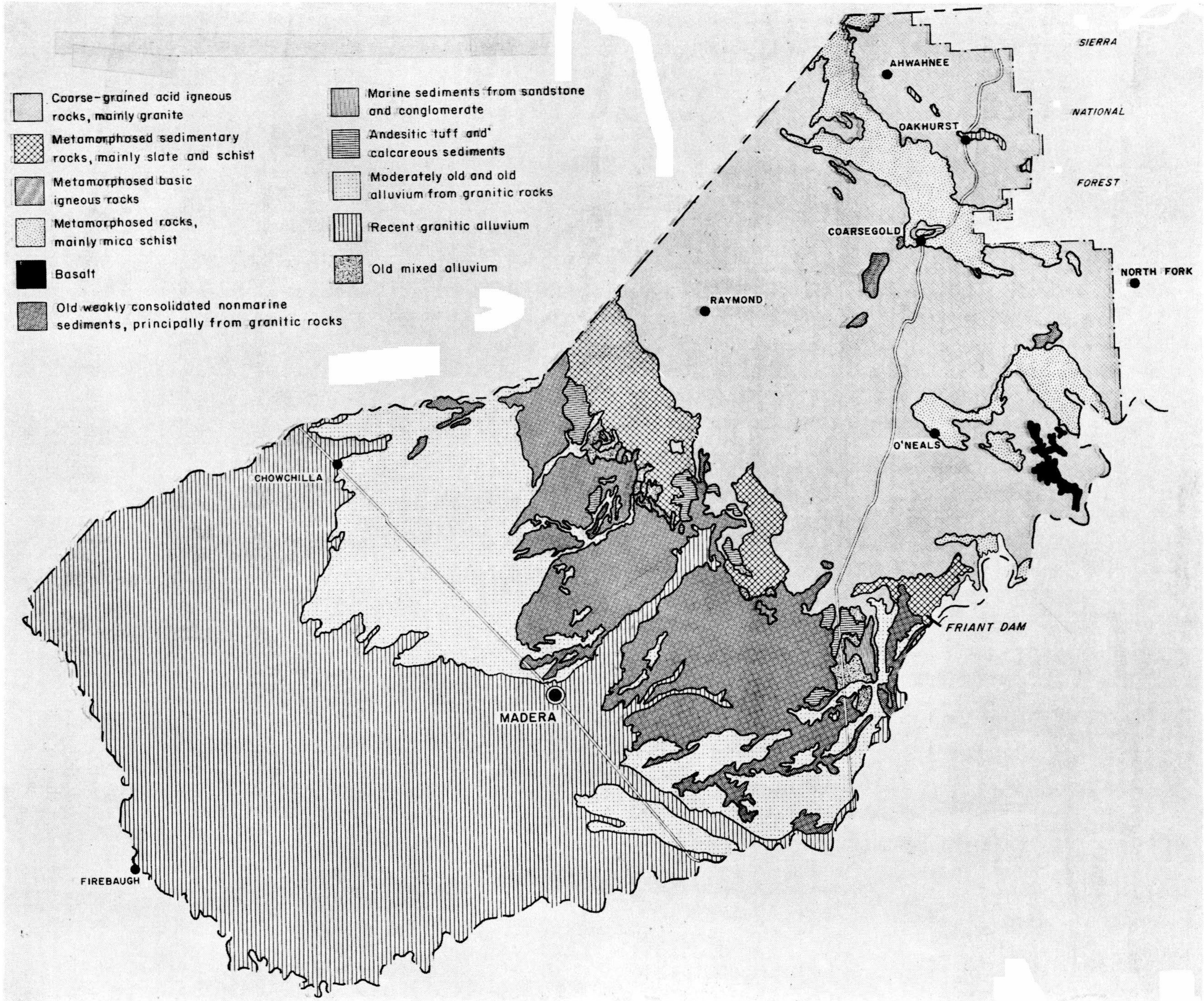

Figure 19.—**Major sources of parent material in the Madera Area.**

Fresno, Lewis, Pozo, Rossi, and Traver soils. The El Peco and Fresno soils appear to have formed from material similar to the stratified, sandy and silty, semilacustrine granitic sediments described as part of the young alluvium.

Old and moderately old granitic alluvium.—This material, deposited on old terraces, is stratified and fairly well sorted. In texture it ranges from medium sand to silt. It weathers to a reddish color. It dates from the Pleistocene epoch and is probably part of the late and middle Victor formations, but its age and the order of deposition has not been studied. The terraces are probably related to a later or middle stage in the glacial history of the Sierra Nevada.

The Alamo, Atwater, Borden, Madera, Ramona, and San Joaquin soils developed from old and moderately old alluvium. All of these soils have distinct clayey subsoils or cemented hardpans or both. On the south bank of the Chowchilla River, west of the Santa Fe tracks, there is a profile of a San Joaquin soil buried by a Madera soil.

Old metasedimentary alluvium.—This moderately to strongly weathered material was deposited by local streams during the Pleistocene epoch. It is probably part of the late and middle Victor formations. From it developed the Buchenau and Jesbel soils, which are characterized by a lime-cemented subsoil.

Moderately old basic igneous alluvium.—Like the old metasedimentary alluvium, this material is moderately to strongly weathered. It was deposited by local streams during the Pleistocene epoch. It is probably part of the late and middle Victor formations. From it developed the reddish-brown, fine-textured Porterville soils.

Weakly consolidated old granitic sediments.—This material occurs on a high, considerably dissected old fan north of the San Joaquin River. It was deposited during the Pleistocene epoch and is probably part of the early Victor formation. The sediments are sorted. Most of the lower part of the deposit is fine and very fine sand, and the upper part is very coarse sand. Much of the coarse material has been stripped away, but, using the highest point of the Montpellier soils, it can still be traced on planar surfaces originating at the San Joaquin River and fanning out toward the west.

These are the oldest of the sandy deposits in the Area. Presumably they are related to an early stage of glaciation in the Sierra Nevada. The Montpellier soils developed from the coarse sand in the upper part of the deposits, and the Cometa, Rocklin, Trigo, and Whitney soils developed from the finer textured underlying material.

High-terrace mixed gravel and cobblestones.—This material is poorly sorted and contains some fine material. Ordinarily it occurs as a capping on remnants of eroded beds of andesitic tuff. It dates from the mountain-building period of the early Pleistocene epoch, and apparently is part of the Arroyo Seco formation (*4*). The gravelly, reddish-brown Corning and Redding soils developed from these deposits.

Andesitic tuff.—This material originated in eruptions in the high Sierra Nevada during the late Miocene and early Pliocene epochs. It is the Mehrten formation (*4*). It supplied the material from which the Raynor soils developed. Included also are small areas of nonmarine calcareous sediments from which the Zaca soils developed.

Basalt.—This is basic volcanic material that originated during the Miocene epoch. It occurs as a hard cap over granite rocks. From it was derived the parent material of the shallow Hideaway soils.

Quartz sandstone.—This is the upper part of the Ione formation (*1*). It dates from the Eocene epoch. In color it is either white and yellow or a mottled red. It is ordinarily fairly hard. From it was derived the parent material of the Hornitos soils.

Granodiorite.—This material, an intrusive rock of the Jurassic system, occurs in broad areas in the Sierra Nevada and the foothills. From it was derived the parent material of the Ahwahnee, Auberry, Holland, Sesame, Tollhouse, and Vista soils.

Metamorphosed basic igneous rocks.—A small area of metamorphosed, basic, intrusive rocks of the Jurassic system occurs near the town of Coarsegold. The Trabuco soils developed from material weathered from these rocks.

Slate and schist.—These rocks are part of the Mariposa complex, which dates from the Jurassic period. They were the sources of the parent material of the Daulton and Whiterock soils. Because of the complex bedding of the true slate, high in graphite, and metasandstone, the separation of Daulton and Whiterock soils was made largely on the basis of color.

Mica schist.—This material is probably part of the Calaveras formation, and dates from before the Cretaceous period. It occurs extensively near the town of Coarsegold and was the source of the parent material of the Coarsegold soils.

Climate

In the Madera Area, the summers are very warm to hot and are virtually rainless. The winters are cool, and most of the rain falls between December and March. The soils are usually moistened to a depth of several feet or, in the case of hardpan and bedrock soils, to the full depth of the soil.

In the valley, plant growth is rapid in spring, but it ceases rather abruptly with the coming of hot weather in May or June and the exhaustion of the limited supply of moisture. The oxidation of organic matter during the hot summers and the limited growth period permit little accumulation of organic matter. Consequently, all but the poorly drained basin and flood-plain soils are low in organic matter, compared to the soils of the more humid climate in the mountains to the east.

There is a gradual increase in total rainfall from west to east across the valley. The range is from about 8.5 inches near Firebaugh on the San Joaquin River to about 15 inches at the western edge of the foothills. On the older terraces the range in annual rainfall is from 10 to 15 inches. Such a limited range should not account for any important soil differences.

Likewise, temperature variations in the basin and terrace areas are not sufficient to account for appreciable differences between soils. Freezing of the soil to a depth of more than a fraction of an inch is very rare.

The normal zonal soils that form under the mild, semiarid climate of the valley are Noncalcic Brown soils. These soils have a light-colored, massive, slightly acid surface soil and a neutral or mildly alkaline subsoil. The older soils on the high terraces are medium acid to strongly acid, a fact that suggests the possibility that these soils have been weathering since the early part of the Pleistocene epoch and that at some previous time the climate was more humid.

In the foothills and mountains in the eastern part of the Area, the elevation increases, from west to east, from about 500 feet to 3,500 feet. As the elevation increases, the annual rainfall increases steadily from 15 to about 35 inches, and the average annual temperature decreases from about 62° to 55° F.

Effects of the higher rainfall and lower temperatures are evident in the vegetation and the soils. Vegetation is increasingly abundant, and the organic-matter content of the soil increases from low to moderate. A dark-colored, granular surface soil replaces the light-colored, massive surface soil of the valley and lower foothills. Other results are greater soil depth, more distinct horizons, and stronger acidity.

Biological forces

In the valley, the original plant cover consisted of grasses and small herbaceous plants. Many were annuals of kinds that grow rapidly in spring and mature quickly before the coming of the hot summer weather. Trees grew only on the edges of stream channels and on the flood plains, where a supply of moisture was available through the summer. The lush growth of grasses on the poorly drained flood plains provided the organic matter that gives the Foster, Temple, Rossi, Grangeville, Chino, and Pozo soils their dark color.

In the foothills and mountains, the plant cover changes with increasing rainfall. Annual grasses and scattered oaks dominate on the lower foothills. Gradually, these give way to a mixture of oaks, grasses, brush, and Digger pines on the higher foothills. Pines and some hardwoods and an understory of grasses and brush grow in the mountains. The more abundant vegetation is the reason for the granular structure and dark color of the surface soil and for the moderate content of organic matter.

Relief

Relief has had an important bearing on soil development in the Madera Area. The basin in the western part of the Area is nearly level and is drained only by winding channels of the streams that drain the foothills to the east. Saline-alkali soils dominate in the basin, as a result of poor or imperfect natural drainage and a high water table in the past.

Young fans cover the western part of the Area; they are very gently sloping or nearly level and have low depositional ridges. Generally, the soils on these fans have not been affected by the water table, but the lowest depressions and old channels show some evidence of long-continued water logging.

On the older fans the relief is generally undulating. Mounded microrelief is common on the hardpan soils (*2*, *5*, *6*). The soils on the older fans have adequate external drainage, but where there is a hardpan internal drainage is very slow. Where there is a mound microrelief, rainwater tends to concentrate in the depressions between the mounds, thus producing an intricate pattern or complex of soils. Typically, the soils on the mounds are well aerated and medium textured, and those in the larger depressions are fine-textured, mottled, and cracked as a result of periodic waterlogging.

The higher fans and terraces adjacent to the incised streamways are partially dissected, and the remnants of the old, gently undulating surface are surrounded by rolling areas and steep escarpments. Erosion is active in these areas, and in many places the recently exposed soil material shows only slight evidence of profile development. The rate of dissection has varied from place to place. Areas where dissection has been rapid have little profile development; more slowly dissected areas have soils of intermediate subsoil development, and undissected areas have strongly weathered soils with a claypan or claypan-hardpan subsoil.

In the lower foothills, the slopes range from undulating to steep, and runoff varies accordingly. The soils are generally shallow but are slightly deeper on the gentler slopes.

In the higher foothills and low mountains the slopes are rolling to steep and the soils are typically moderately deep to deep. The amount of bedrock outcrop tends to increase with slope.

Time

The time factor presents many interesting problems in the Madera Area. The study of stratigraphy, physiography, and erosion and the comparison of soil profiles has made it possible to estimate the relative age of a number of the soils. The relative position of the various fans and terraces establishes, to a degree, their comparative ages. In general, the lowest stream bottoms consist of the most recent alluvium and the highest terraces or fans consist of the oldest alluvium.

The highest fans and terraces consist of mixed gravel derived from metamorphic rocks. From this material the strongly developed Corning and Redding soils formed. As indicated in the section on parent material, these fans have been tentatively correlated with Arroyo Seco gravel (*4*). They originated early in the Pleistocene epoch and are probably the oldest fans in the Area. The lower terraces all consist of nongravelly, sandy sediments deposited on a gentle gradient of 9 to 13 feet per mile. On the eldest of these are the strongly weathered claypan soils of the Montpellier series. On the dissected part of the fan the soils vary a great deal in degree of profile development. Those on the younger, lower terraces and fans have progressively less distinct profiles, and those on the flood plain have little or no horizon differentiation.

In the foothills and mountains, the land surface has been subject to steady geological erosion, and no attempt was made to determine the age of the soils. Presumably the soils are of relatively recent origin, although the parent rocks are very old.

Classification of Soils

The general framework of classification followed in this report is the one proposed by Baldwin, Kellogg, and Thorp (*9*) in 1938 and modified by Thorp and Smith (*8*) in 1949. Horizon designations and descriptive terms generally follow the Soil Survey Manual (*10*). Table 17

TABLE 17.—*Soil series by great soil groups, and certain factors of soil formation*

ZONAL SOILS

Great soil group and series	Parent material	Drainage	Degree of profile development
Noncalcic Brown soils:			
Atwater	Granitic alluvium	Good	Minimal.
Borden	Granitic alluvium	Good	Medial.
Cometa	Granitic alluvium	Good	Maximal.
Corning	Mixed alluvium	Good	Maximal.
Dinuba	Granitic alluvium	Moderately good	Minimal.
Greenfield	Granitic alluvium	Good	Minimal.
Madera	Dominantly granitic alluvium	Good	Maximal; hardpan.
Marguerite	Alluvium from slate and schist	Good	Minimal.
Montpellier	Granitic alluvium	Good	Maximal.
Pachappa	Granitic alluvium	Good	Minimal.
Ramona	Granitic alluvium	Good	Medial.
Redding	Mixed alluvium	Good	Maximal; hardpan.
Rocklin	Granitic alluvium	Good	Medial; hardpan.
San Joaquin	Granitic alluvium	Good	Maximal; hardpan.
Sesame	Granite	Good	Medial.
Vista	Granite	Good	Minimal.
Whitney	Softly consolidated granitic sediments	Good	Minimal.
Chestnut soils:			
Buchenau	Alluvium from metasedimentary rocks	Moderately good	Minimal; hardpan.
Jesbel	Alluvium from metasedimentary rocks	Good	Maximal; hardpan.
Brunizems:			
Ahwahnee	Granite	Good	Minimal.
Auberry	Granite	Good	Medial.
Reddish Prairie soils:			
Coarsegold	Mica schist	Good to somewhat excessive.	Medial.
Trabuco	Basic igneous rock	Good to somewhat excessive.	Maximal.
Reddish-Brown Lateritic soils:			
Holland	Granite	Good	Medial.

INTRAZONAL SOILS

Great soil group and series	Parent material	Drainage	Degree of profile development
Humic Gley soils:			
Alamo	Granitic alluvium	Poor	Medial; hardpan.
Bear Creek	Dominantly granitic alluvium	Imperfect to moderately good.	Minimal.
Chino	Granitic alluvium	Poor to imperfect	Minimal.
Foster	Granitic alluvium	Poor to imperfect	Dark-colored A_1 horizon.
Grangeville	Granitic alluvium	Imperfect to moderately good.	Dark-colored A_1 horizon.
Pozo	Granitic alluvium	Imperfect	Dark-colored A_1 horizon; hardpan.
Rossi	Granitic alluvium	Poor to imperfect	Medial.
Temple	Granitic alluvium	Poor to imperfect	Minimal.
Solonetz soils:			
Fresno	Granitic alluvium	Imperfect	Medial; hardpan.
Lewis	Granitic alluvium	Imperfect	Maximal; hardpan.
Traver	Granitic alluvium	Good	Minimal.
Grumusols:			
Porterville	Basic igneous alluvium	Good	None.
Raynor	Andesitic tuff	Good	None.
Zaca	Calcareous sandstone and shale	Good	None.

TABLE 17.—*Soil series by great soil groups, and certain factors of soil formation*—Continued

AZONAL SOILS

Great soil group and series	Parent material	Drainage	Degree of profile development
Alluvial soils:			
Cajon	Granitic alluvium	Somewhat excessive	None.
Columbia	Granitic alluvium	Imperfect	None.
El Peco	Granitic alluvium	Imperfect	None; hardpan.
Hanford	Granitic alluvium	Good	None.
Hildreth	Granitic alluvium	Imperfect	None.
Tujunga	Granitic alluvium	Somewhat excessive	None.
Visalia	Granitic alluvium	Imperfect to moderately good.	None.
Wunjey	Granitic alluvium	Moderately good	None.
Regosols:			
Calhi	Granitic eolian sand	Somewhat excessive	None.
Delhi	Granitic eolian sand	Excessive or somewhat excessive.	None.
Lithosols:			
Daulton	Graphitic slate	Good to somewhat excessive.	None.
Hideaway	Basic flows	Good	None.
Hornitos	Acid sandstone and conglomerate	Good to somewhat excessive.	None.
Tollhouse	Granite	Excessive	None.
Trigo	Softly consolidated granitic sediments	Good	None.
Whiterock	Sandy slate and schist	Good to somewhat excessive.	None.

gives the higher categories of classification as well as some important features of each soil series. Tables 18, 19, 20, and 21 contain supporting laboratory data. The soil series are discussed by soil orders, as shown in table 17, first the zonal soils, then the intrazonal, and finally the azonal.

Noncalcic Brown soils

Noncalcic Brown soils develop in a warm, semiarid to subhumid climate having cool, moist winters and rather hot, dry summers. The vegetation is either chaparral (brush) and thin forest or grass and a few scattered trees. The surface soil is brown, reddish brown, or red, and mellow or somewhat compact. The subsoil is heavier, tougher, and redder, and is commonly leached of lime carbonates but about neutral or slightly alkaline in reaction (*9*).

Noncalcic Brown soils dominate in the central part of the Madera Area. They developed on benches and terraces from various well-drained parent materials, mostly old granitic alluvium now partly consolidated. In the lower foothills Noncalcic Brown soils developed from weathered granitic bedrock.

Three stages of profile development are recognized: (1) minimal (weak), (2) medial (moderate), and (3) maximal (strong). The soils of moderate and maximal development include some that have hardpans.

Minimal development.—This stage is illustrated by a profile of Greenfield coarse sandy loam, located in the SW¼NW¼ sec. 18, T. 10 S., R. 18 E.

A_1 and A_3 0 to 23 inches, pale-brown (10YR 6/3) coarse sandy loam; dark brown (10YR 4/3) when moist; essentially massive when dry, and very weak, very fine, granular structure when moist; slightly hard when dry, very friable when moist; organic-matter content is low and decreases with depth; slightly acid (pH 6.3); gradual, smooth boundary.

B_1 23 to 37 inches, light yellowish-brown (10YR 6/4) heavy sandy loam; dark yellowish brown (10YR 4/4) when moist; weak, fine, subangular blocky structure; slightly hard when dry, very friable when moist; thin, patchy clay films; neutral (pH 6.6); gradual, smooth boundary.

B_2 37 to 51 inches, light yellowish-brown (10YR 6/4) heavy fine sandy loam; dark yellowish brown (10YR 4/4) when moist; weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; thin, patchy clay films; neutral (pH 6.8); gradual, smooth boundary.

C 51 to 72 inches, brownish-yellow and yellow (10YR 6/6 and 7/6), stratified loamy sand, sandy loam, and fine sandy loam; yellowish brown (10YR 5/6) when moist; massive; soft when dry, very friable when moist; neutral (pH 7.0).

The Greenfield soils were derived from granitic alluvium much like the parent material of the Hanford soils, but Greenfield soils are somewhat older and weathering is more advanced. Compared to the Hanford soils, the Greenfield have slightly more clay in the B horizon and more distinctly brownish (stronger chroma) colors in the B and C horizons. Presumably the presence of iron oxides accounts for these difference in color. The A horizon is about like that of the Hanford soils, and the reaction is about the same.

In this area there are six other series that are classified as Noncalcic Brown soils of minimal development: the Atwater, Dinuba, Marguerite, Pachappa, Vista, and Whitney series.

The Atwater series consists of pale-brown, noncalcareous soils derived from wind-reworked, coarse-textured granitic material similar to but older than that of the Delhi series. The A horizon is coarse textured and the B horizon typically contains slightly more clay than the A horizon, but the profile is otherwise similar to that of the Greenfield soils.

The Dinuba series consists of pale-brown, slightly calcareous soils that were derived from granitic sediments and have an unrelated silty substratum. These soils are on low, moderately well drained alluvial fans. Lime and other salty substances that were in the parent material are common in the subsoil and substratum. The reaction is normally neutral to strongly alkaline. The subsoil and substratum are mottled.

The Marguerite series consists of gray, noncalcareous soils that developed from dark-colored alluvium derived from graphitic slate and schist. In color these soils are darker and grayer than the Greenfield. In texture they are medium to moderately fine. In other characteristics, the Marguerite soils are much like the Greenfield soils. The differences between the two result chiefly from differences in parent material.

The Pachappa series consists of grayish-brown, slightly calcareous soils derived from granitic sediments. Like the Dinuba soils, the Pachappa occupy low alluvial fans and contain, largely in the subsoil and substratum, lime and other salty substances that were in the parent material. The reaction ranges from slightly acid to strongly alkaline. In other characteristics these soils are similar to the Greenfield soils.

The Vista series consists of noncalcareous brown soils that developed from material weathered from the underlying granitic bedrock. These soils occupy gentle to steep slopes in the foothills. Outcrops of bedrock are common. Changes in color, structure, and texture with depth are slight. These soils are much like the Greenfield soils except that they are underlain by bedrock at a moderate depth.

The Whitney series consists of noncalcareous brown soils that developed from weakly consolidated granitic sediments. The slopes are undulating to hilly, and the profiles are weakly developed because they are on the sloping parts of the recently dissected old alluvial fans. These soils are much like the Greenfield soils but are more strongly sloping and are moderately deep over weakly consolidated sediments.

Medial development.—This stage is illustrated by a profile of Ramona sandy loam located in the SE¼SE¼ sec. 9, T. 12 S., R. 20 E.

A_1 0 to 8 inches, light-brown (7.5YR 6/4) sandy loam; dark brown (7.5YR 4/4) when moist; essentially massive when dry, and very weak, very fine, granular structure when moist; very hard when dry, very friable when moist; low in organic matter; few fine roots and very fine pores; medium acid (pH 5.8); clear, smooth boundary.

A_3 8 to 22 inches, strong-brown (7.5YR 5/6) heavy sandy loam; dark brown (7.5YR 4/4) when moist; essentially massive; very hard when dry, friable when moist; very low in organic matter; few fine roots; pores more numerous and few of moderate size; slightly acid (pH 6.1); clear, smooth boundary.

B_2 22 to 42 inches, strong-brown (7.5YR 5/6) light sandy clay loam; strong brown (7.5YR 4/4) when moist; weak, medium, prismatic and moderate, medium, blocky structure; very hard when dry, firm when moist; thin, continuous clay films; few fine roots; numerous fine pores; slightly acid (pH 6.3); gradual, smooth boundary.

C 42 to 60 inches, brown (7.5YR 5/4) heavy sandy loam; dark brown (7.5YR 4/4) when moist; massive; hard when dry, firm when moist; few fine roots; pores numerous and fine in size; slightly acid (pH 6.4).

Like the Greenfield and the Hanford soils, the Ramona soils were derived from granitic alluvium, but the parent material is older and weathering is more advanced. Moderate amounts of clay have accumulated in the B horizon, and the color of the B horizon is distinctly strong brown (stronger in chroma). Additional release of iron and the formation of oxides presumably account for the stronger color patterns. Differences in structure and consistence between the A and B horizons are also more evident than in the Greenfield soils. The color of the A horizon is more reddish in the hue and stronger in chroma, but the organic-matter content is low. The surface soil is medium acid, but the subsoil and substratum are slightly acid; this indicates that the base status is high and that there has been little downward movement of bases in the profile.

In this area there are three other series that are classified as Noncalcic Brown soils of medial development: the Borden, Sesame, and Rocklin series.

The Borden series consists of brown, slightly calcareous soils derived from granitic sediments. These soils are associated with and similar to the Pachappa soils. They differ from the Pachappa mainly in having a moderate amount of clay and a moderately distinct structure in the B horizon. Most of the lime in the lower part of the B horizon is in the form of soft segregations and nodules.

The Sesame series consists of dark grayish-brown, moderately deep, noncalcareous soils derived from material weathered from the granitic bedrock. These soils occur mostly in the lower foothills, chiefly in association with the Vista soils. Except for their dark color, they are similar to the Ramona soils. The cause of the dark color is not known, for these soils are low in organic matter. Dark-colored minerals in the parent material may be partly responsible.

The Rocklin series consists of light-brown, noncalcareous soils derived from weakly to moderately consolidated granitic sediments. These soils occupy dissected, old, low terraces, chiefly in association with the Whitney soils. In clay content, color, and structure, the subsoil is similar to that of the Ramona soils. The principal difference between the Rocklin and the Ramona soils is the presence in the Rocklin soils of a thin, strongly cemented to indurated, iron-silica hardpan that caps the weakly to moderately consolidated parent material.

Maximal development.—This stage is illustrated by a profile of Cometa sandy loam located in the SW¼SE¼ sec. 11, T. 10 S., R. 18 E.

A_1 0 to 7 inches, brown (10YR 5/3) heavy sandy loam; dark brown (10YR 3/3) when moist; essentially massive when dry, and very weak, very fine, granular structure when moist; hard when dry, friable when moist; low in organic matter; few grass roots; few fine pores; slightly acid (pH 6.2); clear, smooth boundary.

A_3 7 to 17 inches, brown (between 7.5YR 5/4 and 10YR 5/3) heavy sandy loam; dark brown (between 7.5YR 4/2 and 3/2) when moist; very weak, very fine, granular structure when moist, and essentially massive when dry; hard when dry, friable when moist; very low in organic matter; few fine pores; slightly acid (pH 6.3); abrupt, smooth boundary.

B_2 17 to 27 inches, reddish-brown (5YR 4/4) sandy clay; dark reddish brown (5YR 3/4) when moist; strong, coarse blocky structure; extremely hard when dry, firm when moist, plastic and slightly sticky when wet; moderate, continuous clay films; very few fine pores; slightly acid (pH 6.4); abrupt, smooth boundary.

C 27 to 40 inches +, light yellowish-brown (10YR 6/4) heavy sandy loam; dark yellowish brown (10YR 4/4) when moist; massive; hard when dry, firm when moist; weak stratification may be visible; granitic character of sediments evident from mineral fragment composition; neutral (pH 7.2); some free lime in seams.

Like the Ramona, Greenfield, and Hanford soils, the Cometa soils were derived from granitic alluvium, but the parent material is older and weathering is much more advanced. Large amounts of clay have accumulated in the B horizon. The color of the B horizon is distinctly reddish brown—an indication of the accumulation of iron oxides as well as clay. Differences in structure and consistence between the A and B horizons are also more distinct. The organic-matter content of the A horizon is low. The slight increase in pH with increasing depth indicates that the base status is high and that there has been little downward movement of bases in the profile. The pattern is the same as in the Greenfield and Ramona soils.

Two other series—the Corning and Montpellier—are classified as Noncalcic Brown soils of maximal development.

The Corning series consists of reddish-yellow, medium-textured soils derived from old mixed alluvium that was typically gravelly and cobbly in texture. The B horizon is red, blocky, and fine textured. The Corning soils in this area are strongly acid throughout, but those in other localities are medium to strongly acid in the upper horizons and less acid in the lower part. These soils are very old. They occur only on a few remnants of some old high terraces that were possibly once much more extensive. The profile could have developed in any of several different kinds of climate. Although the A horizon is most like that of the Noncalcic Brown soils, the strongly acid B horizon is more like that of the Reddish Brown Lateritic soils, which develop in regions of higher rainfall.

The Montpellier series consists of brown, moderately coarse textured soils derived from old granitic alluvium. The B horizon, a thick layer of dense sandy clay loam, is slowly permeable; it is much like that of the Cometa soils except that it is lower in clay and of greater thickness. Because the parent material is coarser textured than that of the Cometa soils, it is generally believed that the amount of clay produced by weathering in the two soils is about the same. The profile is slightly acid throughout.

Maximal development with hardpan.—This stage is illustrated by a profile of Madera loam located in the SW¼NW¼ sec. 20, T. 10 S., R. 16 E.

A_{1p} 0 to 9 inches, light yellowish-brown (10YR 6/4) loam; dark yellowish brown (10YR 4/4) when moist; essentially massive when dry, and very weak, very fine, granular structure when moist; very hard when dry, friable when moist; numerous fine roots and fine pores; low in organic matter; medium acid (pH 5.8); clear, smooth boundary.

B_1 9 to 18 inches, yellowish-brown (10YR 5/4) light sandy clay loam; dark yellowish brown (10YR 4/4) when moist; weak, coarse, prismatic structure; extremely hard when dry, firm when moist; thin, patchy clay films on ped faces and sand grains, most of colloid forming bridges between sand grains; neutral (pH 6.9); few fine roots and fine pores; abrupt, smooth boundary.

B_2 18 to 25 inches, yellowish-brown (10YR 5/4) sandy clay; dark yellowish brown when moist; weak, coarse, prismatic and moderate, medium, blocky structure; extremely hard when dry, very firm when moist; moderately thick, nearly continuous clay films on ped faces, in pores, and in bridges between sand grains; neutral (pH 7.1); very abrupt, smooth boundary.

C_m 25 to 28 inches, yellowish-brown (10YR 5/4), indurated, iron-silica cemented hardpan; dark yellowish-brown (10YR 4/4) when moist; lime segregated in fine seams; cementation strongest in uppermost few inches and becoming weaker with increasing depth; dark-colored manganese stainings throughout, presumably along old structural planes; gradual, smooth boundary.

C 28 to 60 inches, pale-brown (10YR 6/3) gritty sandy loam; brown and dark brown (10YR 4/3 and 5/3) when moist; massive; hard when dry, firm when moist; slightly stratified and weakly cemented in places; mildly alkaline (pH 7.4 to 7.8).

The Madera soils are much like the Cometa soils, except for color and the presence of the iron-silica hardpan at shallow to moderate depths. The yellowish-brown colors are thought to be inherited from dark-colored minerals in the parent material. The reaction is typically medium acid in the surface soil and less acid in the lower layers. Thin seams of lime may occur in the hardpan.

The origin of the hardpan in soils such as this is much debated. One possible explanation is the following: Rapid warming of the moist soil in spring favors rapid chemical and biological activity, the release of bases, the solution of silicates, and the release of iron. Rapid drying of the soil follows almost immediately. The result is that the iron and silica are irreversibly precipitated. Thus, the more slowly permeable substrata are gradually cemented into a nearly impermeable mass.

Two other series in this Area—the Redding and the San Joaquin—consist of strongly developed Noncalcic Brown soils with hardpans.

The Redding series consists of reddish-brown, medium-textured soils derived from the old, mixed, gravelly and cobbly alluvium. The B horizon is red, blocky clay. Otherwise the profile is much like that of the Corning soils, except for the indurated, iron-silica hardpan below the B horizon.

The San Joaquin series consists of yellowish-red, moderately coarse textured soils derived from old granitic sediments. The B horizon is reddish yellow, blocky, and fine textured. Otherwise, the profile is much like that of the Madera soils.

Chestnut soils

Chestnut soils have a dark-brown or dark grayish-brown surface soil that grades into a light-gray or white, calcareous horizon at a depth of 1½ to 2 feet. These soils develop in temperate to cool semiarid regions under a mixture of short and tall grasses (*9*).

Chestnut soils occupy a small acreage on terraces in the central part of the Area. They developed from old local alluvium derived mostly from slate and schist. Drainage is moderately good or good.

Two stages of profile development are recognized in this Area: (1) minimal (weak) and (2) maximal (strong). Only the maximal stage is described in detail.

Maximal development.—This stage is illustrated by a profile of Jesbel gravelly clay loam located in the SW¼ SW¼ sec. 16, T. 9 S., R. 18 E.

A_1 0 to 5 inches, dark grayish-brown (10YR 4/2) gravelly clay loam; very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; hard when dry, firm when moist; numerous fine roots; moderately porous; moderate in organic matter; neutral (pH 7.2); noncalcareous; clear, smooth boundary.

A_3 5 to 14 inches, dark grayish-brown (10YR 4/2) gravelly clay loam; very dark grayish brown (10YR 3/2) when moist; moderately low in organic matter; nearly massive when dry, and very weak, fine, granular structure when moist; roots less numerous than in A_1 horizon; many very fine pores; neutral (pH 6.8); noncalcareous; abrupt, smooth boundary.

B_2 14 to 24 inches, dark-brown (7.5YR 4/4) gravelly light clay; darker brown (7.5YR 3/4) when moist; strong, medium, blocky structure; very hard when dry, very firm when moist; moderate, continuous clay films; a few fine roots; a few very fine pores; neutral (pH 7.1); noncalcareous; abrupt, slightly wavy boundary.

C_{cam} 24 to 33 inches, white (10YR 8/2), strongly lime-cemented gravelly caliche hardpan; light gray (10YR 7/2) when moist; abrupt, slightly wavy boundary.

C_2 33 to 42 inches +, brown (10YR 5/3) gravelly sandy loam; dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist; mildly alkaline (pH 7.7); moderately calcareous; the gravel content increases with depth.

A moderate amount of organic matter has accumulated in the A horizon. Lime has been leached from the A and B horizons and concentrated in the strongly cemented C_{cam} horizon. The B horizon of blocky clay, abruptly underlying the A horizon, indicates that the formation and accumulation of clay has accompanied the removal of lime from the upper horizons.

The other Chestnut soils in this Area—the Buchenau soils—have weakly expressed horizons. The A horizon and the C_{cam} horizon are similar to those of the Jesbel soils. The B horizon is only weakly differentiated. Free lime in both the A and B horizons indicates that removal of lime is continuing.

Brunizems

Brunizems (formerly called Prairie soils) have a dark-brown to nearly black, slightly acid surface soil and a brown, well-oxidized subsoil. The parent materials vary in composition, especially in content of lime (*9*).

In the Madera Area, Brunizems occupy a zone between the Noncalcic Brown and the Reddish-Brown Lateritic soils. They are in the eastern part of the survey Area, mostly in the higher foothills, at elevations of 1,000 to 2,800 feet. The rainfall is between 15 and 30 inches, and the mean annual temperatures are between 56° and 62° F. The soils overlie granitic rocks and have developed from material weathered from these rocks. Drainage is good to somewhat excessive.

Two stages of development are recognized in this Area: (1) minimal (weak), and (2) medial (moderate). The medial stage is described in detail.

Medial development.—This stage is illustrated by a profile of Auberry sandy loam located a quarter of a mile west of New Auberry on the North Fork-Auberry Road in Fresno County.

A_1 0 to 7 inches, grayish-brown (10YR 5/2) coarse sandy loam; dark brown (10YR 3/3) when moist; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist; numerous fine pores; abundant fine grass roots; slightly acid (pH 6.2); moderate in organic matter; clear, smooth boundary.

A_3 7 to 12 inches, pale-brown (10YR 6/3) heavy sandy loam; dark grayish brown (10YR 3.5/2) when moist; weak, medium to fine, subangular blocky structure; hard when dry, friable when moist; some grass roots; medium acid (pH 6.0); moderately low in organic matter; clear, smooth boundary.

B_1 12 to 16 inches, brown (10YR 5/3) gritty loam; brown (10YR 3.5/3) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; few roots; thin, nearly continuous clay films; medium acid (pH 6.0); clear, smooth boundary.

B_2 16 to 35 inches, brown (10YR 5/3) light sandy clay loam; dark yellowish brown (10YR 4/4) when moist; moderate, coarse to very coarse, angular blocky structure; very hard when dry, firm when moist; dense; moderate, continuous clay films; strongly acid (pH 5.3); abrupt, smooth boundary.

B_3 35 to 42 inches, pale-brown (10YR 6/3 to 7/4) gritty loam; yellowish brown (10YR 5/4) when moist; weak, medium to fine, subangular blocky structure; slightly hard when dry, friable when moist; highly micaceous; thin, patchy clay films; medium acid (pH 5.6); abrupt, wavy boundary.

C_2/D_r 42 inches +, very pale brown (10YR 8/3 to 8/4) loamy sand; varied yellowish brown to dark gray when moist; massive; loose when dry or moist; neutral (pH 6.6); weathered parent rock; continues to unweathered rock; variable in depth.

A moderate amount of organic matter has accumulated in the A horizon. The reaction is slightly acid in the A horizon, medium acid in the B_3 horizon, and neutral in the weathered C_2 horizon. Leaching of bases to a moderate depth is indicated by this pattern. A moderate increase in the clay content of the B horizon has taken place.

The other Brunizems in this Area—the Ahwahnee soils—have weakly expressed horizons. The A horizon is essentially the same as that of the Auberry soils, but the clay content of the B horizon has increased only slightly. The reaction is slightly acid in the surface soil and medium acid in the lower part of the profile.

Reddish Prairie soils

Reddish Prairie soils are redder than Brunizems, possibly because of the composition of the parent material or the climate under which they developed.

These soils occupy a zone between the Noncalcic Brown and Reddish Brown Lateritic soils. They are in the eastern part of the survey Area, in the higher foothills, at elevations of 1,700 to 3,500 feet. The rainfall is between 20 and 35 inches, and the mean annual temperatures are between 56° and 58° F. The soils overlie mica schist and basic igneous rocks and have developed from material weathered from these rocks. Drainage is good to somewhat excessive.

Two stages of development are recognized in this area: (1) medial (moderate), and (2) maximal (strong). The medial stage is described in detail.

Medial development.—This stage is illustrated by a profile of Coarsegold loam located a quarter of a mile west of the northeast corner of sec. 10, T. 8 S., R. 21 E.

A_1 0 to 5 inches, brown (7.5YR 5/3) loam; dark brown (7.5YR 3/3) when moist; nearly massive when dry; weak, fine, granular structure when moist; slightly hard when dry, friable when moist; numerous fine pores and wormholes, some up to an eighth of an inch in diameter; abundant worm casts locally produce a moderate, fine granular structure; moderate in organic matter; slightly acid (pH 6.4); clear, smooth boundary.

B_1 5 to 17 inches, reddish-brown (5YR 5/4) heavy loam; dark reddish brown (5YR 3/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; clay films thin and continuous in worm channels and pores, thin and patchy on peds; worm casts abundant; slightly acid (pH 6.5); clear, smooth boundary.

B_{21} 17 to 27 inches, reddish-brown (5YR 4/4) gravelly clay loam; dark reddish brown (5YR 3/4) when moist; weak, coarse, subangular blocky structure; hard when dry, firm when moist; thin, nearly continuous clay films; numerous root channels, some up to a quarter of an inch in diameter, with shining compression surfaces; neutral (pH 7.0); clear, smooth boundary.

B_{22} 27 to 38 inches, reddish-brown (5YR 4/4) heavy clay loam; dark reddish brown (5YR 3/4) when moist; moderate, coarse, blocky structure; very hard when dry, very firm when moist; moderate, continuous clay films; numerous large root channels, some up to one-fourth of an inch in diameter with shining compression surfaces; few pores, mostly very fine; neutral (pH 7.0); clear, wavy boundary.

C_2/D_r 38 to 50 inches +, decomposing bedrock and soil material; variable color pattern, mostly reddish brown (2.5YR 5/4) when dry and light reddish brown (2.5YR 6/4) when moist; some fine, strong-brown stains and streaks; disintegrating mica schist, becoming less decomposed with depth.

This profile is similar to the Auberry profile described as representative of the medial Brunizems. It has a moderate accumulation of organic matter in the A horizon, and a little more clay in the B horizon than in the A horizon. The A horizon is slightly acid, but the pH increases gradually with depth and the lower layers are neutral. The principal difference is that the Coarsegold soils have a reddish-brown B horizon. A larger and more readily released supply of iron in the mica schist parent material is the principal reason for the reddish-brown color.

The other Reddish Prairie soils in the Area—the Trabuco soils—have strongly expressed horizons. They are much like the Coarsegold soils, but the B horizon is reddish-brown clay and has a strong, blocky structure. The parent rock is a readily weathered basic igneous rock high in iron.

Reddish-Brown Lateritic soils

Reddish-Brown Lateritic soils occur in the humid tropics and in a few places in cooler climates. The soils have somewhat different characteristics under the two climates. In the Madera Area, the soils of this group have a grayish-brown A horizon that is moderately high in organic matter. The B_2 horizon is reddish brown and contains more clay than the A_1 and A_3 horizons.

Reddish-Brown Lateritic soils occur in the eastern part of the Madera Area. They are in the high foothills and low mountains, east of the Brunizems and the Reddish Prairie soils. The elevation is more than 2,800 feet; it ranges up to 3,500 feet. Rainfall is between 30 and 40 inches, and the mean annual temperature is near 55° F. These soils overlie granitic rock and have developed from material weathered from this rock. Drainage is good to somewhat excessive.

In this Area, the Reddish-Brown Lateritic group is illustrated by the following profile of Holland sandy loam located at Garthwaite Summit on State Highway 41 between Coarsegold and Oakhurst.

A_1 0 to 6 inches, grayish-brown (10YR 5/2) sandy loam; very dark brown (10YR 2/2) when moist; moderate, medium and fine, granular structure; slightly hard when dry, friable when moist; numerous fine roots; abundant worm casts, worm holes, and root holes, some up to an eighth of an inch in diameter; micaceous; slightly acid (pH 6.2); clear, smooth boundary.

A_3 6 to 11 inches, brown (10YR 5/3) heavy sandy loam; dark brown (10YR 3/3) when moist; nearly massive when dry; weak, fine, granular structure when moist; slightly hard when dry, friable when moist; slightly sticky when wet; numerous fine pores; locally abundant worm casts and channels; medium-sized roots common; micaceous; medium acid (pH 6.0); clear, wavy boundary.

B_1 11 to 22 inches, light-brown (7.5YR 6/4) light sandy clay loam; dark brown (7.5YR 4/4) when moist; thin clay films nearly continuous on ped faces, and continuous in pores; clay films are reddish brown (5YR 5/4) or yellowish red (5YR 5/6) when moist; weak, coarse, subangular blocky structure; hard when dry, firm when moist, slightly sticky when wet; a few fine pores; numerous root channels, some fairly large; some medium-sized roots; micaceous; medium acid (pH 5.7); diffuse, smooth boundary.

B_2 22 to 44 inches, reddish-brown (5YR 5/4) sandy clay loam; yellowish red (5YR 5/6) when moist; moderate, medium and coarse, blocky structure; very hard when dry, firm when moist, sticky when wet; moderately thick, continuous clay films; strongly acid (pH 5.5); diffuse, smooth boundary.

C_1 44 to 58 inches, very pale brown (10YR 7/4) sandy loam; yellowish brown (10YR 5/4) when moist; massive; hard when dry, friable when moist; micaceous; medium acid (pH 6.0); clear, irregular boundary.

C_2D_r 58 inches +, weathered, physically disintegrated quartz diorite; variable in color; several to many feet thick; grades to unweathered rock.

This soil has several features characteristic of the lateritic group. It has a dark-colored A horizon with a high carbon: nitrogen ratio, generally between 20 and 25. This horizon seems to be associated with a vegetation consisting of shrubs and small trees. The reddish-brown B horizon has a moderate grade of structure and a moderate increase in clay as compared with the A and C horizons. The soil is slightly acid in the A horizon and strongly acid in the B horizon, suggesting that bases are being leached downward and that the whole profile is slowly becoming more acid.

Humic Gley soils

Humic Gley soils are poorly to very poorly drained hydromorphic soils that have a moderately thick, dark-colored organic-mineral horizon underlain by a mineral gley horizon (*8*). Gley horizons are ordinarily bluish gray or olive gray, more or less sticky, compact, and often structureless. They develop where moisture is excessive (*9*).

Humic Gley soils occur in the basin and on the flood plain, in areas where surface runoff was very slow and the water table was high. Extensive pumping and other drainage practices have improved the drainage greatly in most areas, but evidence of the original poor drainage is still present. Dense growths of grasses, sedges, and reeds produced large amounts of organic matter, which darkened the soils to considerable depth in most places.

The underlying material is typically olive gray or olive brown and more or less mottled.

Three stages of development are recognized: (1) dark-colored A horizon only; (2) dark-colored A horizon and minimal (weak) textural B horizon, and (3) dark-colored A horizon and medial (moderate) textural B horizon. Two of these stages include soils that have a hardpan.

Dark-colored A horizon only.—This stage is illustrated by a profile of Foster loam located in the SE¼NW¼ sec. 6, T. 13 S., R. 15 E.

A_{11p} 0 to 20 inches, gray (10YR 5/1) loam; very dark gray (10YR 3/1) when moist; weak, very fine, granular structure; slightly hard when dry, friable when moist; highly micaceous; high in organic matter; roots very numerous; mildly alkaline (pH 7.5); moderately calcareous; clear, smooth boundary.

A_{12g} 20 to 32 inches, gray (10YR 6/1), stratified, highly micaceous loam, fine sandy loam, or fine sand; common, fine, distinct, yellowish-brown (10YR 5/4 and 5/8) mottles; when moist, dark gray (10YR 4/1) with strong-brown (7.5YR 5/6 and 5/8) mottles; highly micaceous; massive; slightly hard when dry, friable when moist; high in organic matter; roots numerous; mildly alkaline (pH 7.7); moderately calcareous, the lime disseminated; gradual, smooth boundary.

C_g 32 to 60 inches, light brownish-gray (10YR 6/2), stratified loam, fine sandy loam, or fine sand; mottled like A_{12g}; dark grayish brown when moist; highly micaceous; roots less numerous and lime content more variable than in A_{12g} horizon; mildly alkaline (pH 7.8).

This profile developed in poorly drained recent alluvium, mostly granitic. A thick, dark-colored A horizon, high in organic matter, is its outstanding feature. The A_{12g} and C horizons are mottled and the profile contains variable amounts of lime, but a B horizon of clay accumulation has not formed.

Two other series—the Grangeville and Pozo—are classified as Humic Gley soils at this stage of development.

The Grangeville series consists of grayish-brown, imperfectly drained, moderately coarse textured soils developed from recent granitic alluvium. These soils are moderately low in organic matter in the A horizon but are otherwise similar to the Foster soils. In most places, pumping has lowered the water table, but the dark-colored A horizon and mottled underlying horizons remain as evidence of poor natural drainage.

The Pozo series consists of dark-gray, imperfectly drained, medium-textured soils derived mainly from granitic alluvium. The A horizon contains a moderate amount of organic matter. It is underlain by a light-colored horizon high in lime, and there is a thin, strongly cemented, lime-silica C_{mca} horizon at a moderate depth. The origin of this soil is obscure; several processes or overlapping stages of development may be involved.

Dark-colored A horizon and weak textural B horizon.—This stage is illustrated by a profile of Chino loam located in the SW¼NE¼ sec. 30, T. 11 S., R. 16 E.

A_1 0 to 4 inches, gray (10YR 5/1) loam; very dark gray (10YR 3/1) when moist; nearly massive when dry, and very weak, fine, granular structure when moist; very hard when dry, friable when moist; moderately high in organic matter; roots very numerous; few fine pores; neutral (pH 6.9); noncalcareous; clear, smooth boundary.

B_2 4 to 11 inches, light-gray (10YR 6/1) light clay loam; dark gray (10YR 4/1) when moist; weak, medium, subangular blocky structure; very hard when dry, firm when moist; thin, patchy clay films; moderately low in organic matter; few roots; numerous fine pores; neutral (pH 6/8); noncalcareous; clear, slightly wavy boundary.

B_{3ca} 11 to 22 inches, grayish-brown (10YR 5/2) heavy loam; dark grayish brown (10YR 4/2) when moist; whitish (10YR 8/2) seams, blotches, and soft lime segregations; weak, medium, subangular blocky structure; very hard when dry, firm when moist; clay films few and very thin; few fine roots; numerous pores, mostly fine; moderately alkaline (pH 7.9); moderately calcareous; clear, slightly wavy boundary.

C_{1g} 22 to 48 inches, grayish-brown (2.5Y 5/2) loam; dark grayish brown (2.5Y 4/2) when moist; massive; hard when dry, friable to firm when moist; few fine roots; numerous pores, mostly fine; moderately alkaline (pH 7.9); slightly calcareous; gradual, wavy boundary.

C_{2g} 48 to 64 inches +, light olive-brown (2.5Y 5/4) loam; olive brown (2.5Y 4/4) when moist; massive; hard when dry, friable to firm when moist; numerous pores, mostly fine; mildly alkaline (pH 7.7); very slightly calcareous.

This soil has a gray A horizon moderately high in organic matter. The B_2 horizon appears to be developing in the lower part of the original A Horizon. The structure of the B horizon is weak, and the increase in clay content is slight. Soft segregations of lime occur in the lower part of the B horizon. The reaction is neutral in the A and B horizons and moderately alkaline in the lower part of the profile.

Two other series—the Bear Creek and the Temple—are classified as Humic Gley soils at this stage of development.

The Bear Creek series consists of dark-gray, imperfectly to moderately well drained, medium-textured soils derived mainly from granitic alluvium. These soils are on narrow alluvial fans and flood plains, mainly in the old low terraces. The organic-matter content of the A horizon is moderately low, and in many ways these soils are intermediate between the Humic Gley soils and the Noncalcic Brown soils, with which they are associated.

The Temple series consists of dark-gray, poorly to imperfectly drained, medium textured to moderately fine textured soils derived mainly from granitic alluvium. The organic-matter content of the A horizon is moderate, and the increase in clay in the B horizon is slight. Lime is normally segregated in the upper or lower part of the B horizon, which is olive gray and mottled.

Dark-colored A horizon and moderate textural B horizon.—There are two series—the Rossi and the Alamo—that consist of Humic Gley soils at this stage of development.

The Rossi series consists of gray, poorly to imperfectly drained, medium textured to moderately fine textured soils derived mainly from granitic alluvium. The organic-matter content of the A horizon is high. A moderate amount of clay has accumulated in the mottled, olive-gray B horizon. Typically, these soils are moderately to strongly saline, and the B horizon contains more than 15 percent exchangeable sodium. For this reason, the Rossi soils have properties grading to those of soils in the Solonetz great soil group.

The Alamo series consists of gray, poorly drained, fine-textured soils derived from predominantly granitic alluvium. They have an iron-silica hardpan in the subsoil.

Although gray in color, the A horizon is low in organic matter. These soils occupy depressions on low terraces. They are associated with the San Joaquin and Madera soils, which also have an iron-silica hardpan.

Solonetz soils

Solonetz soils have a thin surface layer of light-colored, leached, ashy material over a darker colored, tough, heavy subsoil of columnar structure. The lower part of the subsoil is generally light gray and highly calcareous (*9*).

Solonetz soils are extensive in the low-lying parts of the basin. The parent material was alluvium derived from granitic and mixed rocks. Drainage is good to imperfect.

Three stages of development are recognized in this Area: (1) minimal (weak), (2) medial (moderate) with hardpan, and (3) maximal (strong) with hardpan.

Minimal development.—This stage is illustrated by a profile of Traver loam located in the SE¼NE¼ sec. 34, T. 11 S., R. 16 E.

A_1 0 to 3 inches, pale-brown (10YR 6/3) loam; brown (10YR 5/3) when moist; essentially massive; many fine, vesicular pores; slightly hard when dry, very friable when moist; low in organic matter; contains much sharp, fine, siliceous sand and small plates and fragments of mica; strongly alkaline (pH 10.0); slightly calcareous; abrupt, smooth boundary.

B_2 3 to 17 inches, light yellowish-brown (2.5Y 6/4) light sandy clay loam; light olive brown (2.5Y 5/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; thin, patchy clay films; strongly alkaline (pH 10.2); slightly calcareous; abrupt, smooth boundary.

B_3 17 to 24 inches, pale-yellow (2.5Y 7/4) fine sandy loam; light olive brown (2.5Y 5/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; thin, patchy clay films; strongly alkaline (pH 8.9); slightly calcareous, lime occurring in small, soft, lighter colored segregations and nodules; gradual, smooth boundary.

C 24 to 64 inches, light yellowish-brown (10YR 6/4) stratified fine sandy loam; dark yellowish brown (10YR 4/4) when moist; massive; slightly hard when dry, friable when moist; strongly alkaline (pH 8.7); moderately calcareous.

This profile is strongly saline. The reaction is strongly alkaline throughout, and the percentage of exchangeable sodium is very high. The organic-matter content of the A horizon is low, and there has been only a slight increase in the clay content of the B horizon.

Medial development with hardpan.—The Fresno soils are at this stage of development. They developed from moderately old granitic alluvium deposited in the basin. They have a lime-silica hardpan below the blocky sandy clay loam B horizon. The A horizon is light gray and low in organic matter.

Maximal development with hardpan.—The Lewis soils are at this stage of development. They formed in alluvium derived from granitic rocks and basic rocks. The profile is much like that of the Fresno soils, but the A horizon is somewhat darker colored and higher in organic matter, and the B horizon consists of brown, blocky clay.

Grumusols

Grumusols (*3*) are dark-colored clayey soils that have a crumbly granular surface structure or a gilgai microrelief or both. Other characteristics are a high coefficient of expansion and contraction, extremely plastic consistence, montmorillonitic clays nearly saturated with calcium or with calcium and magnesium, mostly calcareous parent materials, dark color of low chroma, medium to low organic-matter content, tall grass or savanna vegetation, and no eluvial or illuvial horizons.

Grumusols occupy a limited area in the central part of the Madera Area. They occur mostly on the gently sloping lower foothills and old high terraces. The parent material consists of softly consolidated andesitic tuff, calcareous sandstone and shale, and basic igneous alluvium. Rainfall is low—about 13 to 16 inches—and drainage is good.

Three series in this Area—Porterville, Raynor, and Zaca—are classified as Grumusols. The following profile of Zaca clay, located in the NE¼SE¼ sec. 16, T. 10 S., R. 19 E., is representative.

A_{11} 0 to 2 inches, dark-gray (10YR 4/1) clay; very dark gray (10YR 3/1) when moist; moderate, fine, granular structure; loose when dry, friable when moist; strongly calcareous, the lime disseminated or in fine soft masses; numerous fine roots; porous; moderate in organic matter; mildly alkaline (pH 7.6) abrupt, smooth boundary.

A_{12} 2 to 19 inches, dark-gray (10YR 4/1) clay; very dark gray (10YR 3/1) when moist; weak, medium, subangular blocky structure; hard when dry, firm when moist; moderately low in organic matter; numerous fine pores; clear, smooth boundary.

A_{13} 19 to 29 inches, dark-gray (10YR 4/1) clay; very dark gray (10YR 3/1) when moist; weak, fine, subangular blocky structure; hard when dry, firm when moist; strongly calcareous, the lime disseminated or in fine, soft masses; numerous fine roots and fine pores; moderately low in organic matter; mildly alkaline, (pH 7.6); a few slickensides; clear, wavy boundary.

C 29 to 35 inches, coarsely mottled gray (10YR 5/1) clay; whitish (10YR 8/2) lime segregations; dark gray (10YR 4/1) when moist; massive; hard when dry, firm when moist; very strongly calcareous, the lime disseminated in soft to hard masses and thin seams; few roots and numerous fine pores; mildly alkaline (pH 7.7); clear, wavy boundary.

D_r 35 inches +, white (10YR 8/2) chalky to marly bedrock; massive and rather softly consolidated; very strongly calcareous (37 percent calcium carbonate equivalent); mildly alkaline (pH 7.8).

The dark-gray color and the moderate to moderately low organic-matter content to moderate depths are the outstanding features of Zaca soils.

The Porterville series consists of reddish-brown, blocky, fine-textured soils derived from basic alluvium. The upper part of the A horizon is noncalcareous, but in the lower part there are small amounts of soft, segregated lime.

The Raynor series consists of dark-gray, blocky, fine-textured soils derived from andesitic tuff. The upper part of the A horizon is noncalcareous, but in the lower part there are slight amounts of lime. The lime is mainly in the form of hard, light-colored segregations. The organic-matter content of the A horizon is low, though the color is dark gray.

Alluvial soils

Alluvial soils consist of recently deposited water-laid materials that have been very little changed by the environment. The characteristics of these soils are determined largely by the nature of the parent material and the manner in which this material was sorted and deposited. The climatic conditions, drainage, and vegetation vary widely (*9*).

In this Area, a representative example of the earliest stage in the development of a soil profile from well-drained granitic alluvium, free of excess soluble salts, alkali, and alkaline earth carbonates, is Hanford fine sandy loam. The profile described below is located in the SW¼NW¼ sec. 30, T. 10 S., R. 18 E.

A_1 0 to 12 inches, pale-brown (10YR 6/3) fine sandy loam; dark brown (10YR 4/3) when moist; massive when dry; very weak, very fine, granular structure when moist; slightly hard when dry, very friable when moist; very numerous fine roots and pores in the uppermost few inches; slightly acid; low in organic matter; gradual, smooth boundary.

C_1 12 to 36 inches, pale-brown (10YR 6/3) fine sandy loam; dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist; neutral; diffuse boundary.

C_2 36 to 60 inches +, light yellowish-brown (10YR 6/4) stratified fine sandy loam, sandy loam, and loamy sand; yellowish brown (10YR 5/4) when moist; massive; slightly hard to soft when dry, very friable when moist; mildly alkaline.

The Hanford soils have a minimum of horizon differentiation. The color is nearly uniform throughout the profile, except for a slight darkening of the A horizon as the result of organic-matter accumulation. The structure is essentially massive throughout, except for very weak granulation during the moist, cool, rainy period. The consistence changes little with depth. The reaction is nearly neutral throughout, and it tends to increase slightly with depth. Normally, these soils contain no lime, but traces are sometimes found in the lower part of the subsoil or in the substratum.

In this Area there are, in addition to the Hanford series, seven series that consist of soils derived from recent alluvial materials: the Cajon, Columbia, El Peco, Hildreth, Tujunga, Visalia, and Wunjey series.

The Cajon series consists of pale-brown, slightly calcareous, coarse-textured, somewhat excessively drained soils derived from granitic sediments. These soils are coarser textured than the Hanford soils, and they contain small amounts of lime and are, consequently, mildly to moderately alkaline instead of nearly neutral. The Cajon soils are single grained, loose, and very rapidly permeable. They are associated with the dark-colored Grangeville soils and occur on low, nearly level alluvial fans and flood plains on which slightly calcareous granitic sediments are deposited.

The Columbia series consists of pale-brown, noncalcareous, moderately coarse textured, imperfectly drained soils derived from materials chiefly of granitic origin. Mottling, principally in the subsoil and substratum, is common. The organic-matter content of the A horizon is moderate. More moisture accounts for both the moderate organic-matter content of the A horizon and the mottling in the subsoil and substratum.

The El Peco series consists of very pale brown, slightly to moderately calcareous, moderately coarse textured to medium textured, imperfectly drained soils that have a strongly cemented lime-silica hardpan at a moderate depth. The underlying sediments consist of silt interstratified with fine sand. These materials were derived mainly from granitic rocks. The reaction is normally moderately to strongly alkaline and increases in alkalinity with depth. Excess salts and alkali are common. The strongly alkaline reaction presumably has been responsible for the solution of silicates in the profile and their concentration in the lime-silica hardpan in the lower part of the subsoil. The slowly to very slowly permeable underlying silt also restricts the downward movement of water and favors the formation of the hardpan. These soils are typically associated with the Fresno soils in the basin. They appear to be an early stage in the formation of the Fresno soils. Several hardpan layers, separated by layers of softer sediments, may be present in the substratum; apparently there were several stages of deposition and incipient hardpan formation.

The Hildreth series consists of gray, fine-textured, imperfectly drained soils derived from dominantly granitic sediments. The surface horizon is noncalcareous, but lime, largely in the form of soft nodules, is present in slight to moderate amounts in the subsoil. These soils occupy very gentle slopes in swales and drainageways on the older terraces and lower foothills. They are associated chiefly with the Cometa, San Joaquin, and Vista soils. The fine texture and lime content raise some question as to the origin of the parent material of these soils. Although dark colored and imperfectly drained, they are moderately low in organic matter. Presumably, most of the organic matter produced each year decomposes during the long, warm, rainless summer, and little of it accumulates. Except for some lime segregation in the subsoil, profile development is very weak. Because of their fine texture, these soils have some of the features of the Raynor soils, which are in the Grumusol (*3*) great soil group.

The Tujunga series consists of pale-brown, noncalcareous, coarse-textured, somewhat excessively drained soils derived from granitic sediments. Except for being coarse textured instead of moderately coarse textured, these soils are similar to the Hanford soils. Except for the absence of lime, they are similar to the Cajon soils. They are associated chiefly with the Hanford soils and accupy present or abandoned waterways on recent alluvial fans and flood plains. Swift-moving streams and floodwaters account for the coarse texture and stratification.

The Visalia series consists of gray to dark-gray, noncalcareous, moderately coarse textured, moderately well drained soils derived from granitic sediments. These soils occur in swales and other nearly level spots on the lower alluvial fans and on the flood plains. Because of the imperfect natural drainage, the vegetation was abundant, and a thick, dark-colored A horizon formed. The Visalia soils are similar to the Grangeville soils but are lime free.

The Wunjey series consists of pale-brown, slightly calcareous, medium-textured, moderately well drained soils derived chiefly from granitic alluvium. Except for being medium textured instead of moderately coarse textured, slightly calcareous, and slightly to strongly saline-alkali, these soils are much like the Hanford soils.

Regosols

Regosols have much in common with Alluvial soils from the standpoint of profile development and horizon distinction. Regosols consist of deep unconsolidated rock (soft mineral deposits) in which few or no clearly expressed soil characteristics have developed; they are confined largely to recent sand dunes and to steeply sloping areas of loess and glacial drift (*8*).

A representative example of a Regosol in this area is Delhi sand. The following profile is located in the SW¼SW¼ sec. 6, T. 11 S., 17 E.

- C_1 0 to 12 inches, pale-brown (10YR 6/3) sand; brown (10YR 5/3) when moist; single grained; loose when dry or moist; mica flakes common; few roots; mildly alkaline; very low in organic matter; diffuse boundary.
- C_2 12 to 24 inches, pale-brown (10YR 6/3) sand; brown (10YR 5/3) when moist; single grained; loose when dry or moist; slightly acid; diffuse boundary.
- C_3 24 to 60 inches, light yellowish-brown (10YR 6/4) sand; yellowish brown (10YR 5/4) when moist; single grained; loose when dry or moist; medium acid.

The Delhi soils have a very deep, uniform profile. They were derived from recent and somewhat older wind-reworked granitic alluvium. The only evidence of profile development is a very slight increase in organic-matter content in the C_1 horizon. Because of the coarse texture, it is likely to be a long time before these soils show much change.

The only other Regosols in the Area are the Calhi soils. They are similar to the Delhi but are slightly calcareous, principally in the subsoil and substratum, and are moderately to strongly alkaline in reaction because they contain excess salts or alkali or both. These soils occur mostly in the basin, in association with Fresno, El Peco, and Dinuba soils. They occupy large mounds and undulating ridges, so they are at slightly higher elevations and on stronger slopes than the associated soils. It is likely that they developed as a result of wind erosion of the surface horizons of the associated soils.

Lithosols

Lithosols have an incomplete solum or no clearly expressed soil morphology; they consist of a freshly and imperfectly weathered mass of hard rock or hard rock fragments and are largely confined to steeply sloping land (*8*).

The Daulton soils, which were derived from graphitic slate, are representative of the Lithosols in this Area. The following profile is located in the NW¼ sec. 4, T. 9 S., R. 18 E.

- A_{11} 0 to 5 inches, dark grayish-brown (10YR 4/2) loam; very dark grayish brown (10YR 3/2) when moist; massive when dry, and weak, fine and very fine, granular structure when moist; hard when dry, friable when moist; grass roots and pores numerous; thin, small slate fragments and chiastolites numerous; moderate in organic matter; slightly acid (pH 6.2) gradual, smooth boundary.
- A_{12} 5 to 17 inches, grayish-brown (10YR 5/2) loam; dark grayish brown (10YR 4/2) when moist; massive when dry; weak, fine, granular structure when moist; very hard when dry, and firm when moist; slate fragments more numerous than in A_{11} horizon; moderately low in organic matter; abrupt but very irregular boundary.
- D_r 17 inches +, light olive-brown (2.5Y 5/4), partly shattered, hard, slaty rock; olive brown (2.5Y 4/4) when moist; some soil material of neutral reaction in thin cracks in upper part; rock is less shattered and more massive with increasing depth.

The dark grayish-brown color and moderate organic-matter content of the A horizon are the distinctive features of these shallow soils. The texture is moderately coarse or medium. The reaction is slightly acid. Numerous tombstonelike outcrops of the parent slate are a conspicuous feature. The soils occur in the lower foothills. Low effective precipitation, loss of water by runoff, and hardness of the parent rock appear to be the principal reasons why these soils are shallow over bedrock.

In this Area there are five other series that are classified as Lithosols: the Hideaway, Hornitos, Tollhouse, Trigo, and Whiterock series.

The Hideaway series consists of brown, medium-textured, strongly acid soils that are moderately low in organic matter. These soils occur on basaltic lava flows that cap some of the mesas in the foothills. Moderately low precipitation, hardness of the bedrock, and possibly its recent origin, appear to account for the shallow profile.

The Hornitos series consists of pale-brown, moderately coarse textured, medium to strongly acid soils that are moderately low in organic matter. These soils overlie conglomerate and sandstone in the lower foothills. The parent rock is composed largely of resistant minerals, mostly quartz and kaolinite, and is usually strongly acid in reaction. Resistance of the parent rock to further weathering, low effective rainfall, and loss of water by runoff account for the shallow profile.

The Tollhouse series consists of very dark grayish-brown, moderately coarse textured, slightly acid soils that are moderate in organic matter. These soils were derived from material weathered from granitic bedrock and occur on steeply sloping fault scarps and canyon walls in the lower mountains. Precipitation is moderate in amount, but it is not effective, because of very rapid runoff. Hard bedrock, steep slopes, and rapid runoff appear to account for the shallow profiles of these soils.

The Trigo series consists of pale-brown, moderately coarse textured, slightly acid soils that are moderately low in organic matter. These soils are underlain by softly consolidated silty granitic alluvium. They occur on dissected parts of old, low terraces. Low and ineffective precipitation appears to account for the shallow profile, rather than runoff or hardness of the underlying material.

The Whiterock series consists of light brownish-gray, moderately coarse textured, medium acid soils that are moderate in organic matter. These soils were derived from sandy slate and schist. They occur in the lower foothills. Tombstonelike outcrops of rock are common. Low effective precipitation, runoff, and hardness of the parent rock appear to be the principal reasons for the shallow profile.

Laboratory Data

Tables 18, 19, 20, and 21 give the results of laboratory analyses of samples of representative soils of the Madera Area. For the soils that are listed in two or more of these tables, the same samples were used for each set of tests.

TABLE 18.—*Mechanical analyses of samples of representative soils of the Madera Area, Calif.*

[Analysis by modified Bouyoucos hydrometer method: Clay determined by hydrometer according to Day (Univ. of Calif.) procedure; sand determined by wet sieving; silt determined by calculating difference between total sand and clay and total sample]

Soil	Depth in inches	Total gravel (>2 mm.)	Sand						Silt (0.05–0.002 mm.)	Clay (<0.002 mm.)
			Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Total sand		
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Alamo clay	0 to 12	0.0						38.4	22.1	39.5
	12 to 22	0						29.5	23.0	47.5
	22 to 30	Hardpan								
Atwater loamy sand	0 to 12	.3	4.0	15.5	26.3	21.3	9.1	76.2	18.3	5.5
	12 to 24	.4						70.6	20.4	9.0
	24 to 39	.1						64.2	17.8	18.0
	39 to 60	0						76.8	9.2	14.0
Bear Creek loam [1]	0 to 20	13.3	4.4	6.6	7.7	23.4	20.9	63.1	13.4	23.5
	20 to 32	50.3						72.1	9.9	18.0
	32 to 43	77.2						82.6	4.9	12.5
	43 to 58	51.6						50.4	13.1	36.5
Borden fine sandy loam	0 to 17	0						62.4	29.6	8.0
	17 to 21	0						54.0	27.0	19.0
	21 to 28	0						61.7	25.3	13.0
	28 to 60	0						61.5	29.5	9.0
Buchenau loam	0 to 8	12.4						49.9	28.6	21.5
	8 to 16	11.4						40.9	31.6	27.5
	16 to 30	11.4						42.0	31.0	27.0
	30 to 38	Lime hardpan								
Calhi loamy sand	0 to 14	0						89.6	5.4	5.0
	14 to 22	0						86.5	8.5	5.0
	22 to 60	0						87.3	8.7	4.0
Chino loam	0 to 4	0						45.1	31.9	23.0
	4 to 11	0						42.1	32.9	25.0
	11 to 22	0						51.8	27.2	21.0
	22 to 48	0						51.9	29.1	19.0
	48 to 64	0						43.5	35.5	21.0
Coarsegold loam	0 to 5	12.4	2.8	2.2	2.5	9.1	26.3	42.9	36.1	21.0
	5 to 17	15.2						40.2	36.8	23.0
	17 to 27	41.7						36.8	30.2	33.0
	27 to 38	17.2						39.6	25.4	35.0
	38 to 50	Mica-schist bedrock								
Columbia fine sandy loam	0 to 14	0						28.8	53.2	18.0
	14 to 36	0						57.0	33.0	10.0
	36 to 60	0						56.1	36.9	7.0
Cometa sandy loam	0 to 7	2.8	6.8	12.0	9.6	22.3	18.2	68.1	16.9	15.0
	7 to 17	2.4						66.9	18.6	14.5
	17 to 27	1.0						48.2	12.8	39.0
	27 to 40+	1.3						72.4	8.6	19.0
Corning gravelly loam	0 to 5	45.5						40.8	39.2	20.0
	5 to 10	51.9						36.1	32.9	31.0
	10 to 18	56.8						28.8	8.2	63.0
	18 to 25	63.7						27.2	3.8	69.0
	25 to 38+	52.5						47.1	6.9	36.0
Daulton loam	0 to 5	28.0						32.5	49.5	18.0
	5 to 17	0						43.6	37.4	19.0
	17+	Slate bedrock								
Daulton fine sandy loam	0 to 7	.8	.6	.7	2.8	33.9	31.2	69.2	21.8	9.0
	7 to 15	5.7	.3	.6	2.7	33.7	30.7	68.0	22.0	10.0
	15+	Slate bedrock								
Delhi sand	0 to 12	0						96.9	1.1	2.0
	12 to 24	0						97.0	0	3.0
	24 to 60	0						96.3	.7	3.0

[1] Not representative, because gravel masks texture and structure of subsoil.

TABLE 18.—*Mechanical analyses of samples of representative soils of the Madera Area, Calif.*—Continued

Soil	Depth in inches	Total gravel (>2 mm.)	Sand: Very coarse sand (2–1 mm.)	Sand: Coarse sand (1–0.5 mm.)	Sand: Medium sand (0.5–0.25 mm.)	Sand: Fine sand (0.25–0.10 mm.)	Sand: Very fine sand (0.10–0.05 mm.)	Sand: Total sand	Silt (0.05–0.002 mm.)	Clay (<0.002 mm.)
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Dinuba fine sandy loam	0 to 10	2. 2	2. 9	12. 9	17. 5	14. 9	20. 2	68. 4	25. 6	6. 0
	10 to 13	0						58. 3	26. 7	15. 0
	13 to 24	0						58. 4	31. 6	10. 0
	24 to 35	16. 3						9. 4	69. 6	21. 0
	35 to 50	0						45. 5	49. 5	5. 0
Foster loam	0 to 20	0						37. 7	40. 3	22. 0
	20 to 32	0						31. 4	46. 6	22. 0
	32 to 60	0						58. 1	33. 9	8. 0
Grangeville fine sandy loam	0 to 11	5. 9						75. 3	15. 7	9. 0
	11 to 20	4. 7						75. 1	14. 9	10. 0
	20 to 60	0						58. 6	26. 4	15. 0
Greenfield coarse sandy loam	0 to 23	15. 6	23. 2	25. 7	12. 1	12. 1	8. 6	81. 7	9. 8	8. 5
	23 to 37	18. 2						79. 5	10. 0	10. 5
	37 to 51	12. 8						74. 7	11. 8	13. 5
	51 to 72	18. 7						83. 7	6. 8	9. 5
Hanford fine sandy loam	0 to 12	0						61. 1	26. 9	12. 0
	12 to 36	0						56. 9	29. 1	14. 0
	36 to 60	0						60. 8	28. 2	11. 0
Hanford (Ripperdan) fine sandy loam, moderately deep and deep over silt.	0 to 10	0						52. 2	39. 8	8. 0
	10 to 26	0						51. 0	42. 0	7. 0
	26 to 27½	Weakly cemented material								
	27½ to 48	0						21. 2	72. 8	6. 0
Hanford fine sandy loam, moderately deep and deep over hardpan.	0 to 12	0						50. 6	39. 4	10. 0
	12 to 34	0						49. 3	40. 7	10. 0
	34 to 38	0						61. 8	33. 2	5. 0
	38+	Unrelated hardpan								
Hideaway very stony loam	0 to 10	1. 6						19. 4	52. 1	28. 5
	10+	Bedrock								
Hildreth sandy clay	0 to 12	1. 1	3. 1	4. 1	8. 2	15. 7	12. 5	43. 6	22. 9	33. 5
	12 to 21	6. 1						45. 5	22. 5	32. 0
	21 to 34	2. 8						52. 7	20. 8	26. 5
	34+	Weathered granitic bedrock, unrelated								
Jesbel gravelly clay loam	0 to 5	29. 2	7. 3	8. 7	6. 0	16. 6	18. 1	56. 7	14. 8	28. 5
	5 to 14	20. 5						57. 1	12. 9	30. 0
	14 to 24	23. 0						47. 9	10. 1	42. 0
	24 to 33	36. 0	Caliche hardpan							
	33 to 42+	68. 6						77. 9	7. 6	14. 5
Lewis loam	0 to 5	0						46. 9	40. 1	13. 0
	5 to 11	0						36. 5	48. 5	15. 0
	11 to 20	0								
	20 to 28	18. 1						27. 0	43. 0	30. 0
	28 to 40	9. 5						31. 8	44. 2	24. 0
	40 to 48	Hardpan								
	48 to 60	0						38. 3	46. 7	15. 0
Marguerite loam [2]	0 to 10	8. 2						46. 2	31. 3	22. 5
	10 to 29	12. 4						50. 1	29. 4	20. 5
	29 to 38	21. 7						54. 8	27. 2	18. 0
	38 to 60	63. 6						67. 7	18. 3	14. 0
Montpellier coarse sandy loam	0 to 11	11. 2	18. 4	18. 7	16. 6	15. 5	9. 5	78. 7	12. 8	8. 5
	11 to 23	12. 9						71. 7	6. 3	22. 0
	23 to 40	24. 6						76. 6	4. 9	18. 5
	40 to 60	36. 3						85. 1	2. 4	12. 5
Pachappa fine sandy loam	0 to 14	0						61. 8	27. 2	11. 0
	14 to 28	0						52. 7	31. 3	16. 0
	28 to 45	0						64. 0	23. 0	13. 0
	45 to 60	0						82. 9	10. 1	7. 0
Porterville clay	0 to 14	0						15. 6	26. 9	57. 5
	14 to 22	4. 6						15. 4	27. 6	57. 0
	22 to 36	5. 8						16. 4	27. 1	56. 5
	36+	Unrelated bedrock								

[2] Not representative, because gravel masks texture and structure of subsoil.

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TABLE 18.—*Mechanical analyses of samples of representative soils of the Madera Area, Calif.*—Continued

Soil	Depth in inches	Total gravel (>2 mm.)	Sand: Very coarse sand (2–1 mm.)	Sand: Coarse sand (1–0.5 mm.)	Sand: Medium sand (0.5–0.25 mm.)	Sand: Fine sand (0.25–0.10 mm.)	Sand: Very fine sand (0.10–0.05 mm.)	Sand: Total sand	Silt (0.05–0.002 mm.)	Clay (<0.002 mm.)
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Pozo loam	0 to 11	0						49. 3	28. 7	22. 0
	11 to 22	0						39. 5	33. 5	27. 0
	22 to 24	Hardpan								
	24 to 36	0						66. 7	27. 3	6. 0
Raynor clay	0 to 3	. 8	1. 1	3. 6	3. 8	7. 8	8. 1	24. 4	24. 6	51. 0
	3 to 27	. 5						24. 8	23. 7	51. 5
	27 to 37	14. 2						43. 1	26. 4	30. 5
	37+	Softly consolidated andesitic tuff parent rock								
Rocklin rocky sandy loam, pumiceous variant.	0 to 6	6. 3						75. 5	18. 5	6. 0
	6 to 18	5. 4						73. 6	18. 4	8. 0
	18 to 32	7. 3						71. 9	12. 1	16. 0
	32 to 36+	13. 0						80. 7	6. 3	13. 0
Rossi silt loam	0 to 3	0						26. 1	51. 9	22. 0
	3 to 14	0						27. 4	40. 6	32. 0
	14 to 38	0						32. 9	36. 1	31. 0
	38 to 66	0						41. 6	43. 3	15. 0
Sesame sandy loam	0 to 8	2. 9	7. 7	13. 2	10. 6	19. 2	14. 7	65. 4	19. 6	15. 0
	8 to 17	1. 6	7. 3	9. 6	14. 5	19. 3	11. 9	62. 6	15. 4	22. 0
	17 to 27	1. 2	7. 5	13. 5	11. 0	19. 0	12. 7	63. 7	15. 3	21. 0
	27 to 40	38. 8	8. 2	11. 2	21. 2	34. 2	14. 4	89. 2	6. 8	4. 0
Temple loam	0 to 5	0						45. 3	30. 7	24. 0
	5 to 20	0						55. 2	18. 8	26. 0
	20 to 28	0						52. 3	21. 7	26. 0
	28 to 54	0						49. 4	22. 6	28. 0
	54 to 64	0						56. 5	26. 4	17. 0
Tollhouse rocky coarse sandy loam	0 to 6	0	12. 8	16. 0	20. 7	20. 8	9. 3	79. 6	12. 4	8. 0
	6 to 20	0						80. 1	8. 9	11. 0
	20+	Bedrock								
Trabuco loam	0 to 10	10. 6	5. 3	4. 6	6. 1	13. 6	13. 9	43. 5	31. 5	25. 0
	10 to 27	28. 1						39. 5	21. 5	39. 0
	27 to 42	4. 2						19. 2	17. 8	63. 0
	42 to 56	6. 4						14. 3	13. 7	72. 0
Traver loam	0 to 3	0	1. 4	3. 2	6. 2	14. 8	22. 2	47. 8	34. 2	18. 0
	3 to 17	0						56. 5	22. 5	21. 0
	17 to 24	0						57. 9	27. 1	15. 0
	24 to 64	0						64. 4	27. 6	8. 0
Trigo fine sandy loam	0 to 3	3. 9	5. 7	8. 3	9. 4	13. 5	13. 2	50. 1	39. 9	10. 0
	3 to 7	4. 0						48. 7	39. 8	11. 5
	7 to 16	3. 2						45. 6	40. 9	13. 5
	16+	Silty substratum								
Tujunga loamy sand	0 to 11	0						88. 8	5. 2	6. 0
	11 to 24	0						88. 7	6. 3	5. 0
	24 to 60	0						90. 7	4. 3	5. 0
Visalia fine sandy loam	0 to 12	0						56. 6	29. 4	14. 0
	12 to 35	0						57. 5	29. 5	13. 0
	35 to 60	0						76. 4	13. 6	10. 0
Vista coarse sandy loam	0 to 12	11. 3	11. 0	17. 4	13. 5	20. 2	12. 2	74. 3	17. 7	8. 0
	12 to 27	9. 0						74. 1	16. 9	9. 0
	27 to 36	5. 9						86. 5	7. 5	6. 0
	36+	Decomposing bedrock								
Whiterock rocky fine sandy loam	0 to 8	37. 5						48. 0	40. 0	12. 0
	8+	Bedrock								
Wunjey very fine sandy loam	0 to 12	0						57. 1	36. 9	6. 0
	12 to 24	0						59. 0	35. 0	6. 0
	24 to 60	0						62. 0	32. 0	6. 0
Zaca clay	0 to 2	1. 8						23. 9	29. 1	47. 0
	2 to 19	2. 1						20. 6	23. 4	56. 0
	19 to 29	3. 9						19. 7	19. 3	61. 0
	29 to 35	0						20. 8	23. 2	56. 0
	35+	1. 7	Softly consolidated parent material					46. 3	25. 7	28. 0

TABLE 19.—*Selected physical and chemical data on samples of representative soils of the Madera Area, Calif.*

[Dashes indicate data was not determined]

Soil	Depth	Bulk density [1]	pH [2]	$CaCO_3$ equivalent [3]	Moisture equivalent [4]	Organic matter [5]	Remarks
	In.	*Gm./cc.*		*Percent*	*Percent*	*Percent*	
Ahwahnee coarse sandy loam	0 to 8	--------	6.3	--------	14.1	2.71	
	8 to 22	--------	6.3	--------	13.8	1.57	
	22 to 36	--------	6.1	--------	12.7	.81	
	36 to 60	--------	6.2	--------	12.2	.53	
Alamo clay [6]	0 to 12	--------	5.9	--------	22.7	.68	
	12 to 22	--------	7.0	--------	26.9	.51	
	22 to 30	--------	--------	--------	--------	--------	Hardpan.
Atwater loamy sand [6]	0 to 12	--------	6.0	--------	6.9	.44	
	12 to 24	--------	6.5	--------	8.1	.23	
	24 to 39	--------	6.7	--------	12.2	.17	
	39 to 60	--------	6.8	--------	9.9	.06	
Bear Creek loam [6]	0 to 20	--------	6.4	--------	17.0	1.18	
	20 to 32	--------	6.7	--------	15.9	.48	
	32 to 43	--------	6.9	--------	12.6	.20	
	43 to 58	--------	7.4	0.3	24.1	.33	
Borden fine sandy loam [6]	0 to 17	1.5	6.2	--------	13.3	.61	
	17 to 21	1.7	8.4	.8	19.8	.48	
	21 to 28	1.4	9.2	3.0	17.6	.95	
	28 to 60	1.4	9.7	.9	14.1	.15	
Buchenau loam [6]	0 to 8	--------	7.9	9.8	23.6	1.85	
	8 to 16	--------	8.0	11.8	24.2	1.53	
	16 to 30	--------	8.3	13.5	24.6	1.16	
	30 to 38	--------	8.6	45.0	--------	--------	Lime hardpan.
Calhi loamy sand [6]	0 to 14	--------	8.3	.1	4.6	.42	
	14 to 22	--------	9.0	.8	5.8	.19	
	22 to 60	--------	10.5	1.3	5.1	.16	
Chino loam [6]	0 to 4	1.4	6.9	--------	26.8	4.85	
	4 to 11	1.7	6.8	--------	21.5	1.63	
	11 to 22	1.7	7.9	4.2	19.8	.62	
	22 to 48	1.8	7.9	1.1	17.5	.37	
	48 to 64	1.8	7.7	.1	19.1	.11	
Coarsegold loam [6]	0 to 5	--------	6.4	--------	20.9	2.83	
	5 to 17	--------	6.6	--------	23.4	1.47	
	17 to 27	--------	6.6	--------	22.6	1.00	
	27 to 38	--------	6.5	--------	23.5	.65	
	38 to 50	--------	--------	--------	--------	--------	Mica schist bedrock.
Columbia fine sandy loam [6]	0 to 14	1.4	6.5	--------	25.0	2.93	
	14 to 36	1.3	6.7	--------	15.0	.77	
	36 to 60	--------	6.3	--------	--------	.68	
Cometa sandy loam [6]	0 to 7	--------	6.2	--------	11.1	.82	
	7 to 17	--------	6.3	--------	11.5	.33	
	17 to 27	--------	6.4	--------	24.5	.42	
	27 to 40	--------	7.2	<.1	16.5	.20	
Corning gravelly loam [6]	0 to 5	1.9	5.5	--------	18.6	1.99	
	5 to 10	2.0	5.6	--------	17.8	.75	
	10 to 18	--------	5.1	--------	24.6	.55	
	18 to 25	1.9	4.8	--------	30.9	.41	
	25 to 38	1.7	5.3	--------	24.6	.22	
Daulton loam [6]	0 to 5	1.6	6.2	--------	17.4	2.57	
	5 to 17	1.7	6.3	--------	17.2	1.17	
	17+	--------	--------	--------	--------	--------	Bedrock.
Daulton fine sandy loam [6]	0 to 7	--------	6.4	--------	12.3	1.39	
	7 to 15	--------	6.3	--------	10.9	.65	
	15+	--------	--------	--------	--------	--------	Bedrock.
Delhi sand [6]	0 to 12	--------	7.5	.1	2.9	.46	
	12 to 24	--------	6.2	--------	2.4	.12	
	24 to 60	--------	5.7	--------	2.7	.11	

See footnotes at end of table.

TABLE 19.—*Selected physical and chemical data on samples of representative soils of the Madera Area, Calif.*—Con.

Soil	Depth	Bulk density [1]	pH [2]	$CaCO_3$ equivalent [3]	Moisture equivalent [4]	Organic matter [5]	Remarks
	In.	*Gm./cc.*		*Percent*	*Percent*	*Percent*	
Dinuba fine sandy loam [6,7]	0 to 10	1.6	8.9	0.5	11.0	0.42	
	10 to 13	1.7	9.8	3.3	18.5	.12	
	13 to 24	1.6	10.2	2.1	14.0	.07	
	24 to 35	1.3	10.0	3.7	35.3	1.17	
	35 to 50	1.4	9.6	1.0	12.0	.10	
Fresno fine sandy loam	0 to 4	1.8	9.2	1.2	12.3	1.07	
	4 to 15	1.6	10.2	9.6	15.9	----	
	15 to 24	1.9	9.4	15.9	----	----	Hardpan.
	24 to 40	1.5	9.2	1.9	20.0	----	
	40 to 60	----	9.3	2.7	14.7	----	
Foster loam [6]	0 to 20	1.2	7.5	8.4	41.0	5.53	
	20 to 32	1.0	7.7	11.3	38.6	2.77	
	32 to 60	1.4	7.8	.4	17.5	.20	
Grangeville fine sandy loam [6,7]	0 to 11	1.5	7.8	.3	12.7	1.74	
	11 to 20	1.4	7.7	.2	12.5	1.29	
	20 to 60	1.5	9.0	1.6	19.6	.66	
Greenfield coarse sandy loam [6]	0 to 23	----	6.3	----	6.1	.41	
	23 to 37	----	6.6	----	6.9	.22	
	37 to 51	----	6.8	----	10.1	.17	
	51 to 72	----	7.0	----	6.5	.05	
Hanford fine sandy loam [6]	0 to 12	1.7	6.2	----	13.1	.84	
	12 to 36	1.5	7.3	.2	12.0	.33	
	36 to 60	1.4	7.7	.1	11.4	.29	
Hanford (Ripperdan) fine sandy loam, moderately deep and deep over silt.	0 to 10	1.6	6.9	----	12.2	.55	
	10 to 26	1.6	7.2	.1	12.7	.38	
	26 to 27½	1.6	8.4	----	----	----	Weakly cemented material.
	27½ to 48	1.4	8.7	.6	26.1	----	
Hanford fine sandy loam, moderately deep and deep over hardpan.[6]	0 to 12	1.6	6.3	----	12.2	.69	
	12 to 34	1.5	7.0	.2	12.4	.22	
	34 to 38	1.8	7.7	.1	----	----	
	38+	----	----	----	----	----	Unrelated hardpan.
Hideaway very stony loam [6]	0 to 10	----	5.0	----	27.1	2.05	
	10+	----	----	----	----	----	Bedrock.
Hildreth sandy clay [6]	0 to 12	----	6.9	----	26.5	1.12	
	12 to 21	----	7.8	.7	26.5	.79	
	21 to 34	----	7.9	3.2	22.4	.48	
	34+	----	----	----	----	----	Weathered granitic bedrock, unrelated.
Hornitos gravelly sandy loam	0 to 9	----	6.0	----	14.9	1.34	
	9 to 22	----	5.1	----	16.8	.31	
	22+	----	----	----	----	----	Bedrock, Ione conglomerate.
Jesbel gravelly clay loam [6]	0 to 5	----	7.2	----	20.3	2.01	
	5 to 14	----	6.8	----	19.9	1.18	
	14 to 24	----	7.1	<.1	27.0	.76	
	24 to 33	----	7.8	23.8	----	----	Caliche hardpan.
	33 to 42+	----	7.7	6.0	13.0	----	
Lewis loam [6]	0 to 5	1.5	7.4	.1	16.5	2.18	
	5 to 11	1.7	7.1	.1	18.4	1.31	
	11 to 20	----	7.5	----	----	----	
	20 to 28	1.7	8.6	4.2	40.2	.10	
	28 to 40	1.8	8.7	1.4	24.3	.34	
	40 to 48	1.6	8.5	11.9	----	----	Hardpan.
	48 to 60	1.6	7.9	1.1	17.7	----	
Madera loam	0 to 9	----	5.8	----	----	.91	
	9 to 18	----	6.9	----	----	.56	
	18 to 25	----	7.1	.1	----	.50	
	25 to 28	----	----	----	----	----	Hardpan

See footnotes at end of table.

TABLE 19.—*Selected physical and chemical data on samples of representative soils of the Madera Area, Calif.*—Con.

Soil	Depth	Bulk density [1]	pH [2]	$CaCO_3$ equivalent [3]	Moisture equivalent [4]	Organic matter [5]	Remarks
	In.	*Gm./cc.*		*Percent*	*Percent*	*Percent*	
Marguerite loam [6]	0 to 10		6.4		19.6	.95	
	10 to 29		6.8		17.4	1.04	
	29 to 38		7.0		16.4	.68	
	38 to 60		7.0		14.0	.47	
Montpellier coarse sandy loam [6]	0 to 11		6.2		8.4	.65	
	11 to 23		6.0		13.0	.37	
	23 to 40		6.3		12.4	.21	
	40 to 60		6.5		8.7		
Pachappa fine sandy loam [6,7]	0 to 14	1.6	7.7	0.1	13.7	.72	
	14 to 28	1.6	9.8	3.2	19.7	.40	
	28 to 45	1.7	10.4	1.0	15.2	.16	
	45 to 60	1.4	9.6	.2	8.2	.06	
Porterville clay [6]	0 to 14		6.9		35.5	1.11	
	14 to 22		7.5	.18	34.3	.91	
	22 to 36		7.7	1.0	33.1	1.07	
	36+						Unrelated bedrock.
Pozo loam [6]	0 to 11	1.7	7.2	.3	23.8	2.69	
	11 to 22	1.6	7.9	5.9	27.2	3.16	
	22 to 24			9.5			Hardpan.
	24 to 36		8.1	15.0	14.8		
Ramona sandy loam	0 to 8		5.8		11.7	.76	
	8 to 22		6.1		11.2	.38	
	22 to 42		6.3		11.4	.14	
	42 to 60		6.4		11.8	.12	
Raynor clay [6]	0 to 3		6.5		35.9	.85	
	3 to 27		7.5	.4	35.8	.55	
	27 to 37		7.5	3.5	30.4	.14	
	37+						Softly consolidated andesitic tuff parent rock.
Rocklin rocky sandy loam, pumiceous variant [6]	0 to 6	1.7	6.2		11.6	.73	
	6 to 18	1.6	5.6		10.1	.39	
	18 to 32	1.8	5.1		12.9	.27	
	32 to 36+	1.7	5.2		13.8	.14	
Rossi silt loam [6]	0 to 3		6.6		34.9	5.76	
	3 to 14	1.5	6.9		29.6	2.71	
	14 to 38	1.6	7.4	29.3	26.4		
	38 to 66		7.4	7.8	20.9		
San Joaquin sandy loam	0 to 5		5.9			.56	
	5 to 11		6.2			.27	
	11 to 19		6.1			.30	
	19 to 23						Hardpan.
	23 to 31+						
Sesame sandy loam [6]	0 to 8		6.2		14.5	.87	
	8 to 17		6.3		18.3	.53	
	17 to 27		6.5		18.5	.36	
	27 to 40		7.1	.07	5.5		
Temple loam [6]	0 to 5	1.6	7.0		39.5	3.41	
	5 to 20	1.8	7.9	5.3	24.1	.49	
	20 to 28	1.6	8.0	11.4	22.0	.44	
	28 to 54	1.7	7.9	12.7	19.1		
Tollhouse rocky coarse sandy loam [6]	0 to 6		6.7		11.1	2.12	
	6 to 20		7.0		9.2	.58	
	20+						Bedrock.
Trabuco loam [6]	0 to 10		6.4		21.5	1.84	
	10 to 27		6.4		22.2	.68	
	27 to 42		6.8		35.7	.51	
	42 to 56		7.0		42.6	.56	

See footnotes at end of table.

TABLE 19.—*Selected physical and chemical data on samples of representative soils of the Madera Area, Calif.*—Con.

Soil	Depth	Bulk density [1]	pH [2]	$CaCO_3$ equivalent [3]	Moisture equivalent [4]	Organic matter [5]	Remarks
	In.	*Gm./cc.*		*Percent*	*Percent*	*Percent*	
Traver loam [6]	0 to 3	1.6	10.0	2.1	19.6	0.56	
	3 to 17	1.5	10.2	2.3	20.9	.26	
	17 to 24	1.5	8.9	1.7	20.8	.21	
	24 to 64	1.2	8.7	4.5	22.6	.31	
Trigo fine sandy loam [6]	0 to 3		6.5		16.2	1.38	
	3 to 7		5.7		15.0	.70	
	7 to 16		5.9		16.2	.72	
	16+		6.8				Silty substratum.
Tujunga loamy sand [6]	0 to 11		7.1	.1	4.3	.24	
	11 to 24		6.8		3.6	.37	
	24 to 60		7.1	.1	3.4	.18	
Visalia fine sandy loam [6]	0 to 12	1.5	6.9		17.2	1.69	
	12 to 35	1.3	7.8	.2	15.7	1.18	
	35 to 60	1.6	7.9	.1	7.6	.38	
Vista coarse sandy loam [6]	0 to 12		6.6		11.3	1.00	
	12 to 27		6.4		10.4	.40	
	27 to 36		6.2		6.1	.09	
	36+						Decomposing bedrock.
Whiterock rocky fine sandy loam [6]	0 to 8	1.7	6.1		18.6	2.06	
	8+						Bedrock.
Whitney fine sandy loam	0 to 19		6.9		17.2	.81	
	19 to 28		7.0		18.9	.34	
	28+		7.8	3.8	21.6	.34	
Wunjey very fine sandy loam [6]	0 to 12		9.6	.7	18.4	.88	
	12 to 24		10.6	.7	17.3	.42	
	24 to 60		10.5	.6	17.6	.23	
Zaca clay [6]	0 to 2		7.6	8.9	35.1	2.28	
	2 to 19		7.6	7.8	37.2	1.71	
	19 to 29		7.6	8.8	37.8	1.02	
	29 to 35		7.7	17.7	37.5	.92	
	35+		7.8	[7] 36.5			

[1] Determined by paraffin coating of dry clods.
[2] Determined by glass electrode method.
[3] Determined by CO_2 gas evolution; measured only if pH is 7.0 or higher.
[4] Determined by centrifuge.
[5] Determined by wet combustion.
[6] Same sample as used for mechanical analysis (see table 18).
[7] Softly consolidated parent material.

TABLE 20.—*Saturation percentage, pH, electrical conductivity, cation and anion concentration, and gypsum requirement of representative soils of the Madera Area, Calif.*

[Analyses by James Quick, University of California; U.S. Salinity Laboratory procedures]

Soil [1]	Depth (inches)	Saturation percentage (percent)	pH	Electrical conductivity (millimhos per centimeter at 25° C.)	Cations (milliequivalents per liter)				Anions (milliequivalents per liter)				Gypsum requirement [2] (tons per acre)
					Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	
Dinuba fine sandy loam	0 to 10	25.3	(3)	2.45	2.24	0.96	23.68	(3)	0.00	21.44	7.68	0.00	(3)
	10 to 13	27.0	(3)	7.0	1.50	3.60	85.80	(3)	6.90	51.60	29.40	3.00	(3)
	13 to 24	23.0	(3)	14.5	.70	1.75	208.60	(3)	19.25	33.25	92.05	65.10	(3)
	[4] 24 to 35	30.0	(3)	24.4	2.24	1.40	444.08	(3)	13.44	41.16	268.80	124.88	(3)
	35 to 50	30.0	(3)	4.1	.81	.54	61.02	(3)	15.93	14.58	22.95	8.64	(3)
Fresno fine sandy loam	0 to 4	24.5	8.75	2.3	1.28	.34	24.6	1.05	0	18.6	6.6	2.1	2.5
	4 to 15	23.5	10.0	5.7	.72	.18	59.8	.72	2.8	15.7	13.7	29.2	8.2
	[5] 15 to 24	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
	24 to 40	31.6	8.7	2.3	.70	.28	24.6	.09	0	16.7	4.1	4.9	3.2
	40 to 60	31.1	8.8	1.85	.74	.50	20.1	.04	0	14.4	3.0	4.0	1.5
Rossi silt loam	0 to 3	55.3	6.6	55.0	320.0	274.0	29.2	2.4	0	5.1	672.0	211.0	0
	3 to 14	45.9	7.2	29.0	115.0	55.0	185.0	.72	0	4.5	318.0	33.5	0
	14 to 38	35.4	7.4	42.0	213.0	78.0	250.0	.28	0	6.4	504.0	30.9	0
	38 to 66	31.7	7.4	39.0	203.0	83.0	203.0	.59	0	5.1	450.0	34.5	0
Traver loam	0 to 3	27.8	9.8	39.0	.94	.04	478.0	8.36	16.9	21.1	408.0	41.3	12.2
	3 to 17	35.7	10.0	28.0	.40	.24	347.0	4.0	28.0	19.7	255.0	48.9	7.2
	17 to 24	39.5	8.4	10.0	1.48	.22	102.0	.38	0	7.3	94.5	2.3	3.7
	24 to 64	42.0	8.3	1.65	1.66	.40	15.6	.03	0	7.4	6.0	4.3	1.6
Wunjey very fine sandy loam	0 to 12	44.7	8.9	3.5	1.46	.70	35.4	2.69	0	26.3	8.2	5.8	9.7
	12 to 24	41.8	10.4	12.0	.46	.26	141.0	1.55	22.3	15.7	77.8	27.5	12.3
	24 to 60	48.8	10.4	11.5	.48	.26	139.0	.32	45.8	15.7	45.3	33.3	16.6

[1] Same samples as those for which physical and chemical data are given in table 19.
[2] Determined by Schoonover method.
[3] Not determined.
[4] Estimated; sample depleted.
[5] Hardpan.

TABLE 21.—*Base exchange capacity, exchangeable sodium, and sodium saturation of samples of representative soils of the Madera Area, Calif.*

[Analyses by Horace King, University of California]

Soil [1]	Depth	Base exchange capacity [2]	Exchangeable sodium [3]	Sodium saturation
	In.	*meq./100gm. dry soil*	*meq./100gm. dry soil*	*Percent*
Dinuba fine sandy loam	0 to 10	4. 86	1. 92	60. 1
	10 to 13	10. 68	8. 63	80. 9
	13 to 24	8. 54	6. 88	80. 5
	24 to 35	17. 72	17. 95	100. 1
	35 to 50	6. 16	4. 90	79. 5
Rossi silt loam	0 to 3	23. 17	2. 16	9. 3
	3 to 14	17. 51	2. 94	16. 8
	14 to 38	9. 92	3. 38	34. 1
	38 to 66	8. 69	1. 33	15. 3
Traver loam	0 to 3	24. 50	12. 62	51. 5
	3 to 17	30. 36	29. 04	95. 3
	17 to 24	19. 68	16. 86	85. 3
	24 to 64	15. 03	5. 25	34. 9
Wunjey very fine sandy loam	0 to 12	24. 71	14. 71	59. 6
	12 to 24	26. 38	24. 58	93. 2
	24 to 60	22. 66	23. 39	103. 1

[1] Same samples as those used for analyses reported in table 20.
[2] Determined by ammonia distillation, using magnesium oxide.
[3] Determined by uranyl zinc acetate procedure.

TABLE 22.—*Farms, acreage, land area, and number of farms by size in Madera County in stated years*

	1939	1949	1954
Area of county acres	1, 374, 720	1, 374, 720	1, 374, 720
Land in farms acres	510, 234	823, 946	889, 824
Proportion of total percent	37. 1	59. 9	64. 7
Number of farms	1, 538	1, 900	1, 806
Average size of farm acres	331. 8	433. 7	492. 7
Number of farms by size:			
Less than 10 acres	75	134	125
10 to 29 acres	301	354	332
30 to 49 acres	278	342	293
50 to 69 acres	132	164	146
70 to 99 acres	191	214	170
100 to 139 acres	106	136	150
140 to 179 acres	100	115	131
180 to 219 acres	37	47	56
220 to 259 acres	35	39	37
260 to 499 acres	114	119	121
500 to 999 acres	63	75	94
1,000 acres and more	106	161	151
Land according to use:			
Cropland total acres	407, 732	394, 273	393, 427
Harvested acres	162, 941	220, 314	229, 052
Pastured acres	137, 253	82, 648	87, 372
Other [1] acres	107, 538	91, 311	77, 003
Non-cropland, total acres	102, 502	429, 673	496, 397
Pasture acres	(2)	216, 616	395, 644
Woodland acres	15, 038	191, 936	84, 453
Other [3] acres	87, 464	21, 121	16, 300

[1] Cultivated summer fallow, idle land, land in soil-improvement crops, crop failures, and land seeded for harvest the next year.
[2] Not reported separately; included in "Other," below.
[3] House lots, lanes, roads, wasteland, etc.

Agriculture

The first permanent settlers in Madera County were Americans and Mexicans who engaged in stock raising in the valley. The stockmen were the only settlers until the early 1870's, when they were gradually succeeded by grain farmers. About this time, canals were constructed to divert floodwater from the Fresno River for irrigation. Soon afterward, canals from the San Joaquin and Chowchilla Rivers were constructed, and thousands of acres were irrigated and used for pasture. Some alfalfa was planted for livestock feed. Around the present site of Madera, alfalfa, grapes, peaches, nuts, and olives were planted. The largest areas of cultivated land were planted to dryfarmed grain. Development of irrigated agriculture progressed slowly, but now large areas are irrigated and used intensively for row, forage, grain, fruit, and nut crops.

Tables 22, 23, 24, 25, and 26 give significant statistics on the use of the agricultural land in Madera County in recent years. The statistics are for Madera County, but are considered to be representative of the Area mapped, which includes practically all the agricultural land in the county.

TABLE 23.—*Types of farms in Madera County in 1954*

	Number	Percent
Field-crop farms	525	29. 1
Cash-grain	43	2. 4
Cotton	478	26. 5
Other	4	. 2
Vegetable farms	30	1. 7
Fruit-and-nut farms	272	15. 0
Dairy farms	326	18. 0
Poultry farms	97	5. 4
Livestock farms other than dairy or poultry	167	9. 2
General farms	115	6. 4
Primarily crop	103	5. 7
Crop and livestock	12	. 7
Miscellaneous and unclassified farms	274	15. 2
Total	1, 806	100. 0

TABLE 24.—*Irrigated farms in Madera County in stated years: acreage and tenure*

	Year	
	1949	1954
Irrigated farms________________number__	1, 537	1, 470
Proportion of all farms______percent__	80. 9	81. 4
Land in irrigated farms___________acres__	488, 567	613, 230
Irrigated land________________acres__	187, 851	193, 804
Average per farm irrigated__acres__	122. 2	131. 8
Irrigated cropland harvested_acres__	137, 394	156, 337
Irrigated pasture___________acres__	48, 449	37, 467
Other irrigated cropland____acres__	[1] 2, 008	(2)
Farms on which all crops harvested were irrigated___________farms__	1, 273	1, 226
Land irrigated on these farms_acres__	121, 794	151, 280
Irrigated farms by acres irrigated:		
1 to 9 acres________________farms__	144	94
10 to 19 acres______________farms__	230	197
20 to 29 acres______________farms__	112	98
30 to 49 acres______________farms__	318	207
50 to 99 acres______________farms__	357	295
100 to 199 acres____________farms__	204	183
200 or more acres___________farms__	172	152
Irrigated farms by tenure of operator:		
Full owner_________________farms__	1, 009	(2)
Part owner_________________farms__	301	(2)
Manager___________________farms__	18	(2)
Tenants___________________farms__	209	(2)

[1] Not harvested, not pastured, failure, etc.
[2] Not reported.

TABLE 25.—*Farm tenure in Madera County in stated years*

Type of tenure	1940	1950	1954
Full owners_____________farms__	1, 008	1, 256	1, 163
acres__	200, 094	222, 393	218, 459
Part owners_____________farms__	217	374	408
acres__	196, 544	498, 161	558, 468
Managers_______________farms__	31	19	11
acres__	17, 747	31, 232	12, 133
All tenants______________farms__	282	251	224
acres__	95, 849	72, 160	100, 764
Proportion of tenancy_______percent__	18. 3	13. 2	12. 4
Cash tenants___________farms__	123	85	73
acres__	29, 731	20, 352	39, 568
Share-cash tenants_____farms__	7	18	27
acres__	2, 526	3, 179	15, 358
Share tenants and croppers__________farms__	141	102	85
acres__	62, 628	41, 368	39, 377
Crop-share tenants and croppers________farms__	(1)	95	73
acres__	(1)	39, 980	35, 702
Livestock-share tenants__________farms__	(1)	7	12
acres__	(1)	1, 388	3, 675
Other and unspecified tenants___________farms__	11	46	39
acres__	964	7, 261	6, 461

[1] Not reported.

TABLE 26.—*Facilities and equipment on farms in Madera County in stated years*

Kind of equipment	1940	1950	1954
Telephones________________farms__	335	927	1, 391
Electricity________________farms__	1, 264	1, 789	1, 771
From powerline__________farms__	1, 227	1, 756	(1)
Electric water pump_______farms__	(1)	1, 568	(1)
Electric water heater______farms__	(1)	721	(1)
Home freezer_____________farms__	(1)	421	859
Electric washing machine___farms__	(1)	1, 605	(1)
Electric chick brooder_____farms__	(1)	177	(1)
Electric feed grinder_______farms__	(1)	45	177
Milking machines____________farms__	(1)	384	441
Grain combines_____________farms__	(1)	100	126
number__	(1)	118	169
Cornpickers________________farms__	(1)	21	33
number__	(1)	26	35
Pickup hay balers___________farms__	(1)	111	219
number__	________	134	239
Motortrucks________________farms__	436	1, 177	1, 374
number__	516	1, 737	2, 178
Tractors__________________farms__	623	1, 238	1, 491
number__	793	2, 275	3, 256
Automobiles________________farms__	1, 342	1, 565	1, 585
number__	1, 922	2, 563	2, 660

[1] Not reported.

Crops

The Madera Area produces many kinds of crops because of its long growing season and wide variety of soils. The best soils can be used for all crops to which the climate is suited, but the shallow and saline-alkali soils are limited to a few specific crops. The acreages of the principal crops are given in tables 27 and 28.

Cotton.—This is the leading cash crop in the Area at present. Cotton is planted in pre-irrigated fields about mid-April. A nitrogenous fertilizer is added at planting or prior to the first regular irrigation, which is about the first of June. The water requirement is 38 to 40 inches, but some farmers apply more than this. The cotton is picked by hand and by machine, starting about October 1 and continuing until March. Fall and winter rains damage some cotton and lower the quality.

Cotton is subject to damage by some insects and nematodes, as well as to damping-off and verticillium wilt. Means of controlling most of these pests and diseases are available.

Cotton is grown on a wide variety of soils, but yields are best on medium-textured soils that have a moderate to high moisture-holding capacity. Cotton will tolerate saline-alkali soils. Because of its adaptable root system, it can be grown on soils that have alkali subsoils.

Cotton is marketed through local gins, some of which are cooperatives.

Potatoes.—Potatoes are one of the important crops raised in the Madera Area. They grow best on deep, sandy, highly fertile, well-drained soils that are free of lime, salts, and alkali. They are planted in mid-February and mid-July and are dug in June and October. Because of their limited root system, they are given numerous light irrigations. Fairly large amounts of nitrogen and phosphorus are applied, and some response to potash has been noted where the soils are intensively managed.

TABLE 27.—*Specified crops harvested in Madera County in stated years*

Crop		Year 1939	1949	1954
Corn:				
For all purposes	farms	138	105	149
	acres	1, 494	2, 129	4, 830
For grain	farms	83	44	46
	acres	833	937	2, 091
	bushels	24, 650	30, 176	87, 592
Hogged, grazed, or cut for fodder or silage	farms	67	71	(1)
	acres	611	1, 192	(1)
Sorghum:				
For all purposes except sirup	farms	105	40	118
	acres	1, 043	890	3, 874
For grain or seed	farms	87	36	62
	acres	927	677	2, 630
	quantities	[2] 28, 585	[3] 9, 111	[3] 62, 742
For dry forage, hay, or silage, or grazed	farms	18	5	(1)
	acres	116	213	(1)
	tons cut	748	403	(1)
Small grain:				
Wheat threshed or combined	farms	48	43	38
	acres	22, 673	13, 180	11, 734
	bushels	325, 406	161, 843	170, 420
Oats threshed or combined	farms	9	20	18
	acres	3, 396	1, 081	1, 710
	bushels	73, 675	21, 376	44, 082
Barley threshed or combined	farms	173	189	251
	acres	60, 437	76, 887	75, 297
	quantities	[2] 1, 157, 732	[3] 644, 537	[3] 924, 537
Rice threshed or combined	farms	------------	5	27
	acres	------------	1, 980	4, 780
	100-pound bags	------------	52, 921	140, 411
Annual legumes:				
Dry beans and seed	farms	38	4	21
	acres	724	152	562
	100-pound bags	5, 901	907	5, 219
Hay crops:				
Alfalfa	farms	498	604	686
	acres	9, 130	30, 024	40, 714
	tons	47, 278	151, 352	216, 785
Clover or timothy	farms	5	7	8
	acres	34	352	363
	tons	71	720	494
Miscellaneous small grain and other	farms	177	118	133
	acres	2, 893	3, 521	3, 580
	tons	3, 764	4, 551	5, 673
Wild hay	farms	5	------------	3
	acres	450	------------	580
	tons	451	------------	580
Other field crops:				
Irish potatoes harvested for home use or for sale	farms	21	41	23
	acres	437	2, 263	1, 615
	100-pound bags	56, 231	520, 780	341, 473
Sweetpotatoes harvested for home use or for sale	farms	13	16	10
	acres	45	36	55
	quantities	[3] 4, 115	[2] 2, 617	[2] 8, 005
Cotton harvested	farms	723	837	796
	acres	44, 270	66, 327	54, 975
	bales	53, 583	72, 848	72, 848
Sugar beets harvested for sugar	farms	------------	7	14
	acres	------------	154	2, 268
	tons	------------	3, 034	52, 002
All vegetables harvested for sale	farms	44	31	34
	acres	382	748	633

[1] Not reported separately. [2] Bushels. [3] 100-pound bags.

TABLE 28.—*Tree fruits, nuts, and grapes harvested in Madera County in stated years*

Crop		Year		
		1939	1949	1954
Apples	farms	64	172	38
	trees of bearing age	4,960	9,188	7,455
	tons harvested	366	150	116
Peaches:				
Clingstone	farms	67	224	46
	trees of bearing age	31,636	12,423	5,438
	tons harvested	1,800	776	492
Freestone	farms	134	422	80
	trees of bearing age	33,588	62,213	45,062
	tons harvested	3,063	3,240	2,946
Pears (Bartlett)	farms	37	133	26
	trees of bearing age	242	594	169
	tons harvested	3	2	2
Plums	farms	76	259	54
	trees of bearing age	11,837	15,566	14,165
	tons harvested	505	492	564
Apricots	farms	181	419	66
	trees of bearing age	55,878	6,388	5,301
	tons harvested	3,431	145	80
Figs	farms	70	200	33
	trees of bearing age	39,042	11,683	25,916
	tons harvested	291	111	1,680
Olives	farms	48	154	41
	trees of bearing age	15,591	43,071	42,820
	tons harvested	250	837	942
Grapes:				
Table (Tokay, Malaga, Emperor, etc.)	farms	61	141	48
	vines of bearing age	318,067	292,195	389,415
	tons harvested	4,001	3,763	5,689
Raisin (Thompson, Muscat, etc.)	farms	404	467	400
	vines of bearing age	5,359,987	6,287,683	6,870,089
	tons harvested	71,873	82,686	96,621
Wine or juice (Zinfandel, Alicante, Carignane, etc.)	farms	127	201	152
	vines of bearing age	957,603	1,862,328	2,030,897
	tons harvested	13,082	20,189	29,505
Walnuts (English)	farms	26	257	53
	trees of bearing age	41	1,511	1,718
	tons harvested	(1)	20	17
Almonds	farms	63	283	55
	trees of bearing age	22,755	32,436	29,635
	tons harvested	296	342	296
Oranges:				
Valencia	farms	7	20	8
	trees of bearing age	16	69	63
	field boxes	(1)	77	232
Navel	farms	20	64	28
	trees of bearing age	55	386	249
	field boxes	(1)	386	269
Grapefruit	farms	2	29	12
	trees of bearing age	----------	42	18
	field boxes	(1)	26	28
Lemons	farms	5	33	16
	trees of bearing age	666	31	20
	quantities	[2] 72	(1)	[3] 52

[1] Less than 1 ton harvested. [2] Tons harvested. [3] Field boxes.

Potatoes are packed for shipping at local packing sheds.

Alfalfa.—Alfalfa may be planted either in spring or in fall. On saline-alkali soils, fall planting is preferred. Alfalfa tolerates salts and alkali and is generally considered an excellent crop to raise in some of the later stages of reclamation. It requires about 42 inches of irrigation water for maximum yields. Six cuttings a season is usual, and, in addition, some fields are pastured to sheep late in fall.

The armyworm, the looper, the atlantic mite, and the spotted alfalfa aphid are common pests of alfalfa. Some damage is done by verticillium wilt, dwarfing, and leaf-spot diseases. Most of the alfalfa produced in the Area is used for feed at local dairies or is trucked to the Los Angeles market.

Irrigated pasture.—Irrigated pasture has increased in acreage at a very rapid rate in recent years. Between 1948 and 1957 it increased from about 2,000 acres to 20,000 acres. Some decline is to be expected in years when the market outlook for annual crops, particularly cotton, is favorable.

Irrigated pasture has the advantage of doing well on shallow hardpan soils and on saline-alkali soils. It is remarkably free of pests and diseases. The water requirement is about 60 inches.

Pasture is seeded from October to April. The plantings made in fall are germinated by the winter rains. The plantings made in spring are pre-irrigated.

Small grain.—Barley, wheat, and oats are the most important small grains, in that order. On the terraces and lower foothills, the usual rotation is grain one year and fallow the next. The grain is planted in the fallowed soil during October or November and is harvested during June and July. Usually it is fertilized with phosphate and small amounts of nitrogen applied at the time of planting. Some small grain is irrigated. The water requirement is about 18 inches.

Although small grain is grown on many different soils, the best yields are obtained on deep, well-drained, medium-textured soils that are free of salts and alkali. Barley (Mariout variety) may be grown on saline-alkali soils as part of the reclamation program.

Grain is practically free of insect pests, and smut is not a serious problem. Winds, weeds, untimely or insufficient rainfall, and ponding of water during unusually wet winters are some of the hazards of grain farming.

Grain sorghum.—All of the sorghum grown in the Area is irrigated. It is planted in April on pre-irrigated soils and is fertilized with nitrogen. It is harvested with combines in September.

The only insect pests are aphids, but sorghum is subject to smut and fusarium wilt.

The highest yields of grain sorghum are produced on medium-textured, well-drained soils that are free of salts and alkali. It is grown, however, on many kinds of soils. It tolerates moderate amounts of salts and alkali and will do well on soils that have alkali subsoils, provided all other conditions are favorable.

Most of the grain sorghum produced in the Area is used locally for livestock feed.

Sugar beets.—Sugar beets grow best on deep, well-drained, highly fertile, medium-textured soils. They grow well on soils that are slightly saline-alkali, but yields are reduced if the soils are moderately saline-alkali.

Sugar beets are planted in March and blocked in April. During the growing season, they may be side-dressed with nitrogenous fertilizer. They are dug between August and November and transported mostly by rail to the sugar refineries.

Grapes.—Raisin grapes (Thompson seedless) are the most common grape crop; wine grapes are next in importance. Comparatively few table grapes are produced. Nearly all of the vineyards are on the San Joaquin River fan.

Grapes do well on well-drained, well-aerated soils. About 30 inches of water is required to mature a crop. Most of the spur-pruned varieties respond to applications of zinc.

Raisin grapes are harvested about September 1 and laid on trays in the vineyards to dry. Wine grapes are harvested about September 15.

The vines and fruit are subject to damage by many insect pests and diseases, but most of these are very well controlled.

Grapes are marketed through dried-fruit cooperatives, dried-fruit packers, and local wineries.

Rice.—Rice is grown on a limited acreage in the western part of the Area. The fields are prepared in fall for spring planting. Rice is sown from airplanes on fields already flooded. Aerial application of nitrogen is a common practice. When the rice is heading out, the fields are drained so the grain will mature. It is harvested with combines in October or November.

The best soils for rice are the fine-textured soils in the basin, where irrigation water is plentiful. Because it requires so much water, rice is a good crop to raise if leaching is necessary for the reclamation of saline soils.

Tree fruits and nuts.—Orchards are not extensive in the Madera Area, and the present trend in agriculture is to further reduce their acreage. There are limited plantings of peaches, figs, nectarines, almonds, plums, apricots, and olives. All of these orchard crops except figs and olives require deep, well-drained soils that are free of salts and alkali. Some figs and olives are grown on shallow soils that are free of salts and alkali.

Slight concentrations of salts and alkali in the subsoil are common in the irrigated areas. Before an orchard is planted, the subsoil at the proposed site should be examined very thoroughly. Salts and alkali in the subsoil may not affect shallow-rooted annual crops, or short-lived perennial crops, and indeed may not affect trees until they are 3 or 4 years old. The presence of salts and alkali in the subsoil of many soils is believed to be one of the reasons for the decrease in the number of orchards in this Area.

Livestock and Livestock Products

Livestock and livestock products are important in the economy of the Madera Area (see table 29). They are the principal or sole source of income on many of the farms in the Area.

History and General Character of the Area

The miners who came in 1849 were the first white men to live in what is now Madera County. Earlier visits, however, were made by soldiers attached to the missions on the coast and by trappers, hunters, and explorers.

The first miners worked the streams for gold. Later, the hard-rock miners dug into the ledges for gold, silver, and copper. During the 1850's and 1860's, many mining communities sprang up in the foothills, but it was not until later that the first settlement was made in the valley.

In 1868 a number of families from the southern states established what was then known as the Alabama settlement. When the Southern Pacific railroad was built through the county, the Alabama settlement was renamed Borden. For a time Borden was one of the largest towns in the San Joaquin Valley.

TABLE 29.—*Livestock and livestock products in Madera County in stated years*

Kind of livestock		Year		
		1939 [1]	1949 [1]	1954
Horses and/or mules	farms	983	530	366
	number	[2] 3, 255	2, 038	1, 427
Cattle and calves	farms	868	1, 101	1, 074
	number	[2] 30, 740	71, 129	100, 993
Milk cows	farms	761	874	696
	number	6, 853	13, 209	16, 630
Dairy products sold:				
Whole milk	farms	336	422	402
	pounds	[3] 4, 915, 518	86, 485, 784	114, 184, 859
Cream	farms	20	11	6
	pounds butterfat	84, 920	29, 187	43, 029
Hogs and pigs	farms	315	362	159
	number	[4] 8, 009	5, 412	2, 528
Sheep and lambs	farms	48	77	140
	number	[5] 8, 548	14, 459	23, 014
Sheep and lambs shorn	farms	29	46	73
	number	8, 702	10, 824	17, 596
Wool shorn	pounds	68, 188	98, 730	160, 974
Goats and kids	farms	23	39	(6)
	number	[4] 145	299	(6)
Chickens on hand	farms	954	1, 195	615
	number	[4] 82, 118	[4] 77, 003	[4] 67, 201
Chickens sold	farms	197	200	94
	number	56, 025	190, 859	367, 308
Chicken eggs	farms	873	218	118
	dozens	[7] 726, 035	[8] 498, 429	[8] 572, 654
Turkeys on hand	farms	151	85	(6)
	number	[4] 2, 948	[4] 4, 871	(6)
Turkeys raised	farms	114	148	105
	number	22, 199	351, 774	508, 534
Ducks raised	farms	34	82	48
	number	900	722	412
Bees owned	farms	27	68	(6)
Hives	number	2, 945	2, 100	(6)
Honey produced	farms	11	25	(6)
	pounds	99, 178	119, 252	(6)

[1] As of April 1.
[2] Over 3 months old.
[3] Gallons.
[4] Over 4 months old.
[5] Over 6 months old.
[6] Not reported.
[7] Produced.
[8] Sold.

The first cultivated crops were barley and wheat. Later, as irrigation was developed, orchards and vineyards were planted. Since the first irrigation water was diverted from streams, the expansion of irrigated agriculture has not stopped.

The vast virgin forests attracted lumbermen. In 1874 a sawmill was built in the lower mountains. A flume 60 miles long transported the sawed lumber from the mill to the town of Madera. This mill continued in operation for 55 years. Its average annual cut was 50 million board feet. Another large company that operated for several years cut an average of 100 million board feet per year. These large mills have since been replaced in part by small portable mills.

Madera County was established in 1893. Before that time the area was part of Fresno County.

Madera, the county seat, is the largest community in the county. It had a population of 10,497 in 1950. The only other town in the valley is Chowchilla (pop. 3,893). North Fork, Raymond, Knowles, Oakhurst, Ahwahnee, and Coarsegold are smaller communities in the foothills and mountains.

The combined rural and urban population of the county was 36,964 in 1950.

Climate [9]

The Madera Area is characterized by hot, dry summers and by fairly mild winter temperatures accompanied by low to moderate precipitation. The distribution of rainfall requires irrigation for maximum crop production. There is abundant sunshine during the crop-growing season, and winds are gentle throughout most of the year. At the lower elevations the growing season is 9 to 10 months long; at the higher elevations it is about 6 months long.

Temperature.—The mean annual temperature is closely related to elevation. On the valley floor a temperature of 60° to 63° F. is typical, and around 50° is characteristic at the 3,000-foot level. The daily maximum in July is in the upper 90's over most of the Area and about 100°

[9] By C. ROBERT ELFORD, State climatologist for California, U.S. Weather Bureau, Department of Commerce.

TABLE 30.—*Freeze data*

Station	Elevation	Temperature at or below—	Spring: Mean date of last occurrence	Spring: Years of record	Spring: Number of years temperature occurred	Fall: Mean date of first occurrence	Fall: Years of record	Fall: Number of years temperature occurred	Mean number of days between first and last occurrences
	Ft.								
North Fork Ranger Station	2,665	32°	April 24	27	27	Nov. 1	24	24	191
		28°	April 4	27	27	Nov. 18	24	23	228
		24°	Feb. 23	26	24	Dec. 8	23	17	288
		20°	Jan. 29	25	19	Dec. 26	23	5	332
		16°	Jan. 11	25	12	Dec. 26	23	5	349
Madera	296	32°	March 1	20	19	Nov. 21	21	21	265
		28°	Jan. 31	20	14	Dec. 5	21	17	308
		24°	Jan. 8	20	6	Dec. 23	21	7	349
		20°	Jan. 2	20	3	(1)	21	3	(1)
		16°	(1)	20	1	(1)	21	1	(1)

[1] When number of occurrences is less than 10, mean dates and number of days between occurrences is not computed.

at some of the hotter points at the lowest elevations. An extreme of 110° or higher has been recorded at nearly all points less than 2,600 feet in elevation. The daily minimum temperature in January is a few degrees above freezing at the lowest elevations and around 28° F. at the 3,000-foot level. Absolute minimums vary widely, depending upon local exposure as well as upon elevation. At one time or another, the temperature has dropped to as low as 10° to 20° above zero at the lowest elevations and to near zero at the 3,000-foot level.

Freeze data from two weather stations are given in table 30. The date of the last 32° reading in spring is about March 1 at the southwestern edge of the county and about May 1 at an elevation of 3,000 feet. The first 32° reading in fall is likely to be as early as November 1 at the 3,000-foot level but may be delayed at the lowest elevations until December 1. These dates vary from year to year, and they also differ from one exposure to another within short distances. The growing season is about 265 days on the valley floor and about 190 days at an elevation of 2,600 feet.

Precipitation.—Precipitation increases with elevation. The annual total is less than 8 inches in the southwestern corner of the Area and nearly 35 inches at North Fork Ranger Station (elevation 2,665 feet). In general, the western half of the Area receives an average of 11 inches a year.

Because the Area receives so little moisture, variations from year to year are significant. Table 31 shows the frequency with which various annual precipitation totals can be expected. It shows, for example, that at Madera, where the annual total averages just over 10 inches, a total of 7.6 inches or more can be expected 3 years out of 4, and a total of 6 inches or more can be expected 9 years out of 10.

Most of the rain falls during the winter. No significant amount falls from May through September. The months of heaviest rainfall are December through March, when monthly totals range from 1.5 inches in the valley to 6 or 7 inches at the 2,600-foot level. At the lower elevations most of the moisture falls as steady rain in winter storms that cover broad areas. Only at the higher

TABLE 31.—*Probable frequency of specified amounts of annual precipitation at specified weather stations*

Station	Elevation	Years of record	Probable minimum annual precipitation in—								
			19 out of 20 years	9 out of 10 years	3 out of 4 years	2 out of 3 years	1 out of 2 years	1 out of 3 years	1 out of 4 years	1 out of 10 years	1 out of 20 years
	Feet		*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
North Fork Ranger Station	2,665	56	18.10	20.80	26.00	28.00	32.30	37.20	39.90	47.40	52.40
San Joaquin Experimental Range	1,470	11	10.10	11.60	14.50	15.60	18.10	20.90	22.40	26.60	29.50
Madera	296	60	5.20	6.00	7.60	8.40	9.70	11.30	12.10	14.80	16.50
Mendota Dam	175	66	3.40	4.10	5.40	6.00	7.30	8.70	9.60	11.90	13.40
Auberry (Fresno County)	1,985	44	13.90	15.80	19.40	20.80	23.90	27.30	29.10	34.40	38.90
Cathay Bull Run Ranch (Mariposa County)	1,425	5	11.00	12.00	14.80	16.00	18.50	21.20	22.70	27.10	30.00
Friant Government Camp (Fresno County)	410	21	7.00	8.10	10.20	10.90	12.80	14.70	15.90	19.00	21.20
Le Grand (Merced County)	255	59	6.80	7.80	9.50	10.30	12.00	13.60	14.60	17.40	19.20

elevations are there likely to be summer thundershowers of high intensity but limited extent. It is estimated that a 1-hour precipitation amounting to 1.20 inches on the valley floor and 1.75 inches at the 2,600-foot level is possible at least once every hundred years. Comparable figures for a 24-hour period would be 2.5 inches in the valley and 12 inches at the 2,600-foot level.

Soil moisture.—Regular measurements of soil moisture have not been recorded in the Madera Area, but it is possible to make fairly reliable estimates of the water balance of the soils. Conditions at Madera are typical of those at the low elevations. Here, the temperature distribution is such that a full cover of plants growing at a maximum rate during the frost-free season—March 1 to November 21—could make use of nearly 33 inches of moisture if that much water were available. Taking into account the use of moisture by plants and the normal distribution of rainfall, the moisture stored in the soil during the winter could be expected to last only until about the middle of May, after which plants would become dormant or would die unless irrigated. Therefore, plants can actually utilize only about 8 inches of the year's rainfall.

At the North Fork Ranger Station, where the growing season lasts from April 24 to November 1, the potential water use during the growing season is 25 inches. The water stored in a soil during winter might support plants till around June 15. Frost-sensitive plants on such soils, therefore, can actually utilize only a little more than 7 inches of moisture per year. Deep-rooted plants not sensitive to frost may be able to use almost 25 inches, if the soil will hold that much.

Wind.—The prevailing wind at the lower elevations is from the northwest, although much of the winter's precipitation falls during periods of southerly wind. Violent windstorms are rare in the Area, but it is likely that there will be several periods of prolonged northerly winds each year. These winds are usually dry enough and strong enough to result in some drying of young plants. The infrequent summer thundershowers at the higher elevations at times are accompanied by damaging but local winds.

Sunshine.—Abundant sunshine is characteristic of this Area. Normally the sun is visible for more than 95 percent of the time between sunrise and sunset during the summer months and for about 50 percent during the winter months. However, during the rainy period in winter there are likely to be a number of days of foggy weather. Sometimes the fog clears before noon, but it may persist for several days without a break.

Physiography, Relief, and Drainage

Madera County is entirely within the drainage basin of the San Joaquin River. It extends from the trough of the San Joaquin Valley eastward to the crest of the Sierra Nevada.

The lowest point within the county is in the northwestern corner where the San Joaquin River flows into Merced County. The elevation at this point is 110 feet above sea level. The valley floor proper rises gradually toward the northeast and joins the foothills of the Sierra Nevada at an elevation of about 450 feet. In the foothills the relief is rolling to steeply sloping. The mountains rise sharply from the foothills, and reach a maximum elevation of 13,156 feet at the top of Mt. Ritter in the northeastern part of the County.

Madera County is divided into two major physiographic divisions: the mountains in the eastern part, and the valley in the western part.

The mountains, which occupy about two-thirds of the county, are further divided into three parts: the high Sierra, the forested Sierra, and the foothills. The high Sierra consists of the barren or nearly barren rocky mountaintops above the timberline, at an elevation of 10,000 feet or more. They have little or no value for agriculture or forestry but contain some important mineral deposits. It is these high, barren, rocky mountains that intercept winter storms as they travel eastward and that store the heavy snows that are so important to the agricultural and industrial economy of the San Joaquin Valley.

The forested Sierra is below the timberline. The elevation is 3,000 to 10,000 feet. This is a steep, rugged area. Most of it is forest covered, but there are many grassy meadows. It yields most of the timber produced in the county, affords some summer grazing, and is an excellent recreation area.

The foothills are rolling to steep and have many outcrops of bedrock. They are covered with oaks and grass, and some areas have a dense growth of brush. They are used mostly for grazing.

The valley is divided into four parts: the terraces, the recent alluvial fans, the basin, and the flood plain.

The terraces are made up of dissected old alluvial material into which the streams have cut. The terraces now lie well above the flood plains of the present streams.

The alluvial fans are smooth and very gently sloping. They lie below the terraces and are subject to flooding and further deposition of soil material during major floods. Manmade flood controls have greatly reduced the flood hazard in recent years. Some of the soils that have been modified by wind rise above the general level of the fans. Most of the soils on the fans are irrigated and used for row, forage, and grain crops, orchards, and vineyards.

The basin is a nearly level area that depends largely on an internal drainage system. Under natural conditions, much of the basin had a high water table and many of the soils contained excess salts and alkali. The salts and alkali generally make cultivation and irrigation difficult.

The flood plain lies between the basin and the San Joaquin River. Under natural conditions, this area was subject to frequent flooding. There were many meandering sloughs and bypass channels that carried much of the floodwater. Friant Dam and a system of levees now protect most of this area from further floods. Many of the sloughs are filled, and large areas are now being intensively tilled to row, forage, and grain crops. Further development and cultivation is to be expected.

The only major year-round stream in the valley is the San Joaquin River. It drains the eastern and southern portions of the Sierra Nevada. It flows southwestward to the lowest point in the valley and then turns northwestward and flows to San Francisco Bay and the ocean. Parts of this river may be dry in years of low rainfall.

The south fork of the Merced River drains the part of the Sierra Nevada that is in and adjacent to Yosemite National Park. The Chowchilla River drains the northwestern part of the Sierra Nevada and fans out into the valley. Ash and Berenda Sloughs branch out to the southwest from the Chowchilla River near the end of the Madera Canal. The Fresno River drains the west-central part of the Sierra Nevada and fans out into the valley. Cottonwood Creek leaves the main channel of the Fresno River about 11 miles northeast of Madera. The Chowchilla and Fresno Rivers are dry except during the winter months. Only when the water is unusually high does the flow from either of these streams reach the San Joaquin River. Large quantities of sediments have been deposited by the Chowchilla and Fresno Rivers where they fan out over the valley floor.

Berenda, Daulton, Dry, Hildreth, Little Dry, and Root Creeks are minor streams that drain the lower foothills of the Sierra Nevada. They are usually dry except during the winter but contribute some local sediment to the valley floor.

Vegetation

The valley, except for the terraces and the basin, is mostly cultivated, and the natural vegetation has been destroyed. The high Sierra is almost barren, but the forested Sierra and the foothills are covered by a varied natural vegetative growth. The forested area, because it receives more rainfall, has more luxuriant vegetation than the foothills. The vegetation of both these upland areas creates a serious fire hazard during the dry season of summer and early fall. Fire lookout and control stations are maintained by both the U.S. Forest Service and the California State Division of Forestry.

Vegetation in the high Sierra.—The sparse vegetation that defies the severe winters of the high Sierra is dominated by a few gnarled and twisted whitebark pines (*Pinus albicaulis*). In protected areas between the rocks, where soil material exists, there is a cover of low-growing plants, including heath (*Phyllodoce* spp.), willow (*Salix* spp.), horsehair sedge (*Carex* spp.), and verbena (*Verbena* spp.).

Vegetation in the forested Sierra.—In the forested Sierra, coniferous trees dominate, mostly lodgepole pine (*Pinus contorta*), Jeffrey pine (*P. Jeffreyi*), ponderosa pine (*P. ponderosa*), sugar pine (*P. lambertiana*), red fir (*Abies magnifica*), white fir (*A. concolor*), and incense-cedar (*Libocedrus decurrens*). Less common is western white pine (*P. monticola*), mountain hemlock (*Tsuga mertensiana*), Sierra juniper (*Juniperus occidentalis*), and giant sequoia (*Sequoia gigantea*). Scattered in the forest are deciduous broadleaf trees of several species, including black oak (*Quercus kelloggii*), mountain alder (*Alnus* spp.), dogwood (*Cornus* spp.), quaking aspen (*Populus tremuloides*), wild cherry (*Prunus emarginata*), willow (*Salix* spp.), maple (*Acer* spp.), and sycamore (*Platanus racemosa*). In the understory are numerous kinds of brush; manzanita (*Arctostaphylos glandulosa*), ceanothus (*Ceanothus jepsonii*), gooseberry (*Ribes* spp.), chinquapin (*Quercus muehlenbergii*), and rhododendron (*Rhododendron* spp.) are common. Beneath this woody vegetation, numerous herbs, grasses, and ferns thrive.

Vegetation in the foothills.—The foothills are covered with grasses, herbs, scattered trees, and large areas of brush. The annual vegetation is dominated by filaree (*Erodium* spp.) and soft chess (*Bromus mollis*). In years of favorable rainfall, particularly in areas of finer textured soils, burclover (*Medicago hispida*), and wild oats (*Avena barbata*) are important forage species. Blue oak (*Quercus douglassii*), live oak (*Q. chrysolepsis*), Digger or bull pine (*P. sabiniana*), and California buckeye (*Aesculus californica*) are the principal trees on the drier hillside sites. In the swales and along the streams, cottonwood (*Populus fremontii*), alder, willow, and sycamore are the most important trees. California buckhorn (*Bumelia lycioides*), silverleaf lupine (*Lupinas albifrons*), yerba-santa (*Eriodictyon californicum*), poison-oak (*Toxicodendron diversilobum*), chamise (*Adenostoma fasciculatum*), blue elderberry (*Sambucus caerulea*), manzanita, and several species of ceanothus are the common kinds of brush.

Vegetation in the valley.—The vegetation in the valley was originally composed mostly of grasses and herbs, with trees along the streams. The forage on the terraces and recent alluvial fans is mainly red brome (*Bromus rubens*), soft chess, foxtail (*Festuca megalura*), and filaree. Burclover and wild oats grow profusely on some of the finer textured soils in years of favorable moisture.

Because of the salts and alkali in the soils of the basin, the vegetation is chiefly saltgrass (*Distichlis stricta*), alkali sacaton (*Sporobolus airoides*), alkali mallow (*Sida hederacea*), alkali heath (*Frankenia grandiflora*), and bush pickleweed (*Allenrolfea occidentalis*). Lippia grows profusely in areas that have been subject to frequent flooding. Cottonwood, alder, willow, wild rose, and blue oak grow along the streams.

Transportation

The main lines of the Santa Fe and Southern Pacific railroads provide Madera County with both passenger and freight service to the San Francisco Bay communities to the north and the Los Angeles area to the south.

United States Highway No. 99, the main artery of motor transportation in the central valley of California, passes through Madera and Chowchilla. It connects Madera County with the major cities in the Sacramento and San Joaquin valleys. State Highway No. 152 connects Madera County with a direct route to the Pacific Coast. State Highway No. 41 provides direct access to the mountainous areas and to Yosemite National Park.

Nearly all farms and ranches in the valley and foothills are served by paved county roads that join the Federal and State highways. The distances from farms to trading centers in 1950, and the kinds of roads between farms and trading centers, were as follows:

Distance to trading center visited most frequently:		
Less than 1 mile	farms	74
1 to 4 miles	farms	538
5 to 9 miles	farms	551
10 or more miles	farms	687
Average distance reported	miles	10
Distance over dirt or unimproved roads:		
0.0 to 0.2 mile	farms	1, 364
0.3 to 0.9 mile	farms	138
1.0 to 4.9 miles	farms	128
5.0 or more miles	farms	50
Average distance reported	miles	0. 5

Kind of road on which farm is located:

Hard surface	farms	1, 601
Gravel, shell, or shale	farms	6
Dirt or unimproved	farms	241

Paved and graded roads extend to parts of the higher mountains, but many of these roads are not maintained throughout the year. The more remote sections of the mountains are accessible only by trails.

Community Facilities

Public schools are available to all of the populated areas in Madera County. There are high schools at Chowchilla, at Madera, and at Raymond. Many students living in the foothills attend Sierra Union High School near Auberry, in Fresno County, and some from the western part of Madera County attend Dos Palos Union High School, which is also in Fresno County.

In each of the larger communities there are one or more grammar schools. Numerous grammar schools are scattered throughout the rural areas. Most of the rural school districts have school bus service.

The Madera County Free Library has its main library in Madera and more than a score of branches distributed throughout the county.

Adequate medical facilities are available in Chowchilla, Madera, and North Fork. There is a tuberculosis hospital at Ahwahnee that is maintained by Madera County and two neighboring counties.

All of the communities and farms in the irrigated part of the county have access to electric power. The range and grainland areas have good electric power facilities, considering the sparse population. Telephone service is available to most parts of the county.

Many of the rural communities have recreation halls; the larger communities have theatres and other centers of recreation. Outdoor recreation is afforded by Sierra National Forest, in which there are many lakes and streams; Millerton Lake on the San Joaquin River; Yosemite National Park; and Devil Postpile National Monument.

Industries

Most of the industries in Madera County are directly concerned with the production or processing of agricultural products.

The Yosemite Cooperative Winery and the Madera Winery are located near the city of Madera. The Madera Winery is one of the largest wineries in the world.

Near Madera there are olive processing plants, grain mills, fruit dehydrators, potato and tomato packing houses, and an alfalfa-meal processing plant.

Throughout the irrigated area there are numerous cotton gins. At Chowchilla there is a large plant that extracts cottonseed oil. The Danish Creamery Association makes butter, evaporated milk, and powdered milk in a large plant in Chowchilla.

In the lower foothills decorative flagstone is cut from numerous small quarries. Near Friant Dam pumice is quarried and made into bricks. Granite from quarries near Knowles and Raymond has been used to build some of the finest buildings in the West.

Hydroelectric power is generated at several places in the Sierra Nevada and is distributed by private utility companies.

In the western part of Madera County, natural gas wells are in production, and exploration for more natural gas and petroleum is going on at present.

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GUIDE TO MAPPING UNITS

Map symbol	*Soil Name*	*Page*	*Capability unit*	*Page*
AaC	Ahwahnee and Auberry coarse sandy loams, 8 to 15 percent slopes	10	IVe-1	71
AaD	Ahwahnee and Auberry coarse sandy loams, 15 to 30 percent slopes	11	VIe-4	73
AbB	Ahwahnee and Auberry rocky coarse sandy loams, 3 to 8 percent slopes	12	VIe-4	73
AbD	Ahwahnee and Auberry rocky coarse sandy loams, 8 to 30 percent slopes	11	VIe-4	73
AbE	Ahwahnee and Auberry rocky coarse sandy loams, 30 to 45 percent slopes	11	VIIe-4	75
AcD	Ahwahnee and Auberry very rocky coarse sandy loams, 15 to 30 percent slopes.	12	VIIe-4	75
AcF	Ahwahnee and Auberry very rocky coarse sandy loams, 30 to 75 percent slopes.	12	VIIe-4	75
AdB	Ahwahnee and Vista coarse sandy loams, 3 to 8 percent slopes	12	IIIe-1	68
AdC	Ahwahnee and Vista coarse sandy loams, 8 to 15 percent slopes	12	IVe-1	71
AdD	Ahwahnee and Vista coarse sandy loams, 15 to 30 percent slopes	12	VIe-4	73
AeB	Ahwahnee and Vista rocky coarse sandy loams, 3 to 8 percent slopes	12	VIe-4	73
AeD	Ahwahnee and Vista rocky coarse sandy loams, 8 to 30 percent slopes	12	VIe-4	73
AeE	Ahwahnee and Vista rocky coarse sandy loams, 30 to 45 percent slopes	13	VIIe-4	75
ArD	Ahwahnee and Vista very rocky coarse sandy loams, 15 to 30 percent slopes.	13	VIIe-4	75
ArF	Ahwahnee and Vista very rocky coarse sandy loams, 30 to 75 percent slopes.	13	VIIe-4	75
AsA	Alamo clay, 0 to 1 percent slopes	13	IIIw-5	69
AtA	Atwater loamy sand, 0 to 3 percent slopes	14	IIe-4	66
AtB	Atwater loamy sand, 3 to 8 percent slopes	14	IIe-4	66
AwA	Atwater loamy sand, moderately deep and deep over hardpan, 0 to 3 percent slopes.	14	IIIe-4	69
AwB	Atwater loamy sand, moderately deep and deep over hardpan, 3 to 8 percent slopes.	14	IIIe-4	69
BeA	Bear Creek loam, 0 to 3 percent slopes	15	IIs-3	67
BfA	Borden fine sandy loam, 0 to 1 percent slopes	15	IIs-7	68
BkA	Borden fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	16	IIIs-6	70
BmA	Borden loam, 0 to 1 percent slopes	16	IIs-7	68
BoA	Borden loam, slightly saline-alkali, 0 to 1 percent slopes	16	IIIs-6	70
BuA	Buchenau fine sandy loam, 0 to 3 percent slopes	16	IIIs-3	69
BvA	Buchenau fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes	17	IIIs-8	70
ByA	Buchenau fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes	17	VIs-8	74
BzA	Buchenau loam, 0 to 3 percent slopes	16	IIIs-3	69
CaA	Cajon loamy sand, 0 to 1 percent slopes	17	IIIe-4	69
CaaA	Cajon loamy sand, slightly saline-alkali, 0 to 1 percent slopes	17	IIIe-4	69
CabA	Cajon loamy sand, moderately saline-alkali, 0 to 1 percent slopes	17	IVs-4	72
CacA	Cajon loamy sand, strongly saline-alkali, 0 to 1 percent slopes	17	VIs-6	74
CbaB	Calhi loamy sand, slightly alkali, 0 to 8 percent slopes	18	IIIe-4	69
CbbB	Calhi loamy sand, moderately alkali, 0 to 8 percent slopes	18	IVs-4	72
CcaA	Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 0 to 3 percent slopes.	18	IIIe-4	69
CcbA	Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 0 to 3 percent slopes.	18	IVs-4	72
CccA	Calhi loamy sand, moderately deep and deep over silt, strongly saline-alkali, 0 to 3 percent slopes.	19	VIs-6	74
CcaB	Calhi loamy sand, moderately deep and deep over silt, slightly saline-alkali, 3 to 8 percent slopes.	18	IIIs-4	69
CcbB	Calhi loamy sand, moderately deep and deep over silt, moderately saline-alkali, 3 to 8 percent slopes.	19	IVs-4	72
CdaA	Calhi loamy sand, shallow over hardpan variant, moderately saline-alkali, 0 to 1 percent slopes.	19	IVs-8	72
CeA	Chino clay loam, 0 to 1 percent slopes	20	IIw-2	67
CeaA	Chino clay loam, slightly saline-alkali, 0 to 1 percent slopes	20	IIs-6	68
CebA	Chino clay loam, moderately saline-alkali, 0 to 1 percent slopes	20	IIIs-6	70
CfA	Chino fine sandy loam, 0 to 1 percent slopes	20	IIw-2	67
CfaA	Chino fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	20	IIs-6	68
CfbA	Chino fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes	20	IIIs-6	70
CgA	Chino loam, 0 to 1 percent slopes	19	IIw-2	67
CgaA	Chino loam, slightly saline-alkali, 0 to 1 percent slopes	20	IIs-6	68
CgbA	Chino loam, moderately saline-alkali, 0 to 1 percent slopes	20	IIIs-6	70
CgcA	Chino loam, strongly saline-alkali, 0 to 1 percent slopes	20	IVw-6	72
ChD	Coarsegold loam, 8 to 30 percent slopes	21	IVe-1	71
ChF	Coarsegold loam, 45 to 75 percent slopes	21	VIIe-1	74
CkD	Coarsegold rocky loam, 15 to 30 percent slopes	21	VIe-1	73
CkF	Coarsegold rocky loam, 30 to 75 percent slopes	21	VIIe-1	74
CmA	Columbia fine sandy loam, 0 to 1 percent slopes	21	IIw-2	67
CmdA	Columbia fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes.	22	IIs-3	67
CmtA	Columbia fine sandy loam, moderately deep and deep over Temple soils 0 to 1 percent slopes.	22	IIw-7	67
CoA	Columbia loamy sand, 0 to 1 percent slopes	22	IIIs-3	69

GUIDE TO MAPPING UNITS—Continued

Map symbol	*Soil Name*	*Page*	*Capability unit*	*Page*
CotA	Columbia loamy sand, over Temple soils, 0 to 1 percent slopes	22	IIw-7	67
CpA	Columbia sandy loam, 0 to 1 percent slopes	22	IIw-2	67
CpdA	Columbia sandy loam, moderately deep over sand, 0 to 1 percent slopes	22	IIw-2	67
CrB	Columbia soils, channeled, 0 to 8 percent slopes	22	IIIe-4	69
CsB	Cometa gravelly sandy loam, 3 to 8 percent slopes	23	IVe-3	71
CtB	Cometa loam, 3 to 8 percent slopes	23	IVe-3	71
CuA	Cometa sandy loams, 0 to 3 percent slopes	23	IVs-3	72
CuB	Cometa sandy loams, 3 to 8 percent slopes	23	IVe-3	71
CuC	Cometa sandy loams, 8 to 15 percent slopes	23	IVe-3	71
CwB	Cometa-Whitney sandy loams, 3 to 8 percent slopes	24	IVe-3	71
CwC	Cometa-Whitney sandy loams, 8 to 15 percent slopes	24	IVe-3	71
CyA	Corning gravelly loam, 0 to 3 percent slopes	24	IVs-3	72
CyB	Corning gravelly loam, 3 to 8 percent slopes	24	IVe-3	71
DaB	Daulton fine sandy loam, 3 to 8 percent slopes	25	VIIe-3	74
DaD	Daulton fine sandy loam, 8 to 30 percent slopes	25	VIIe-3	74
DaE	Daulton fine sandy loam, 30 to 45 percent slopes	25	VIIe-3	74
DbD	Daulton loam, 8 to 30 percent slopes	25	VIIe-3	74
DcB	Daulton rocky fine sandy loam, 3 to 8 percent slopes	25	VIIe-3	74
DcE	Daulton rocky fine sandy loam, 30 to 45 percent slopes	26	VIIe-3	74
DeA	Delhi sand, 0 to 3 percent slopes	26	IVe-4	71
DeB	Delhi sand, 3 to 8 percent slopes	26	IVe-4	71
DfA	Delhi sand, moderately deep and deep over hardpan, 0 to 3 percent slopes	26	IVe-4	71
DmA	Dinuba fine sandy loam, 0 to 1 percent slopes	27	IIIs-3	69
DoA	Dinuba loam, 0 to 1 percent slopes	27	IIIs-3	69
DpA	Dinuba-El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes.	27	IIIs-8	70
DsA	Dinuba-El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes.	27	IVs-8	72
DtA	Dinuba-El Peco loams, slightly saline-alkali, 0 to 1 percent slopes	28	IIIs-8	70
DuA	Dinuba-El Peco loams, moderately saline-alkali, 0 to 1 percent slopes	28	IVs-8	72
EdA	El Peco-Dinuba fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes.	28	VIs-8	74
FaA	Foster clay loam, 0 to 1 percent slopes	30	IIw-2	67
FaaA	Foster clay loam, slightly saline-alkali, 0 to 1 percent slopes	30	IIs-6	68
FabA	Foster clay loam, moderately saline-alkali, 0 to 1 percent slopes	30	IIIs-6	70
FacA	Foster clay loam, strongly saline-alkali, 0 to 1 percent slopes	30	IVw-6	72
FbA	Foster loams, 0 to 1 percent slopes	29	IIw-2	67
FbaA	Foster loams, slightly saline-alkali, 0 to 1 percent slopes	29	IIs-6	68
FbbA	Foster loams, moderately saline-alkali, 0 to 1 percent slopes	29	IIIs-6	70
FbcA	Foster loams, strongly saline-alkali, 0 to 1 percent slopes	29	IVw-6	72
FbdA	Foster loams, sandy substratum, 0 to 1 percent slopes	29	IIw-2	67
FbeA	Foster loams, moderately deep and deep over Temple soils, 0 to 1 percent slopes.	29	IIw-7	67
FcbA	Foster loams, moderately deep and deep over Temple soils, moderately saline-alkali, 0 to 1 percent slopes.	30	IIIs-6	70
FdcA	Foster-Chino loams, strongly saline-alkali, 0 to 1 percent slopes	30	IVw-6	72
FeaA	Fresno and El Peco fine sandy loams, slightly saline-alkali, 0 to 1 percent slopes.	31	IIIs-8	70
FebA	Fresno and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes.	31	IVs-8	72
FecA	Fresno and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes.	30	VIs-8	74
FfaA	Fresno and El Peco loams, slightly saline-alkali, 0 to 1 percent slopes	31	IIIs-8	70
FfbA	Fresno and El Peco loams, moderately saline-alkali, 0 to 1 percent slopes	31	IVs-8	72
FfcA	Fresno and El Peco loams, strongly saline-alkali, 0 to 1 percent slopes	31	VIs-8	74
FgaA	Fresno, El Peco, and Chino soils, slightly saline-alkali, 0 to 1 percent slopes.	32	IIIs-8	70
FgbA	Fresno, El Peco, and Chino soils, moderately saline-alkali, 0 to 1 percent slopes.	32	IVs-8	72
FhbA	Fresno, El Peco, and Lewis soils, moderately saline-alkali, 0 to 1 percent slopes.	32	IVs-8	72
FhcA	Fresno, El Peco, and Lewis soils, strongly saline-alkali, 0 to 1 percent slopes.	32	VIs-8	74
FkaA	Fresno, El Peco, and Pozo soils, slightly saline-alkali, 0 to 1 percent slopes	32	IIIs-8	70
FkbA	Fresno, El Peco, and Pozo soils, moderately saline-alkali, 0 to 1 percent slopes.	32	IVs-8	72
GaA	Grangeville fine sandy loam, 0 to 1 percent slopes	32	I-1	66
GbA	Grangeville fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	33	IIs-6	68
GcA	Grangeville fine sandy loam, over Traver soils, 0 to 1 percent slopes	33	IIs-6	68
GdA	Grangeville fine sandy loam, over Traver soils, slightly saline-alkali, 0 to 1 percent slopes.	34	IIs-6	68
GeA	Grangeville fine sandy loam, moderately deep and deep over Temple soils, 0 to 1 percent slopes.	34	IIw-7	67
GfA	Grangeville fine sandy loam, deep over hardpan, 0 to 1 percent slopes	34	IIs-3	67
GhA	Grangeville fine sandy loam, deep over alkali hardpan, 0 to 1 percent slopes.	34	IIs-3	67

GUIDE TO MAPPING UNITS—Continued

Map symbol	*Soil Name*	*Page*	*Capability unit*	*Page*
GkA	Grangeville fine sandy loam, deep over alkali hardpan, slightly saline-alkali, 0 to 1 percent slopes.	34	IIs–3	67
GmA	Grangeville sandy loam, 0 to 1 percent slopes	33	I–1	66
GnA	Grangeville sandy loam, slightly saline-alkali, 0 to 1 percent slopes	33	IIs–6	68
Gp	Gravel pits	34	VIIIs–1	75
GrA	Greenfield coarse sandy loam, 0 to 3 percent slopes	34	I–1	66
GrB	Greenfield coarse sandy loam, 3 to 8 percent slopes	35	IIe–1	66
GsA	Greenfield fine sandy loam, 0 to 3 percent slopes	35	I–1	66
GsB	Greenfield fine sandy loam, 3 to 8 percent slopes	35	IIe–1	66
GuA	Greenfield sandy loam, 0 to 3 percent slopes	35	I–1	66
GuB	Greenfield sandy loam, 3 to 8 percent slopes	35	IIe–1	66
GvA	Greenfield sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes.	35	IIs–3	67
GvB	Greenfield sandy loam, moderately deep and deep over hardpan, 3 to 8 percent slopes.	35	IIs–3	67
HaA	Hanford fine sandy loam, 0 to 1 percent slopes	36	I–1	66
HbA	Hanford fine sandy loam, moderately deep and deep over hardpan, 0 to 1 percent slopes.	36	IIIs–3	69
HcA	Hanford (Ripperdan) fine sandy loam, shallow variant, 0 to 3 percent slopes	37	IIIs–3	69
HdA	Hanford (Ripperdan) fine sandy loam, moderately deep and deep over silt, 0 to 3 percent slopes.	37	IIIs–3	69
HeB	Hanford gravelly sandy loam, 3 to 8 percent slopes	36	IIe–1	66
HfA	Hanford sandy loam, 0 to 3 percent slopes	36	I–1	66
HgA	Hanford sandy loam, moderately deep and deep over hardpan, 0 to 3 percent slopes.	36	IIIs–3	69
HhA	Hanford sandy loam, moderately deep over sand, 0 to 3 percent slopes	36	IIIe–4	69
HkB	Hideaway very stony loam, 0 to 8 percent slopes	37	VIIe–9	75
HkD	Hideaway very stony loam, 15 to 30 percent slopes	38	VIIe–9	75
HmA	Hildreth sandy clay, 0 to 3 percent slopes	38	IIIw–5	69
HnB	Hildreth-San Joaquin complex, 0 to 8 percent slopes	39	IIIw–5	69
HoD	Holland sandy loam, 15 to 30 percent slopes	39	VIe–4	73
HoE	Holland sandy loam, 30 to 45 percent slopes	39	VIIe–4	75
HrE	Holland rocky sandy loam, 30 to 45 percent slopes	40	VIIe–4	75
HsB	Hornitos gravelly sandy loam, 3 to 8 percent slopes	40	VIIe–9	75
HsD	Hornitos gravelly sandy loam, 8 to 30 percent slopes	40	VIIe–9	75
HvD	Hornitos very rocky sandy loam, 8 to 30 percent slopes	40	VIIe–9	75
JeA	Jesbel clay, 0 to 3 percent slopes	41	IIIs–5	70
JgB	Jesbel gravelly clay, 3 to 8 percent slopes	41	IIIs–5	70
JyA	Jesbel gravelly clay loam, 0 to 3 percent slopes	40	IVs–3	72
LeA	Lewis loam, slightly saline-alkali, 0 to 1 percent slopes	41	IIIs–8	70
LwA	Lewis loam, moderately saline-alkali, 0 to 1 percent slopes	41	IVs–8	72
MaA	Madera fine sandy loam, 0 to 3 percent slopes	42	IVs–3	72
MbA	Madera loam, 0 to 3 percent slopes	42	IVs–3	72
McA	Madera-Alamo complex, 0 to 1 percent slopes	42	IVs–3	72
MdA	Madera-Lewis complex, slightly saline-alkali, 0 to 1 percent slopes	42	IVs–3	72
MmA	Marguerite clay loam, 0 to 3 percent slopes	43	I–1	66
MnA	Marguerite clay loam, moderately saline-alkali, 0 to 3 percent slopes	43	IIIs–6	70
MoA	Marguerite loam, 0 to 3 percent slopes	42	I–1	66
MrA	Marguerite loam, slightly saline-alkali, 0 to 3 percent slopes	43	IIs–6	68
MsA	Marguerite loam, moderately saline-alkali, 0 to 3 percent slopes	43	IIIs–6	70
MtB	Montpellier coarse sandy loam, 3 to 8 percent slopes	43	IVe–3	71
MtC	Montpellier coarse sandy loam, 8 to 15 percent slopes	43	IVe–3	71
PaA	Pachappa fine sandy loam, 0 to 1 percent slopes	44	I–1	66
PbA	Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	44	IIs–6	68
PcA	Pachappa sandy loam, 0 to 1 percent slopes	44	I–1	66
PdA	Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes	44	IIs–6	68
PeA	Pachappa sandy loam, moderately deep and deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes.	44	IIIs–8	70
PfA	Porterville clay, 0 to 3 percent slopes	45	IIIs–5	70
PfB	Porterville clay, 3 to 8 percent slopes	45	IIIs–5	70
PgB	Porterville rocky clay, 3 to 8 percent slopes	45	IIIs–5	70
PhA	Pozo clay loam, 0 to 1 percent slopes	46	IIIs–3	69
PkA	Pozo clay loam, slightly saline, 0 to 1 percent slopes	46	IIIs–8	70
PmA	Pozo clay loam, moderately saline, 0 to 1 percent slopes	46	IVs–8	72
PnA	Pozo clay loam, strongly saline, 0 to 1 percent slopes	46	VIs–8	74
PoA	Pozo loam, 0 to 1 percent slopes	45	IIIs–3	69
PsA	Pozo loam, slightly saline, 0 to 1 percent slopes	46	IIIs–8	70
PtA	Pozo loam, moderately saline, 0 to 1 percent slopes	46	IVs–8	72
PvA	Pozo loam, strongly saline, 0 to 1 percent slopes	46	VIs–8	74
RaA	Ramona sandy loam, 0 to 3 percent slopes	46	IIs–7	68
RaB	Ramona sandy loam, 3 to 8 percent slopes	47	IIIe–1	68
RbA	Ramona sandy loam, deep over hardpan, 0 to 3 percent slopes	47	IIs–7	68
RcA	Raynor clay, 0 to 3 percent slopes	47	IIIs–5	70
RcB	Raynor clay, 3 to 8 percent slopes	47	IIIs–5	70
RdA	Redding gravelly loam, 0 to 3 percent slopes	48	IVs–3	72
RdC	Redding gravelly loam, 3 to 15 percent slopes	48	IVe–3	71

GUIDE TO MAPPING UNITS—Continued

Map symbol	*Soil Name*	*Page*	*Capability unit*	*Page*
RfC	Redding gravelly sandy loam, 3 to 15 percent slopes	48	IVe-3	71
RgC	Redding-Raynor complex, 3 to 15 percent slopes	48	IVe-3	71
Rh	Riverwash	48	VIIIs-1	75
Rk	Rock land, Hornitos soil material	49	VIIIs-1	75
RmB	Rocklin rocky sandy loam, pumiceous variant, 3 to 8 percent slopes	49	VIIe-9	75
RmD	Rocklin rocky sandy loam, pumiceous variant, 8 to 30 percent slopes	49	VIIe-9	75
RoA	Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes	50	IIIs-6	70
RpA	Rossi clay loam, strongly saline-alkali, 0 to 1 percent slopes	50	IVw-6	72
RrA	Rossi silt loam, slightly saline-alkali, 0 to 1 percent slopes	50	IIIs-6	70
RsA	Rossi silt loam, moderately saline-alkali, 0 to 1 percent slopes	50	IVw-6	72
RtA	Rossi silt loam, strongly saline-alkali, 0 to 1 percent slopes	50	IVw-6	72
SaA	San Joaquin sandy loams, 0 to 3 percent slopes	51	IVs-3	72
SbA	San Joaquin-Alamo complex, 0 to 3 percent slopes	51	IVs-3	72
ScB	San Joaquin-Whitney sandy loams, 0 to 8 percent slopes	51	IVe-3	71
SeB	Sesame loam, 3 to 8 percent slopes	52	IIIe-1	68
SeC	Sesame loam, 8 to 15 percent slopes	52	IVe-1	71
SkC	Sesame rocky loam, 8 to 15 percent slopes	52	VIe-4	73
SnB	Sesame rocky sandy loam, 3 to 8 percent slopes	52	VIe-4	73
SyB	Sesame sandy loam, 3 to 8 percent slopes	52	IIIe-1	68
TaA	Temple clay, 0 to 1 percent slopes	53	IIw-2	67
TbA	Temple clay loam, 0 to 1 percent slopes	53	IIw-2	67
TcA	Temple clay loam, slightly saline, 0 to 1 percent slopes	53	IIs-6	68
TdA	Temple loam, 0 to 1 percent slopes	53	IIw-2	67
TeA	Temple loam, slightly saline, 0 to 1 percent slopes	53	IIs-6	68
Tf	Terrace escarpments	53	VIIIs-1	75
TgF	Tollhouse rocky coarse sandy loam, 30 to 75 percent slopes	54	VIIe-4	75
ThE	Trabuco loam, 15 to 45 percent slopes	54	VIe-1	73
TkC	Trabuco rocky loam, 8 to 15 percent slopes	54	VIe-1	73
TkF	Trabuco rocky loam, 45 to 75 percent slopes	54	VIIe-1	74
TmA	Traver loam, slightly saline-alkali, 0 to 1 percent slopes	55	IIs-6	68
TnA	Traver loam, moderately saline-alkali, 0 to 1 percent slopes	55	IIIs-6	70
ToA	Traver loam, strongly saline-alkali, 0 to 1 percent slopes	55	IVs-6	72
TpA	Traver-Chino complex, slightly saline-alkali, 0 to 1 percent slopes	55	IIs-6	68
TrA	Traver-Chino complex, moderately saline-alkali, 0 to 1 percent slopes	56	IIIs-6	70
TsA	Traver, Fresno, and El Peco fine sandy loams, moderately saline-alkali, 0 to 1 percent slopes.	56	IVs-8	72
TtA	Traver, Fresno, and El Peco fine sandy loams, strongly saline-alkali, 0 to 1 percent slopes.	56	VIs-8	74
TuB	Trigo fine sandy loam, 3 to 8 percent slopes	56	IVe-3	71
TuC	Trigo fine sandy loam, 8 to 15 percent slopes	56	IVe-3	71
TvB	Trigo-Cometa sandy loams, 3 to 8 percent slopes	57	IVe-3	71
TwA	Tujunga loamy sand, 0 to 3 percent slopes	57	IIIe-4	69
TwB	Tujunga loamy sand, 3 to 8 percent slopes	57	IIIe-4	69
TxA	Tujunga loamy sand, moderately deep and deep over hardpan, 0 to 3 percent slopes.	57	IIIe-4	69
TyA	Tujunga loamy sand, moderately deep and deep over silt, 0 to 3 percent slopes.	58	IIIe-4	69
TzB	Tujunga and Hanford soils, channeled, 0 to 8 percent slopes	57	IIIe-4	69
VaA	Visalia fine sandy loam, 0 to 1 percent slopes	58	I-1	66
VdA	Visalia sandy loam, 0 to 3 percent slopes	58	I-1	66
VnA	Visalia sandy loam, moderately deep over sand, 0 to 3 percent slopes	58	IIIe-4	69
VsB	Vista-Sesame complex, 3 to 8 percent slopes	59	IIIe-1	68
WaB	Whiterock rocky fine sandy loam, 3 to 8 percent slopes	59	VIIe-3	74
WaE	Whiterock rocky fine sandy loam, 30 to 45 percent slopes	59	VIIe-3	74
WbD	Whiterock very rocky fine sandy loam, 8 to 30 percent slopes	60	VIIe-3	74
WfB	Whitney fine sandy loam, 3 to 8 percent slopes	60	IIIe-1	68
WfC	Whitney fine sandy loam, 8 to 15 percent slopes	60	IVe-1	71
WmA	Whitney loam, 0 to 3 percent slopes	60	IIIe-1	68
WmB	Whitney loam, 3 to 8 percent slopes	60	IIIe-1	68
WmC	Whitney loam, 8 to 15 percent slopes	60	IVe-1	71
WnD	Whitney sandy loam, 15 to 30 percent slopes, eroded	60	VIe-4	73
WoC	Whitney and Rocklin gravelly sandy loams, 3 to 15 percent slopes	61	IVe-1	71
WrB	Whitney and Rocklin sandy loams, 3 to 8 percent slopes	61	IIIe-1	68
WrC	Whitney and Rocklin sandy loams, 8 to 15 percent slopes	61	IVe-1	71
WtB	Whitney-Trigo fine sandy loams, 3 to 8 percent slopes	61	IIIe-1	68
WuA	Wunjey very fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	61	IIs-6	68
WvA	Wunjey very fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes.	61	IIIs-6	70
WxA	Wunjey very fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes	61	IVs-6	72
WyB	Wunjey very fine sandy loam, strongly saline-alkali, channeled, 1 to 8 percent slopes.	62	IVs-6	72
ZaB	Zaca clay, 3 to 8 percent slopes	62	IIIs-5	70

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