U. S. DEPARTMENT OF AGRICULTURE

BUREAU OF SOILS

IN COOPERATION WITH THE UNIVERSITY OF CALIFORNIA
AGRICULTURAL EXPERIMENT STATION

SOIL SURVEY OF THE LANCASTER AREA CALIFORNIA

BY

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[Advance Sheets—Field Operations of the Bureau of Soils, 1922]

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[PUBLIC RESOLUTION—No. 9]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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SOIL SURVEY OF THE LANCASTER AREA, CALIFORNIA

By E. J. CARPENTER, of the United States Department of Agriculture, in Charge, and STANLEY W. COSBY, of the University of California

DESCRIPTION OF THE AREA

The Lancaster area is situated in the southwestern part of the Mohave Desert region, in what is locally known as the Antelope Valley. It lies mainly in the northern part of Los Angeles County, but includes a small part of the southeastern part of Kern County. The city of Los Angeles lies to the southwest at a distance of 40 miles by air line or 86 miles by highway through Mint Canyon in the San Gabriel Mountains. The survey covers an area of 530 square miles, or 339,200 acres.

FIG. 20.—Sketch map showing location of the Lancaster area, California

The Lancaster area includes only a part of the Antelope Valley. The country mapped consists mainly of a mountainous belt, occupying the southwestern part, and a broad plain, on which stand a few prominent buttes, forming the rest.

The southwestern mountainous area consists of a linear ridge, Portal Ridge, of unequal height, ranging from a few hundred feet above the valley floor immediately north of it to a thousand or more on its highest points. It averages about a mile in width, being somewhat more than that in the western part of its course within the area mapped and less than that in the eastern part. It is interrupted by a few low gaps connecting he Leonis Valley, lying to the south of the ridge, with the Antelope Valley north of it.

Like Portal Ridge, the Leonis Valley is narrow and takes a straight course across the area. Its floor ranges from a few hundred yards to a mile or more in width. The elevation of its floor is somewhat greater than that of the Antelope Valley immediately north of Portal Ridge.

South of the Leonis Valley lies a rugged mountainous area that covers the rest of the southwestern part of the area.

The included part of the Antelope Valley consists of a smooth plain sloping northward from Portal Ridge to an axial low belt extending from the northwest corner of the area mapped eastward to the center of Rosamond Lake and eastward from there. The slope along the axial belt is eastward; north of it, it is southward. The slope is rather rapid for the first mile or so north of the ridge and very gradual beyond that.

The Elizabeth Lake quadrangle of the United States Geological Survey, which was used as a base map for the greater part of the area, has been revised where necessary to show changes in cultural features. As shown on these topographic sheets, the elevations of the principal agricultural districts of the valley do not vary greatly, but the variations are sufficient to provide good drainage to the gently sloping fans bordering the mountains. In the trough of the valley, however, slight differences in elevation have given rise to poorly drained areas. At Lancaster the elevation is shown to be 2,356 feet above sea level; at Rosamond it is about 2,350 feet; and at Rosamond Lake, the lowest point in the valley, it is 2,275 feet. Other elevations within the agricultural section of the valley range from 2,669 feet at Palmdale, 2,395 feet at Del Sur, and 2,520 feet at Willow Springs, to 3,500 feet or more in the Leonis Valley. Some of the peaks in the bordering mountain ranges attain an elevation of from 6,000 to 9,000 feet or more, and the highest are snow capped throughout the greater part of the year.

The area surveyed is the least densely populated of any agricultural section of Los Angeles County. This is due in part to the fact that the water supply has not been extensively developed for irrigation; also to the fact that in the past many people, attracted to the area by the low price of land and proximity to a large city, but, having no knowledge of arid conditions, did not make adequate provision for water and consequently failed and moved away, leaving their lands unoccupied. Within the last 10 years the settlement has taken on a more permanent character, especially since the development of pump irrigation and the realization of the limits to the development of gravity water.

Several prosperous settlements in the valley are devoted to fruit or alfalfa production. The Littlerock, Pearland, and Palmdale districts, each thickly populated, are devoted largely to the production of pears. Farther west along the footslopes of Portal Ridge are many well-developed orchards irrigated by pumps, as well as several orchards producing almonds and several varieties of early fruits under dry-farm practices. In the Leonis Valley, which is quite well developed, fruits, grains, and nuts are produced successfully without irrigation. Several rather populous communities in the vicinity of Lancaster, Roosevelt School, and Redman School are utilizing pumped water for the production of alfalfa.

There are no incorporated towns in the area. Lancaster, the largest town, has a good waterworks system, and, in common with Palmdale, the next largest town in the area, has electric power, good stores, hotels, and a bank. Other towns and local settlements of smaller size are Rosamond with a hotel and general store, Littlerock, Del Sur, Willow Springs, Redman, and Roosevelt. Schools, rural mail delivery, telephones, and electric lights are available throughout the greater part of the area surveyed.

The population is drawn from practically every State in the Union, as well as from several foreign lands, chief of which are Germany, Canada, and England. Mexicans are not numerous, though a few are employed on the railway as section hands. The few Japanese in the area are engaged in agricultural pursuits.

The "Valley Line" of the Southern Pacific Railroad, operating through the San Joaquin Valley from Los Angeles to San Francisco, traverses the central part of the area from north to south. A paved road which parallels the railroad throughout the area is part of the Midland Trail used by tourists traveling from Salt Lake City to Southern California. This road also makes connections with other highways in the San Joaquin Valley. Another paved road extends from Lancaster to the east as far as the Roosevelt and Redman districts. In the early development of the country most of the roads were made without reference to land lines, but with the fencing off of the open range the roads have been made on section lines. Many of the roads are well graded and accessible by good lateral roads.

Some agricultural products are marketed locally, though most of the surplus alfalfa, poultry, and dairy products are sent to Los Angeles, either by truck or rail. Fruit shipped from the valley reaches many of the principal eastern markets.

CLIMATE

The climate of that part of the Mohave Desert included within this survey varies greatly and has a marked influence on the soils, crops, and agricultural practices. In this respect rainfall appears to be the most important climatic factor. In the lower lying central part of the area the annual precipitation amounts to 6 inches or less and irrigation is necessary. In general the rainfall increases with the altitude. The mountains and higher slopes in the southern and southwestern parts of this area have a mean annual precipitation of 12 inches or more. In such localities there is considerable dry farming of grain, and even fruit and almonds are produced.

A distinct seasonal variation in precipitation occurs in this area. The greatest amount of rain falls during the winter months. The summer rains are very irregular and usually come as thunderstorms or cloud-bursts, which frequently are of such violence that they do more harm than good to growing crops.

Strong winds, prevailingly from the west, blow across the Antelope Valley at various seasons of the year. There is little to break their force except the scattering growth of Joshua trees (*Yucca arborescens*), desert shrubs, and such windbreaks as the farmers have planted for the protection of their orchards and fields.

High temperatures, particularly during the summer months are characteristic of this area. The thermometer rises above 100° F. many days each summer and occasionally rises to 110° or 115° F. The evenings are much cooler, however, owing to the low relative humidity. Winter temperatures seem to be higher here than in regions of the same elevation and latitude farther inland. The thermometer frequently reaches 60° F. or more during the winter days and falls to only a few degrees below freezing at night, although temperatures occasionally go as low as 15° F. or even lower.

Snow lies on the higher peaks bordering the area for the greater part of the year, and during the winter months light snowfalls are generally experienced even on the floor of the valley.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation at Mohave at an elevation of

2,751 feet. This station, on the Southern Pacific Railroad about 13 miles north of the northern boundary of this survey is the only station in this region at which complete data are available. The records, it is believed, represent fairly the conditions in the area surveyed.

Normal monthly, seasonal, and annual temperature and precipitation at Mohave, Kern County

[Elevation, 2,751 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1881)	Total amount for the wettest year (1889)
	° F.	° F.	° F.	Inches	Inches	Inches
December	47.2	78	15	0.98	T.	7.30
January	46.0	82	10	.92	0.00	.35
February	49.0	90	15	.94	.00	.03
Winter	47.4	90	10	2.84	T.	7.68
March	52.2	95	20	.86	.06	3.43
April	59.5	100	24	.21	.18	.00
May	68.0	102	32	.04	.00	T.
Spring	59.9	102	20	1.11	.24	3.43
June	77.4	112	42	.03	.00	.00
July	85.5	117	51	.09	.00	.00
August	83.7	118	48	.08	.00	.81
Summer	82.2	118	42	.20	.00	.81
September	76.3	110	31	.08	.00	.27
October	65.7	99	28	.21	T.	2.21
November	54.6	96	20	.34	T.	.45
Fall	65.5	110	20	.63	T.	2.93
Year	63.8	118	10	4.78	.24	14.85

It will be noted that the mean annual precipitation is 4.78 inches, of which about 83 per cent falls during the winter and spring months.

The mean annual temperature at Mohave is 63.8° F. The absolute maximum is 118° F., which was recorded during the month of August, and the minimum 10° F.

The average date of the last killing frost in the spring, as reported for Mohave, is February 27 and the average first in the fall is November 18. The average length of the growing season, as shown by these dates, is 264 days. Frost occurrence in this region is, however, erratic and killing frost has been recorded on April 1, 32 days later than the average date, and on September 30, which is 49 days earlier than the average. Such variations are of decided economic importance in the Lancaster area, particularly in areas of poor air drainage, as warm spring days force the fruit trees into blossom, and sudden changes in temperature accompanied by killing frosts frequently do much damage to fruit crops.

The following tables give rainfall data for a number of points in and near the area of the survey. Manzana lies about 8 miles from the western boundary of the survey at an elevation of 2,850 feet; Fairmont is just outside the area near the Antelope Buttes at an elevation of 3,047 feet; the E. T. Earl Ranch is in sec. 36, T. 7 N., R.

13 W., at an elevation of about 2,450 feet; and the Palmdale irrigation headworks lies at an elevation of 3,299 feet.

Normal monthly, seasonal, and annual precipitation at Manzana and Fairmont

Month	At Manzana, elevation 2,850 feet			At Fairmont, elevation 3,047 feet		
	Mean	Total amount for the driest year (1898)	Total amount for the wettest year (1901)	Mean	Total amount for the driest year (1919)	Total amount for the wettest year (1909)
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
December	0.87	0.14	0.00	2.44	1.22	5.46
January	1.52	1.70	3.20	5.55	.17	8.00
February	1.27	.02	6.68	3.85	1.42	5.99
Winter	3.66	1.86	9.88	11.84	2.81	19.45
March	1.23	.47	.25	3.47	2.32	5.96
April	.59	.00	.61	.53	.07	.00
May	.13	.25	.12	.42	.14	.00
Spring	1.95	.72	.98	4.42	2.53	5.96
June	.02	.00	.00	.02	.00	T.
July	.00	T.	.00	.04	T.	T.
August	.24	.28	.08	.03	.00	.12
Summer	.26	.28	.08	.09	T.	.12
September	.07	.00	.10	.36	.35	.24
October	.51	.21	.09	.51	.13	.65
November	.69	T.	2.55	.63	.40	1.37
Fall	1.27	.21	2.74	1.50	.88	2.26
Year	7.14	3.07	13.68	17.85	6.22	27.79

Precipitation record at E. T. Earl Ranch, sec. 36, T. 7 N., R. 13 W.[1]

[Elevation about 2,450 feet]

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
1913–14	0.13	0.10	0.00	0.00	0.35	1.07	4.40	3.53	0.12	0.12	0.15	0.00	9.97
1914–15	.02	.00	.00	.15	.12	3.24	4.10	3.55	.45	.46	.76	.00	12.85
1915–16	.00	.00	.00	.00	.47	1.17	4.62	1.04	.98	.15	.00	.00	8.43
1916–17	.00	.00	.12	.31	.06	2.86	1.88	.43	.15	.10	.00	.00	5.91
1917–18	.55	.00	.00	.00	.05	.00	.06	3.10	3.66	.00	.02	.31	7.75
1918–19	.04	.97	1.75	.00	.79	1.39	.22	.84	1.83	.15	.04	.00	8.02
1919–20	.00	.00	.00	.00	.17	.93	1.13	2.55	1.88				
6-year means	.12	.18	.31	.08	.31	1.62	2.55	2.08	1.20	.16	.16	.05	8.82

[1] Record furnished by E. T. Earl estate. Taken from unpublished water-supply paper of Antelope Valley.

Precipitation record at Palmdale headworks (on Littlerock Creek)[1]

[Elevation, 3,299 feet]

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
1896–97	0.25	1.35	0.32	1.42	0.43	0.98	3.78	3.71	1.31	0.04	0.32	0.00	13.91
1897–98	.03	1.57	T.	.86	.00	.14	2.38	.07	.90	.00	.21	.00	6.16
1898–99	.02	.05	.00	.00	T.	.87	1.00	.31	.97	.00	.00	.00	3.22
1899–00	.00	.00	.00	1.28	.27	.32	.65	.00	.80	.57	.76	.00	4.65
1900–01	.00	.00	.00	.20	1.79	.00	1.34	4.50	.38	.15	T.	.00	8.36
1901–02	.00	.33	T.	.32	.04	.00							(2)
5-year means	.06	.59	.06	.75	.50	.46	1.83	1.72	.87	.15	.25	.00	7.26

[1] Record from Water-Supply Paper 278, U. S. Geological Survey, p. 15.
[2] Record for several months in the year lacking.

AGRICULTURE

Although the development of the Antelope Valley has taken place during the last 40 years, little is definitely known of its early agriculture. During the eighties it was used for winter and spring grazing of cattle and other range stock which were moved into the surrounding mountains during the warm summer months. About 1890 a number of more venturesome ranchers, mainly about Del Sur, Fairmont, and Neenach, the latter two outside the area, attempted to grow grain by dry-farming methods. Then, as to-day, the success of the crop was dependent upon the winter rains, which varied from year to year. It is reported [1] that 750 carloads of wheat were shipped from this region in 1893.

The Antelope Valley received its share of attention during the period of land exploitation which occurred in southern California in the nineties, and between 1890 and 1895 six irrigation districts were formed under the Wright Act. These were located on the upper slopes of the alluvial fans and planned to obtain their water by gravity flow from the streams emerging from the mountains. Of these the Littlerock irrigation district is the only one that has been entirely successful. The Palmdale district was forced to undergo some changes and a new district was organized under another State law.

During this time of rapid development thousands of acres were planted to trees; 1,300 acres are said to have been planted to almonds and prunes at Littlerock (then the Alpine Springs colony); 1,500 acres were sold at Manzana (which lies a few miles west of the area surveyed) and planted mainly to almonds. On probably 1,000 additional acres, in scattered tracts, trees had been set out through private enterprise.

Beginning with the season of 1893–94 there was an 11-year period of very low rainfall, which seriously affected the newly planted orchards. The trees on the west side of the valley, particularly those with little or no facilities for irrigation, were the first to suffer. Most of the younger trees died, and hundreds of acres were abandoned by the discouraged colonists. In 1910 less than 5,000 acres are said to have been irrigated in the valley. Later plantings have been mainly of pears, and to a lesser extent of apples.

At present approximately 10,000 acres are irrigated from wells. It was discovered in the eighties that flowing wells could be obtained in the vicinity of Lancaster by drilling to depths of 200 to 500 feet. This development was most rapid between 1900 and 1908. It is reported that more than 300 wells had been drilled by 1908. Although it is probable that at least 500 wells have been drilled in the valley, not all of them are in use at the present time. Unfortunately most of the early drilling took place on land too high in content of alkali for profitable production of crops. According to figures furnished by the Southern California Edison Co., there are about 235 wells equipped with pumps operated by electric power and more than 25 wells either flowing or operated by gasoline engines.

[1] Farm, Field, and Fireside, Apr. 21, 1894.

The principal crops grown in this area are pears, apples, almonds, apricots, and other fruits; alfalfa and grain hay; some wheat, barley, and corn; and some squash, melons, beans, and other truck crops. A few dairy cattle are kept and some beef cattle are produced. The alfalfa and pear crops are by far the most important and form the main source of income in the Lancaster area.

According to figures furnished to David G. Thompson by the Southern Pacific Railroad Co., and quoted by him in his unpublished paper on "Available Supply of Ground Water in the Antelope Valley, California," the shipments of agricultural products from stations in the Antelope Valley, in carload lots, are as follows:

Shipments of agricultural products from Antelope Valley

[Carloads]

Station	Hay			Grain			Livestock			Deciduous fruits		
	1917	1918	1919	1917	1918	1919	1917	1918	1919	1917	1918	1919
Lancaster	333	809	1,479	2	2	3	54	73	63	8	3	1
Palmdale	------	17	------	------	------	3	------	10	5	------	72	102
Rosamond	2	20	57	------	------	------	------	------	1	------	------	------
Total	335	846	1,536	2	2	6	54	83	69	8	75	103

The following table, compiled from data obtained by the writers in March, 1922, from the Southern Pacific Railroad Co., shows the number of carloads of products shipped from stations within the area surveyed:

Shipments of agricultural products from the Lancaster area

[Carloads]

Year	Hay	Wheat	Barley	Corn	Grain [1]	Castor beans	Almonds	Pears	Apples	Grapes	Fertilizer
1919	1,547	24	6	0	4	3	3	95	18	2	20
1920	842	22	3	0	1	0	0	107	8	11	8
1921	241	10	1	1	1	0	3	146	5	6	0

[1] Kind of grain not specified.

Although these shipments do not represent all the agricultural products raised in this area during these years, considerable importance can be attached to the gradual increase in shipments of deciduous fruits (mainly pears) from 8 carloads in 1917 to more than 146 carloads in 1921. The production in 1922 is expected to be even larger than in previous years, owing to new acreages coming into bearing and to a larger yield from established orchards not yet matured and at maximum production.

The item of hay consists of alfalfa grown mainly about the Roosevelt and Redman Schools. Although only 241 carloads were shipped by rail in 1921, the production had been increased to about 2,500 carloads or 30,000 tons. Some was used locally, but about 20,000 tons were shipped by auto truck. (Pl. XX, fig. 1.)

Owing to differences in soils, alkali content, and the availability of water for irrigation, there have been developed in this area two distinct and separate agricultural sections.

The production of alfalfa takes place mainly on the soils of the Rosamond series (Pl. XX, fig. 2). The factor of economical water supply has caused the growers to locate as near as possible to the area of flowing wells, which coincides in the main with the area of soils with high percentages of alkali. Consequently we find the majority of the alfalfa fields occupying a strip of land just outside the zone of high alkali accumulation, but not so distant from it that the cost of pumping would be too high. The fruit growers, on the other hand, have planted their orchards on the upper alluvial slopes, on soils mainly of the Hesperia, Cajon, or Adelanto series. Irrigation here is mainly by gravity, although a large acreage is irrigated from wells. A greater lift and hence greater cost per unit of water can be sustained by the orchardist than by the alfalfa grower. In the intermediate country between these two localities a number of farmers have attempted one or the other of these crops, and where conditions are favorable they have been successful.

At present alfalfa is the leading crop in point of production in the area covered by this survey. Approximately 7,000 acres, mainly in the Redman and Roosevelt sections, are producing an average of a little less than 5 tons of hay per acre. More land is being prepared and planted to alfalfa, so the production may be expected to increase. The hay is of excellent quality. The greater part of it is shipped to Los Angeles for sale to dairymen and others. An average price of $25 a ton was received last season (1921). Chilean alfalfa seems to be the favored variety, although considerable Peruvian (both the smooth and hairy) has been sown the last two or three years. The first cutting usually is made late in April and the last late in October. According to the soil, the crop is irrigated once, twice, or three times per cutting. Water costs range from $2.50 to $4.50 per ton of hay. The alfalfa is remarkably free from weeds or disease in this region. Occasionally a field becomes infested with foxtail, devil's grass, or even salt grass, but judicious handling will remove it. One field west of the Roosevelt School is said to be 30 years old and appears to be in good condition and yielding well.

Pears are the most important fruit crop in this area. Some 3,000 acres are planted to pears, yielding from one-half ton to 5 tons per acre, according to age of the trees. The greater part of this acreage is in either the Littlerock or Palmdale irrigation districts. The remainder occupies similar soils and topography, but is usually irrigated by water pumped from wells. Numerous plantings are planned or planted and a larger production may be expected during the next few years. Most of the fruit is disposed of through Los Angeles commission houses, a little being sold locally. Bartlett is the variety planted. Compared with older fruit-growing districts, this region may be said to be practically free of insect pests and diseases. Spraying for the codling moth and blister mite is sometimes necessary. Considerable attention must be paid to irrigation also, as the trees appear to be particularly susceptible to little leaf, probably owing to the high rate of evaporation. Orchards are irrigated about every 35 days, varying from this, of course, according to soil and weather conditions.

Apples, apricots, and almonds also are grown to a small extent on the upper alluvial-fan slopes, particularly in the southwestern part of the area. In all they occupy about 900 acres. Most of these trees were planted a number of years ago and a large proportion are dry farmed, particularly the almonds. Some plums, peaches, figs, and olives have also been planted. Grapes are grown on about 700 acres in the area, mainly on the soils of the Holland series in the foothill valleys of the San Gabriel Range. This acreage is increasing, as more than 100 acres are being planted this season (1922). Some of the newer plantings are to be irrigated, but all the old producing vines are dry farmed. They yield about one-half ton of fruit per acre. Varieties are mainly of the wine-grape group, although some Flame Tokay, Sultanina (Thompson Seedless), and others are grown.

Throughout the valley orchards as well as dwellings should be protected by windbreaks. The athol tree (*Tamarix articulata*) offers much promise for this purpose. It is an evergreen, requires very little moisture, makes a rapid growth, and apparently is not injurious to the growth of adjoining fruit trees.

Dairying is practiced in a very small way in the vicinity of Lancaster. The local demand for fresh milk is supplied and the surplus shipped to Los Angeles creameries. Daily shipments range from 500 to 700 gallons.

Grains and grain hay are grown by dry-farming methods south and west of Del Sur. About 1,300 acres are sown annually. Some growers plant in alternate years; others attempt a crop each season. Wheat seems to be more satisfactory than barley, as the latter, unless forced by intersowing with rye or wheat, fails to achieve sufficient height of stalk. Yields vary from one-quarter to 1 ton per acre.

Numerous miscellaneous crops are grown mainly for home or neighborhood consumption, among them being several varieties of sorghum, millet, squash, watermelons, beans, and other garden crops.

During the war a number of farmers planted the castor bean, which proved a success as far as the plant was concerned, but is said to have produced a bean of very low oil content. Nevertheless, three carloads of castor beans were shipped from Lancaster in 1919.

Farm laborers in the Lancaster area are mainly American-born whites. The proximity to Los Angeles assures a good supply of labor, although most of the farmers employ their neighbors or some of the near-by townsfolk. In 1921 the prevailing wage amounted to $50 a month, with board and lodging.

SOILS

The Lancaster area lies in the Mohave Desert region of southern California. The soils have been weathered and accumulated under arid conditions and are characteristic in their general features of the soils of such regions throughout the United States. Lime is abundant as a general thing and is quite evenly distributed in the more recently deposited soils. With age and slow weathering, however, it has tended to accumulate in certain sections or horizons and in places has formed a lime-cemented hardpan. Owing to progres-

sive weathering and slight leaching, soluble salts have accumulated in areas of poor drainage, resulting in what is commonly known as "alkali."

The mountains bordering the survey rise abruptly from the gently sloping alluvial fans at their base and are frequently dissected by deep, narrow canyons. The soil material is usually coarse near the mountains, especially where mountain canyons open on the plain, and increases in fineness as the distance from the mountains increases.

The soils of the area have been differentiated into a number of series on the basis of their profile, including the characteristics of the parent material, and the series have been further differentiated into types on the basis of the texture of the surface soil.

The soils of the Holland series are brown or dark brown and have a slightly reddish brown cast when wet. The subsoil usually consists of a reddish-brown compact, gritty material, and is underlain at shallow depths by a yellowish-brown more friable or gritty material, which rests upon bedrock at an average depth of about 40 inches. These soils are micaceous and friable and in places may extend without marked change in profile to the parent rock. They are weathered in place from the underlying granites or schists which are in evidence as outcrops or broken bowlders on the surface. The topography is generally mountainous or hilly, resulting in excessive drainage. One type, the Holland sandy loam, is mapped in this survey.

The surface soils of the Adelanto series are brown to light reddish brown or light grayish brown, usually micaceous and friable, devoid of lime accumulations, and low in organic matter. At an average depth of about 20 inches they are underlain by a compact reddish-brown or brownish-red material of heavier texture containing accumulated lime in occasional seams or lenses. The lower subsoil is a more friable but rather heavy textured material, containing lime irregularly distributed. The series is derived from the weathering of unconsolidated alluvial deposits derived largely from granites and associated igneous rocks. It occupies gently sloping alluvial fans and rolling or hilly, slightly higher remnants of older fans locally somewhat eroded. Drainage is well developed, insuring a complete freedom from alkali and making the soils well adapted to irrigation. Three types and two phases of this series are mapped, the Adelanto sand, the rolling phase of the gravelly sand, the loamy sand with a rolling phase, and the sandy loam.

The soils of the Ramona series are brown or dull brown in color, becoming darker when wet. They are micaceous, usually gritty, without accumulations of lime to an average depth of about 18 inches. The subsoil is compact, tends to be heavier textured than the surface soils, and is dull reddish brown in color. It is comparatively low in lime content but in places contains lime in slightly grayish colored accumulations irregularly distributed. The deeper subsoil or substratum is less compact than the upper subsoil, and generally slightly lighter textured, as the clay and finer separates have not been carried below the upper compact zone to any marked extent. The Ramona types differ from the Adelanto in that they have a somewhat darker color and a higher apparent organic matter content, and the subsoil is less distinctly calcareous. They occur under conditions of slightly higher rainfall and support a grass

cover, whereas the Adelanto soils support a native vegetation of desert shrubs. The Ramona soils also appear to be developed more largely from unconsolidated deposits derived from dark-colored schistose rocks than do the Adelanto soils. The topography varies from smooth and gently sloping on the alluvail fans to rolling or hilly on areas slightly higher in elevation. The soils are well drained and could in most cases be leveled for irrigation at small expense. The Ramona series is represented in the area by the loamy sand, with a rolling phase, and the sandy loam.

The Hesperia series includes types with light-brown to light reddish brown soils overlying a slightly compact subsoil of similar or slightly richer brown color, which show no marked textural change. There is not much lime in either surface or subsoil, though a little lime is uniformly distributed through the slightly compact zone or horizon. The series represents a valley-filling soil in which weathering has not progressed sufficiently to result in the compact and heavy textured subsoil of the older soils of this province. The soils are derived largely from granites, schists, and similar igneous or metamorphic rocks. The topography is generally smooth and gently sloping, and well adapted to irrigation. The drainage is excellent, resulting in a complete freedom from accumulations of alkali salts. The Hesperia sand, loamy sand, and sandy loam types are mapped, as well as hummocky phases of the sand and loamy sand types, and red and dark-colored phases of the loamy sand.

The surface soils of the Rosamond series are light brown to light grayish brown and calcareous. The subsoil is calcareous, moderately compact, of practically the same color or slightly lighter than the surface soils and in places somewhat stratified. The soils, especially in the vicinity of Roosevelt and Redman Schools, have a pinkish tint when dry, which becomes a light reddish brown when wet. Lime is quite evenly distributed throughout the soil profile, except in the sand type, which is locally noncalcareous or but slightly calcareous to a depth of 8 or 10 inches. The series is derived largely from igneous, quartz-bearing, crystalline rocks, with slight admixture of sedimentary rock materials. The series is differentiated from the Hesperia on the basis of a higher lime content of surface soil and subsoil and a restricted subdrainage. Under field conditions the average color also is slightly lighter. The surface is generally smooth and gently sloping, affording fair surface drainage, but underdrainage is somewhat retarded. Alkali salts are found in local areas, especially where they approach the more poorly drained soils of the valley trough. The Rosamond sand, fine sandy loam, loam, silt loam, and clay loam are mapped, also a hummocky phase and a well-drained phase of the sand and a hummocky phase of the fine sandy loam.

The surface soils of the Sunrise series are predominantly light brown, but include some material of reddish-brown color also. They are low in organic matter and high in lime, resulting in a tendency to bake upon drying. The subsoil consists of a gray calcareous material irregularly cemented to varying degrees of hardness. Within the types of the series are found areas with firmly cemented hardpan, while in other areas the subsoil consists of very compact gray material of heavy texture containing occasional lime-cemented

nodules. The lower subsoil is less compact, generally of lighter texture, and gray or drab in color. The soils are of mixed origin, but are derived largely from granites and related rocks. They generally have a smooth gently sloping surface conducive to fair surface drainage. The subsoil is partly, if not wholly, impervious to the movement of water and impedes materially the root development of plants. Three types are mapped—the Sunrise sand, fine sandy loam, and silt loam.

The Domino series is characterized by light brownish gray to medium-gray calcareous soils which overlie a gray, calcareous, firmly cemented hardpan at shallow depths. In this survey small areas of darker soils of grayish-brown or dark-brown color, which overlie cemented material of dark-gray color are included. The hardpan formation is of varying thickness, but generally at depths of 30 to 42 inches is underlain by a gray, calcareous, heavy-textured material which contains occasional lime nodules or concretions and may be cemented in places. The series occupies flat or gently sloping areas in which drainage is fairly well developed, but not sufficiently to prevent alkali accumulations. The soils are derived from the weathering of old valley-filling material, principally of granitic origin, but including some material derived from sedimentary rocks. The Domino sand and the fine sandy loam, with a heavy phase, are mapped in this survey.

The surface soils of the types in the Pond series are light brownish gray to gray, highly calcareous, and poorly drained. At a depth ranging between 15 and 42 inches is found a gray or chalky, highly calcareous, compacted material usually sticky when wet, though of medium to light texture. This is underlain by a more friable, coarser textured, drab or gray material. The series is characterized by a high water table and poor drainage throughout. Some variations occur within the series in which the chalky, highly calcareous subsoil is wanting. The substratum, unlike the subsoil, is readily permeable to water, but owing to the occurrence of the series in the comparatively flat trough of the valley there is slight movement of water. The series is of mixed origin, but is developed mainly from alluvial deposits derived largely from the quartz-bearing igneous and metamorphic rocks. The Pond sand, sandy loam, fine sandy loam, and loam types are mapped, together with hummocky phases of the sand and fine sandy loam, a well-drained phase of the loam, and dark-colored phases of the sandy loam and clay.

The surface soils of the types of the Cajon series are brown or light grayish brown and slightly calcareous. At 12 to 30 inches they are underlain by a subsoil of friable structure similar in color and lime content to the material above. The texture of the subsoil may vary somewhat because of stratification, but in general it is about the same as the soil. Small, angular gravel and grit are common throughout the soil profile. The topography is smooth or slightly undulating, with sufficient slope to give good drainage but not enough to interfere with irrigation. The Cajon sand and fine sandy loam are mapped in this survey.

The types in the Tujunga series are characterized by light brownish gray or light grayish brown soils overlying a subsoil of the same color but usually of lighter texture, consisting largely of coarse sand

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FIG. 1.—AUTO TRUCK WITH TRAILER FREIGHTING OUT 240 BALES OF ALFALFA HAY

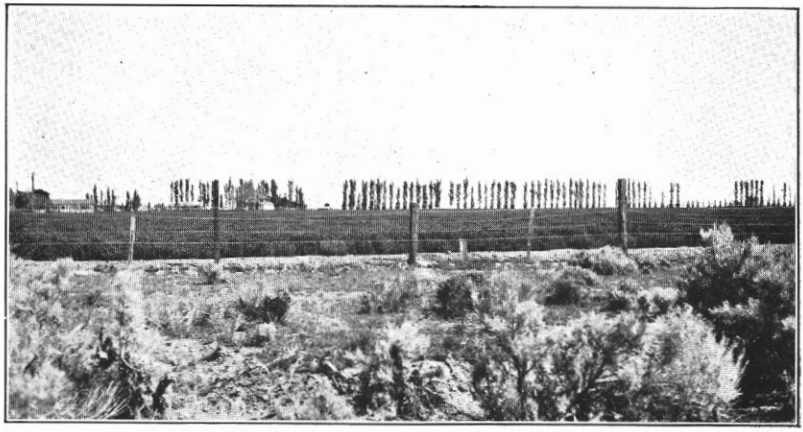

FIG. 2.—A FIELD OF ALFALFA ON THE ROSAMOND SAND

Well-improved alfalfa ranch in background, virgin desert land in foreground

and gravel. The soils of this series are typically noncalcareous and are separated from the associated Cajon soils largely on that basis. In the vicinity of stream courses the types are frequently overflowed and have very much the character of Riverwash. The soil material is washed from granitic or schistose rocks of the bordering mountain ranges. The surface is smooth or slightly dissected by shallow drainage channels. The soils are in general excessively drained owing to the porous character of the subsoil. The Tujunga sand and gravelly sand are mapped.

The types of the Hanford series have brown to light-brown, micaceous soils, leached of lime. The subsoil is similar in color to the soil, may show stratification, and is loose and permeable throughout the 6-foot section. Angular gravel, largely of schistose origin, is found throughout the areas in this survey. The series occupies the upper parts of gently sloping alluvial fans and includes considerable surface wash from the adjacent mountain slopes. The surface is smooth and gently undulating, with sufficient slope to insure good drainage. In this survey the series is developed in a section where the rainfall is slightly more plentiful than over most of the valley, and the soils are utilized largely in the production of grain without irrigation. The Hanford gravelly sandy loam is mapped.

The Chino series comprises types with dark brownish gray or dark-gray calcareous soils, highly micaceous and well supplied with organic matter. The subsoil consists of stratified calcareous material of a grayer color than the surface, and is slightly mottled with rusty brown. The types of this series are derived largely from material of granitic or metamorphic rocks. They have developed under conditions of poor drainage and contain alkali in places. The surface is smooth and comparatively flat, except in the vicinity of drainage channels. Erosion which has set in quite recently has resulted in steep-banked cuts 1 foot to several feet in depth. The water table is generally high and in the vicinity of cuts the subsoil is continually moist from seepage water. The Chino fine sandy loam is the only type mapped.

Five types of miscellaneous material which do not fall under the classified soil series are mapped in the area. These are Riverwash, Rough mountainous land, Rough broken and stony land, Dunesand, and Playa deposits. Under present conditions and methods of farming the types comprising this group are largely nonagricultural.

Riverwash occupies the channels of the larger streams traversing the alluvial fans. It consists mainly of gravel and bowlders and is frequently flood swept.

Rough mountainous land and Rough broken and stony land are associated with the mountainous and hilly areas bordering or included within the survey, and are either entirely or largely nonagricultural on account of their steep and broken topography or stony character.

Dunesand consists of loose, incoherent, wind-blown sand, forming shifting mounds or ridges several feet in height.

In all desert regions are found low, flat sinks or depressions called playas. These occupy the beds of intermittent ponds or lakes, which

are covered with shallow, turbid drainage waters following periods of storm, are barren of vegetation, and consist of soil material of a very compact and impervious character. Several areas of Playa deposits occur in the present survey. These are partly, if not entirely, unfit for agriculture under present conditions.

The salient characteristics of the various series of soils are given in the following table:

Soils of the Lancaster area, California

Group and series	Soil	Subsoil	Substratum	Drainage
Residual soils:				
Holland	Brown	Brown to reddish	Bedrock of schist, granite, etc.	Good.
Old valley-filling soils:				
Adelanto	Brown to light reddish brown.	Reddish brown, calcareous, compact.	Reddish brown or brown, less compact.	Good.
Ramona	Brown to dull brown.	Dull reddish brown, compact, slightly calcareous.	Dull reddish brown, less compact.	Good.
Hesperia	Brown to light reddish brown.	Same color as soil, slightly calcareous, slightly compact.	Same as soil	Good.
Rosamond	Light brown to grayish brown, calcareous.	Same or lighter color than soil, calcareous.	Same as subsoil	Surface fair; subdrainage restricted.
Sunrise	Light brown to light reddish brown, calcareous.	Gray, calcareous, hardpan.	Gray or drab, calcareous.	Fair.
Domino	Brownish gray to gray, calcareous.	Gray, calcareous, hardpan.	do	Fair to poor.
Pond	do	Gray, highly calcareous.	do	Very poor, at 4 to 6 feet.
Recent-alluvial soils:				
Cajon	Brown to light grayish brown, slightly calcareous.	Same as soil	Same as soil	Good.
Tujunga	Light gray to light grayish brown, noncalcareous.	do	do	Do.
Hanford	Brown to light brown, noncalcareous.	do	do	Do.
Chino	Dark brownish gray to dark gray, calcareous.	Slightly grayer in color than soil, calcareous.	Same as subsoil, but slightly mottled.	Poor.

In subsequent pages of this report the various soil types of the Lancaster area are described in detail. Their distribution is shown on the map accompanying this report, and their actual and relative extent are given in the following table:

Areas of different soils

Soil	Acres	Per cent	Soil	Acres	Per cent
Hesperia loamy sand	31,040		Rosamond fine sandy loam	14,784	
Dark-colored phase	10,880	13.0	Hummocky phase	2,432	5.1
Red phase	1,344		Adelanto loamy sand	12,160	
Hummocky phase	832		Rolling phase	1,664	4.1
Rosamond sand	31,424		Hesperia sand	10,816	
Well-drained phase	4,864	11.5	Hummocky phase	2,752	4.0
Hummocky phase	2,752		Rosamond silt loam	13,248	3.9
Pond loam	29,952	9.3	Pond sandy loam	12,224	3.9
Well-drained phase	1,600		Dark-colored phase	1,024	
Rough mountainous land	25,344	7.5	Pond sand	3,904	3.8
Ramona loamy sand	16,128	5.5	Hummocky phase	8,960	
Rolling phase	2,240		Rosamond loam	11,712	3.5

Areas of different soils—Continued

Soil	Acres	Per cent	Soil	Acres	Per cent
Adelanto sand	10,560	3.1	Adelanto gravelly sand, rolling phase	1,984	0.6
Rough broken and stony land	10,432	3.1	Domino sand	1,856	.5
Tujunga gravelly sand	8,640	2.5	Dunesand	1,664	.5
Sunrise fine sandy loam	7,552	2.2	Tujunga sand	1,600	.5
Playa deposits	7,104	2.1	Cajon sand	1,600	.5
Rosamond clay loam	4,224	1.2	Pond clay, dark-colored phase	1,536	.5
Pond fine sandy loam	2,752	1.1	Cajon fine sandy loam	1,408	.4
Hummocky phase	1,024		Chino fine sandy loam	1,152	.3
Hesperia sandy loam	3,584	1.0	Sunrise silt loam	1,024	.3
Domino fine sandy loam	1,728	1.0	Hanford gravelly sandy loam	768	.2
Heavy phase	1,792		Riverwash	448	.1
Holland sandy loam	3,072	.9			
Adelanto sandy loam	2,944	.9	Total	339,200	
Sunrise sand	2,560	.8			
Ramona sandy loam	2,112	.6			

HOLLAND SANDY LOAM

The surface soil of the Holland sandy loam, which has a depth of 6 to 15 inches, is a brown or dark-brown, noncalcareous sandy loam of rather heavy texture. Small, angular fragments of quartz and disintegrated granitic rock and grit are present, resulting in an open friable structure and aiding in the ease of cultivation, but such coarse material is not in sufficient quantity to make this a gravelly type. Mica is quite abundant, appearing in partly disintegrated platy fragments. The upper subsoil consists of a reddish-brown or dark reddish brown, moderately compact, noncalcareous material, somewhat gritty and of sandy loam or heavier texture. Below depths varying from 18 to 40 inches or more the material is a yellowish-brown, less compact, gritty sandy loam, fine sandy loam, or loam. This layer contains rock fragments, the proportion of which increases to bedrock, ordinarily lying at 28 to 60 inches below the surface. In places the subsoil is only slightly compact and grades into the disintegrating bedrock with little change in color or texture.

The Holland sandy loam is a residual soil, having weathered in place from the underlying granite or micaceous schist, and occupies the hilly or mountainous areas in the southern part of the survey. The largest areas of the type occur along Portal Ridge in the vicinity of Elizabeth Lake and on the Antelope Buttes farther north. The topography is irregular, the surface features consisting of the rounded tops of ridges, rolling slopes, and also many steep areas that can be cultivated only with difficulty. The soil absorbs moisture readily, but is eroded in many places, and in summer soon becomes parched and dry. Drainage is well developed and in many cases excessive.

The native vegetation consists largely of sagebrush and juniper. Where the soil is especially shallow it supports only a light covering of grasses during the spring months. About 40 per cent of the type is under cultivation. The principal crops are wheat and barley. Grapes occupy a small acreage and yield on an average about three-fourths ton per acre without irrigation. Wheat yields 16 to 20 sacks per acre, and barley practically the same.

Under dry-farm practices the soil should be cultivated sufficiently while not in crop to keep down the weeds and maintain a light mulch

over the surface. The addition of organic matter would aid in absorption and retention of moisture.

The following table gives the results of mechanical analyses of samples of the soil, upper subsoil, and lower subsoil of the Holland sandy loam:

Mechanical analyses of Holland sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
575763	Soil, 0 to 12 inches	7.5	8.9	8.3	15.7	15.2	16.1	26.7
575764	Upper subsoil, 12 to 24 inches	24.7	20.3	8.9	14.1	12.1	8.4	10.8
575765	Lower subsoil, 24 to 32 inches	1.1	4.1	4.4	21.2	26.9	24.3	18.0

ADELANTO GRAVELLY SAND, ROLLING PHASE

The typical material of the Adelanto gravelly sand does not occur in this area, but there is in the area somewhat more than 3 square miles of the rolling phase of the type.

This consists of a light-brown or somewhat reddish brown sand of loose structure, carrying much gravel on the surface, underlain by reddish-brown to dull-red compact sand or sandy loam material containing occasional mottlings and soft seams of limy material. The deeper material is usually less compacted and of lighter color. The soil is derived from deposits occupying eroded remnants of alluvial fans and foot slopes and has been in position long enough to have developed a soil profile normal to the region.

The material of the soil and subsoil of the Adelanto gravelly sand, rolling phase, is the same as that of the Adelanto sand, differences between the two types consisting in the topography and the occurrence of gravels over the surface. The phase is confined to the small valleys along the San Andreas fault line, where it occupies old alluvial fans along the lower slopes of the San Gabriel Mountains. Erosion, which is active only in small local areas at the present time, has resulted in a hilly or rolling topography south and east of Harold. This makes the land less desirable for farming and limits the possibility of irrigation to a considerable extent. Drainage is excessive over most of the phase.

A small part of the phase is used in the production of grain or for pasture. With more favorable moisture conditions it could best be utilized in the production of grain. Under irrigation it could be used in the production of fruit. As the areas have good natural air drainage, the orchards would be less subject to frost damage than those on the lower soils.

ADELANTO SAND

The surface soil of the Adelanto sand, to a depth of 6 to 24 inches, consists of a brown or reddish-brown, loose, incoherent sand, composed of the various grades from coarse to very fine. It is free from accumulations of lime carbonate or other soluble salts. The upper subsoil is a reddish-brown or brownish-red compact sand or sandy

loam containing occasional seams of soft, limy material. This layer may continue without material change in color or structure to a depth of 6 feet or more, but generally it is underlain by similarly textured material, slightly less compact and of lighter color. Areas in which the surface soil is accumulating slowly from occasional wash or wind deposition have a deeper soil overlying a moderately compact subsoil, which in turn overlies the compact, heavy-textured layer characteristic of the series. In the vicinity of Una Lake and in the lower end of the Anaverde Valley occur two small areas, embracing in all about 1 square mile, which are of gravelly sand texture and are shown on the soil map by gravel symbols.

The Adelanto sand is rather extensively developed in this area. It occurs principally along the lower alluvial-fan slopes west of Palmdale and in the vicinity of the Belleview School. Smaller areas are mapped in the vicinity of Denis and Quartz Hill. The type is intimately associated with somewhat younger valley-filling soils and in places may include small areas of the latter.

The type is a typical mature desert soil. It comes from material that has been carried to its present position by water at some past time, and through a period of weathering has accumulated the finer soil materials and partly soluble mineral compounds in the subsoil, producing a compact and irregularly calcareous subsoil horizon.

The native vegetation consists largely of sagebrush, rabbit brush, and giant yucca, which in most cases is easily removed in preparing land for cultivation. The type is used in the production of various crops, including wheat, barley, fruits, and nuts. Under irrigation it takes water slowly, but when water is applied the yields are commonly good. In dry-farmed areas apricots and almonds, owing to their early maturity, have proved to be the most successful crops. However, with the sudden changes in temperature characteristic of high desert regions, late frosts are of frequent occurrence, and the results with these crops are more or less uncertain. Where water is available for irrigation, pears generally are considered the most successful fruit for this region, although apples and cherries seem also to do well.

Land values vary, depending on the location, the improvements, and the state of development of orchards on the type. Well-improved land in bearing orchard is held at $1,000 to $1,200 an acre. Unimproved land of this type can be had for $40 to $80 an acre.

Owing to the location of the type it is difficult to obtain water by pumping, and at the present time gravity water is available for only a small part of the type. With irrigation additional areas of the type would be productive of many crops, the most successful of which probably would be pears, grapes, and apples. Currants and gooseberries also appear to offer considerable promise. The addition of organic matter would increase the water-holding capacity and the productiveness of the soil.

ADELANTO LOAMY SAND

The surface soil of the Adelanto loamy sand, in the virgin condition, consists of 6 to 24 inches of reddish-brown friable loamy sand approaching a sandy loam in texture, free of accumulations of alkali salts or lime carbonate. This is underlain by a moderately compact

layer of brown or reddish-brown loamy sand or sandy loam, somewhat streaked with gray, but like the soil devoid of accumulations of limy material. Below this, at depths of 10 to 36 inches or more, occurs a very compact brownish-red loam or clay loam having a columnar or jointed structure when dry. Concentrations of lime carbonate are generally present in this layer, appearing in narrow seams in the soil material or in cavities formed by the decay of plant roots. The fourth layer, encountered at depths generally below 40 inches, consists of a somewhat less compact brownish-red loam or in some cases a gravelly heavy sandy loam or loam, containing occasional seams or nodules of limy material.

The Adelanto loamy sand is a mature, valley-filling soil, maturity in this case being shown by the accumulation in a compact zone of fine soil materials and soluble salts carried down from the overlying soil. The parent material consists largely of the disintegration products of granite, schist, or gneiss, which commonly yield considerable potash, lime, and the more or less soluble salts of sodium and magnesium.

This type is fairly extensive and occurs mainly along the lower slopes of the alluvial fans north of Portal Ridge. The more important areas are in the vicinity of Del Sur, Quartz Hill, and Palmdale and north and northwest of Palmdale. Several smaller bodies are found in the northern part of the survey along the base of the Rosamond Buttes. The topography is for the most part smooth and gently sloping, affording excellent drainage and adapting the soil especially well to irrigation.

In the vicinity of Del Sur the Adelanto loamy sand is utilized to some extent for the production of dry-farmed grains; elsewhere the crops grown on the type are dependent on irrigation for successful maturity. In the vicinity of Palmdale a small part of the type is used in the production of pears, with gravity water for irrigation. Pumped water has not been developed to any extent, although the future may show that it is feasible to pump water for special crops. Pears produced on the type are of good quality and in favorable seasons the yields are excellent. Dry-farmed wheat and barley yield practically the same, averaging 9 to 12 bushels per acre.

Land of this type within the irrigation districts is held at $100 to $250 an acre, the average price being about $200. With good improvements and bearing orchards the land is held at $1,000 to $1,200 an acre.

The Adelanto loamy sand is inherently fertile, and under irrigation should be productive of all crops suited to the climate of this region. The soil has a low content of organic matter, and when devoted to specialized crops it should be built up by applying barnyard manure or turning under cover crops. The addition of this material will increase the capacity of the soil for moisture.

Adelanto loamy sand, rolling phase.—The rolling phase of the Adelanto loamy sand consists of a reddish-brown loamy sand surface soil overlying a compact, slightly calcareous, brownish-red or reddish-brown subsoil. It is similar in all respects except topography to the Adelanto loamy sand. The phase occupies old alluvial fans slightly higher than the surrounding soils and of rolling or hilly surface, which would be unfavorable to irrigation. Erosion is active

in places in the vicinity of drainage ways, though it is of minor consequence at the present time. The largest areas of the phase lie southeast of Palmdale, where they border the lower foothills of the San Gabriel Mountains, occupying the small valleys along the San Andreas fault. Drainage is generally excessive. The phase is utilized to a small extent for the production of dry-farmed grain and as pasture land.

ADELANTO SANDY LOAM

The Adelanto sandy loam consists of 6 to 30 inches of brown or light reddish brown, friable, noncalcareous sandy loam overlying a very compact, slightly calcareous, brownish-red or reddish-brown loam or clay loam. A less compact layer is encountered at an average depth of about 50 inches. This consists of reddish-brown or light reddish brown heavy sandy loam or loam. The soil, which is low in organic matter, absorbs water readily, but owing to the compact subsoil the type has a low water-holding capacity and becomes dry in early summer. Both soil and subsoil are gritty in places. Some areas carry considerable gravel, and these have been shown by symbols on the soil map.

Included with the Adelanto sandy loam, particularly at Harold, are a few small bodies of soil which, if larger, would have been mapped under the Mohave series, which is extensively developed in other areas of the State. The soil consists of brownish-red or red gravelly sandy loam, free of lime accumulations, overlying a very compact red or brownish-red clay loam, which in turn overlies a less compact zone of practically the same color. Both subsoil and substratum are calcareous, the lime having accumulated as soft nodules in cracks or cavities. The Mohave types differ from the Adelanto mainly in the more pronounced red color of the surface soils. In local areas the subsoil of the Adelanto sandy loam has been exposed by surface wash and resembles the Mohave soil very much in color.

The Adelanto sandy loam is most extensively developed in the vicinity of and east of Palmdale. An area of considerable size that is somewhat gravelly occurs at the lower end of the Leonis Valley. Two small areas lie a short distance west of Rosamond. The more gravelly areas are indicated on the soil map by gravel symbols.

Only a small part of the type has been utilized, owing to the difficulty of obtaining irrigation water. Where water is available, however, vigorous pear and apple orchards are giving good yields. With further development the type should prove well adapted to tree fruits as well as berries and general farm crops.

Unimproved land of this type can be bought at $40 to $80 an acre. Land within the Palmdale irrigation district is held at $150 to $250 an acre. Improved land in producing pear orchards sells for $1,000 to $1,200 an acre.

Cover crops have not been grown extensively in the orchards, largely because of a scarcity of water. However, a special effort should be made to obtain a stand of some good cover crop, for which Melilotus indica appears to be well suited. It is suggested that this be planted early in the fall and plowed under before the growth becomes at all fibrous. The time of plowing will naturally depend largely on the time of seeding, but ordinarily should not be later

than the middle of February. It is essential for continued successful fruit production that organic matter be added to the soil. On this type, especially, such addition would enable the soil to absorb and retain water much better and would largely obviate the running together and baking of the surface.

RAMONA LOAMY SAND

The surface soil of the Ramona loamy sand is a dull-brown or dark grayish brown noncalcareous loamy sand, 6 to 24 inches deep. The subsoil is composed of two horizons, an upper one consisting of a dull-brown or dull reddish brown slightly compact coarse sand, sandy loam, or material of heavier texture, which is underlain by a very compact dull reddish brown sandy loam or loam. The subsoil is in many places gritty and usually is calcareous, with accumulations of lime carbonate irregularly distributed in seams or lenses. The compact zone is sometimes encountered at depths of 20 to 36 inches and in such cases is generally underlain within 6 feet by more friable material of similar color. (Pl. XXI, fig. 1.) Locally the soil contains considerable coarse sand. In the vicinity of the Antelope Buttes and in some other places the soil is rather gritty. Several areas covered with gravel are shown on the soil map by gravel symbols.

The type is derived from the weathering of old unconsolidated alluvial deposits and has a profile typical of a mature soil occurring under conditions of low rainfall. The surface soil has been leached of its lime carbonate, which, together with some of the finer clay materials, has been arrested in its downward percolation at the point of compaction in the subsoil. Through a long period of weathering the subsoil has become very compact. It assumes a jointed or columnar structure upon drying, retards somewhat the downward passage of water, and interferes with root development. When exposed to the air it becomes hard and flinty, but in no case has a cemented hardpan developed, nor is that condition likely to arise.

The Ramona loamy sand resembles the soils of the Adelanto series in the character of the soil profile, but is differentiated by the darker color of the soil. It appears to occur under conditions of slightly higher rainfall and in the virgin condition is grass covered throughout the greater part of its occurrence, while the Adelanto soils support the typical desert vegetation of the region.

Areas of the type containing gravel in sufficient quantity to interfere somewhat with cultivation but not to lower the agricultural value materially are found in the upper end of the Anaverde Valley, along the upper fan slopes adjoining Portal Ridge to the south of Del Sur, and around the Antelope Buttes. The gravel, which for the most part is angular, consists of granite or schistose rock. Other areas of the type, of greater extent and agricultural importance, are found along the western boundary of the survey, especially around the Antelope Buttes, and south as far as Portal Ridge. The topography is gently rolling and undulating, with sufficient slope to insure good drainage and a consequent freedom from accumulations of alkali salts.

The type affords good grazing during the spring months, but dries out in the early summer, leaving the grasses parched and brown. Along the fan slopes south and west of Del Sur the type is utilized principally in the production of dry-farmed wheat and barley and some milo. About 20 per cent of the type is under cultivation.

The soil is plowed during the spring after the harvesting of a crop and left fallow throughout the summer. The date of plowing depends on the season, but in general it is about the 1st of April. Some farmers simply disk the land in place of plowing. During the summer the fields are mulched by running a cyclone cultivator or weed eradicator over the soil often enough to prevent any weed growth and to maintain a mulch of loose earth. The following fall the ground is seeded as soon as the first fall rains occur. Wheat and barley are both seeded at about the same rate, the usual quantity being about 30 pounds per acre. Harvesting is done almost entirely with a header, and the grain is then threshed and sacked ready for hauling to market.

Wheat is generally considered a surer crop than barley, as the latter often does not make sufficient stalk growth and much grain is lost in harvesting. Wheat yields an average of 8 to 12 bushels per acre, and barley about the same. Maximum yields run as high as 30 bushels in unusually good seasons. Almonds and apricots, also a few olives, are grown on the type without irrigation, although, because of frost and uncertain seasonal rainfall, the yields are not always satisfactory. The yield of apricots runs from 1 to 3 tons per acre, and that of olives about three-fourths ton.

Unimproved land of this type is held at $40 to $80 an acre, and improved land is held at $70 to $100 an acre; or, in the case of orchard land, at $400 to $700 an acre.

The Ramona loamy sand is a productive soil, and with the development of water for irrigation it should prove valuable in the production of fruits and other specialized crops as well as grain. In its virgin condition it is low in organic matter, which should be supplied under irrigation. In connection with present dry-farm operations it is suggested that a greater number of turkeys and chickens be kept, as conditions appear favorable for their production.

Ramona loamy sand, rolling phase.—The rolling phase of the Ramona loamy sand differs from the typical soil only in topography and drainage. The phase occurs mainly in the southwest corner of the area adjoining Portal Ridge, where it occupies the remnants of former alluvial fans which have been dissected and eroded, leaving a rolling or hilly country, for the most part excessively drained and adapted only to dry-farmed grains or pasture.

Several small areas of the phase, which are of gravelly texture, are found southwest of Del Sur and around the Antelope Buttes. These areas, which are slightly more droughty than the remainder of the phase, contain much angular gravel of medium size, derived largely from granite and schist. They are indicated on the soil map by gravel symbols.

The phase as a whole has little agricultural value, aside from the pasturage it affords and the adaptability of small areas to dry-farmed grains.

The following table gives the results of mechanical analyses of samples of the soil, upper subsoil, and lower subsoil of the typical Ramona loamy sand:

Mechanical analyses of Ramona loamy sand

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
575732	Soil, 0 to 18 inches	20.2	20.0	9.3	15.7	16.5	11.6	6.6
575733	Upper subsoil, 18 to 42 inches	19.1	20.3	9.4	14.7	16.8	10.5	8.5
575734	Lower subsoil, 42 to 72 inches	15.1	18.5	9.3	13.4	13.4	13.4	16.7

RAMONA SANDY LOAM

The Ramona sandy loam has a surface soil of 6 to 30 inches of dull-brown or dark grayish brown, micaceous sandy loam, which generally contains many small, angular rock particles. Below this is a dull reddish brown or dark reddish brown, very compact, gritty, heavy sandy loam or loam, which may either continue to the depth of 6 feet or more without change or may be underlain by a gravelly or gritty loam of less compact structure within the 6-foot section. The surface soil is devoid of lime, and but small accumulations are found in lenses or seams in the subsoil.

The type is weathered from unconsolidated alluvial-fan material derived from rocks of a wide range in character. The surface soil takes water readily and is easily penetrated by plant roots. The subsoil, however, absorbs water very slowly and is less favorable for plant-root development.

The type is confined to several small areas, the largest of which borders a shallow drainage channel in the western part of the survey, about 1½ miles south of the Antelope Buttes. Other areas occur about 3 miles west of Del Sur and along the western edge of the survey west and northwest of the Little Buttes. Two small areas are in the lower end of the Leonis Valley. The topography varies from smooth and gently sloping to gently rolling. Drainage is good but not excessive, making the soils well suited to irrigation if water should become available.

The Ramona sandy loam is utilized principally in the production of wheat and barley without irrigation. About 60 per cent of the type is in cultivation. The yields are generally more satisfactory than elsewhere throughout this section, owing in part to the more favorable location of the type with respect to rainfall and in part to its location with respect to other soils. The largest area of the type, bordering a drainage way, lies somewhat lower than the surrounding soils and consequently receives more moisture from run-off and percolation. The yields of wheat and barley are slightly higher than on the Ramona loamy sand.

Because of its small extent this type is not sold alone, but it has a somewhat higher agricultural value than the surrounding soils.

HESPERIA SAND

The Hesperia sand to a depth of 12 to 30 inches is a light-brown or light reddish brown, incoherent, noncalcareous sand, in which the various grades of coarse, medium, and fine sand are represented and the content of silt and clay is very low. The subsoil consists of a slightly compact brown or light reddish brown sand, loamy sand, or light sandy loam, containing small amounts of lime irregularly distributed. The subsoil generally does not show any marked difference in either texture or structure to a depth of 6 feet, though locally a substratum is found slightly less compact or in some places slightly lighter in texture.

In a few small areas, particularly in the vicinity of Denis, the soil has been shifted somewhat by wind action since deposition, but in no place does it partake of the character of Dunesand. The type includes patches of slightly heavier texture in depressions. In the vicinity of Littlerock Creek the subsoil is locally interstratified with silt and sand, the strata varying in thickness from 6 to 20 inches or more, and the heavier textured material being more calcareous than the typical subsoil of the Hesperia sand.

The Hesperia sand is an old valley-filling soil in which weathering has progressed only to the extent that a very slightly or in some cases a moderately compact subsoil horizon has developed. Fragments of granitic or metamorphic rock are frequently found scattered over the surface and indicate the character of the parent material.

The type is rather extensively developed throughout the southeastern part of the survey, the largest areas being in the vicinity of Denis and about 4 miles northeast of Palmdale. Other areas of varying size are found about 3 miles west of Esperanza School and on each side of Littlerock Creek for several miles south of Roosevelt School. The topography varies from smooth to slightly undulating or hummocky, and the slope is always sufficient for the free movement of surface water, though not steep enough to cause erosion.

The Hesperia sand is little utilized for agriculture at the present time, not more than 10 per cent of it being under cultivation. The native vegetation consists largely of giant yucca, rabbit brush, and other desert growths. Under irrigation the soil absorbs water readily but loses it rapidly through percolation and evaporation. Under irrigation it is utilized principally in the production of pears or alfalfa. Owing to the large volume of water necessary to mature a crop, it is not as good an agricultural soil as some of the heavier textured types.

Unimproved land of this type is held at $30 to $60 an acre, depending on location. Improved land sells for $150 to $200 an acre.

With cheap water for irrigation, the type can be used economically in the production of a variety of crops, chief of which are pears, small fruits, berries, and other early maturing crops. The soil should first of all be liberally supplied with organic matter to improve its tilth and water-holding capacity.

Hesperia sand, hummocky phase.—The hummocky phase of Hesperia sand has been differentiated from the typical Hesperia sand on account of its wind-blown hummocky topography rather than on

account of any material difference in soil or subsoil. Between the hummocks the surface soil is shallower than typical, consisting of 10 to 15 inches of brown or light reddish brown sand, or in some places loamy sand, overlying the typical subsoil of Hesperia sand.

A slight variation in color is found in the soil and subsoil of the hummocky phase in the vicinity of the Littlerock Channel, where the color approaches a light grayish brown. Also in the northwest corner of sec. 31, T. 8 N., R. 13 W., the soil mapped as the hummocky phase of Hesperia sand overlies a very compact and partly cemented material at depths ranging from 50 to 72 inches. The cemented substratum is of limited extent and irregular occurrence, but under irrigation it would be of marked agricultural importance.

The phase consists of hummocks or ridges of wind-blown sand ranging from 1 to 3 feet or more in height. They have collected around desert brush, and owing to the protection offered from further wind movement have become stabilized and in places support some form of vegetation. The cost of leveling such areas for irrigation would vary greatly, but in all cases it would add materially to the expense of putting them under cultivation. The phase is utilized only for pasture, for which it has little value.

The following table gives the results of mechanical analyses of samples of the soil, upper subsoil, and lower subsoil of the typical Hesperia sand:

Mechanical analyses of Hesperia sand

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
575716	Soil, 0 to 18 inches	2.0	15.8	18.1	39.1	19.6	1.8	3.3
575717	Upper subsoil, 18 to 36 inches	.7	11.3	17.5	42.1	22.1	2.7	3.8
575718	Lower subsoil, 36 to 72 inches	2.6	14.2	20.5	41.1	17.5	2.3	3.0

HESPERIA LOAMY SAND

The surface of the Hesperia loamy sand consists of 15 to 30 inches of noncalcareous, light-brown or light reddish brown, friable loamy sand. The upper subsoil is a light-brown or light reddish brown, slightly compact sandy loam or fine sandy loam. Underlying this at depths varying from 30 to 50 inches is a less compact horizon which is generally of about the same texture as the upper subsoil or slightly lighter. Lime is evenly distributed in small amounts throughout the subsoil and substratum. Both soil and subsoil absorb water readily and retain it quite well where properly handled under cultivation. In the virgin condition, however, the soil dries out quickly.

Grit and small gravel are found here and there throughout the type, and in some areas, which have been shown on the soil map by gravel symbols, they occur in sufficient quantity to modify the structure. The gravel consists of angular fragments of granitic and schistose rocks, varying from the size of a pea to 2 inches or more in diameter. The agricultural value of these gravelly areas is practically the same as of the areas free of gravel, though the soil tends

to dry out somewhat quicker and is harder to handle under cultivation. Two areas of this character are mainly in sec. 32, T. 6 N., R. 12 W. Another area of larger size, in which the gravel has a pinkish tint owing to its derivation from pinkish or reddish rhyolitic rocks, is found at the base of the butte just east of Willow Springs.

The Hesperia loamy sand is extensively developed, especially along the upper fan slopes adjacent to the mountains, where surface wash and detrital material from local drainage ways has accumulated. The largest area lies about 3 miles south of Lancaster, along the drainage channels of Amargosa Creek. Another large area lies about 3 miles east of Palmdale, bordering Littlerock Creek. Several areas also are mapped along the upper fan slopes west of Palmdale, in the vicinity of Del Sur, Esperanza School, Quartz Hill, and the Rosamond Buttes, and to the south of the Little Buttes.

The topography varies from slightly undulating to smooth and gently sloping. Occasional hummocks are found over the type, and areas in which these are numerous and pronounced have been separated as a hummocky phase. Drainage is thorough, and the type is well adapted to irrigation.

The native vegetation, which consists largely of sagebrush, rabbit brush, and giant yucca, has been cleared from about 20 per cent of the type and the soil placed under cultivation. The principal crops are alfalfa and pears. Wheat, milo, peanuts, and sweet potatoes are grown to some extent. Alfalfa yields well on this type, although the more calcareous soils of the lower valley are generally considered better adapted to alfalfa. Pears offer considerable promise on this type, especially on the higher areas where the air drainage is fairly good. Several young orchards are on the type, and where properly cared for and watered the trees are in excellent condition. Some protection should be made against frost, however, as it does not have as satisfactory air drainage as the soils on the upper slopes. Wheat and milo are grown without irrigation and yield about as well as on the Ramona loamy sand.

The Hesperia loamy sand is held at $40 to $85 an acre in its virgin condition, or slightly higher when under fence. Improved ranches producing alfalfa are held at $200 to $350 an acre, while young pear orchards are valued at $600 to $900 or more an acre, depending on the age of the trees.

This type of soil is easily cultivated and with the addition of organic matter can be maintained in good tilth. It is well adapted to irrigation, but because of the slightly porous condition of the subsoil it would probably be best adapted to deep-rooted crops with low water requirements. Early maturing fruits, berries, and vegetables should do especially well, and it is believed that prunes, late blooming plums, and cherries could be successfully grown under favorable irrigation conditions. Grapes, especially those which are resistant to frost, should do as well on this type as on any soil in the valley.

It is suggested that before planting any of the special crops the soil should be put in alfalfa for a year or two and a good stand plowed under at the end of the growing season. The following year the soil should be summer fallowed or put in some cultivated

crop in order to give the vegetable matter time to decay. If trees or vines are planted on the soil the year following alfalfa it will be found that the surface soil dries out quickly and frequently does not give a good contact with the young root system.

Hesperia loamy sand, red phase.—The surface soil of the red phase of Hesperia loamy sand consists of 10 to 24 inches of noncalcareous dark reddish brown or dark brownish red loamy sand. The subsoil is a dark reddish brown, slightly compact, heavy loamy sand. Beneath the compact zone is a reddish-brown or dark reddish brown loamy sand or fine sandy loam, which is loose and friable. The subsoil and substratum have a small content of lime carbonate uniformly distributed. Angular gravel, consisting of granite, mica schist, and reddish-colored rhyolite, is found throughout the soil and subsoil of this phase. The soil absorbs moisture readily, but owing to its porous character it is quite droughty. An area of the phase occurs east of Harold in which the texture is a clay loam, but as the area is probably less than 30 acres in extent it has not been mapped separately.

The phase is of similar occurrence and origin as the typical soil, but differs from it in the pronounced reddish color of the soil and subsoil. If more extensively developed it would have been mapped as a type of a new series.

The red phase of the Hesperia loamy sand occupies the upper fan slopes, and also borders the drainage channel of a small intermittent creek southwest of Harold. The topography varies from smooth and gently sloping to steeply sloping, the latter in areas adjoining the mountains. Drainage is good to excessive.

The phase supports a rather heavy growth of juniper along the upper fan slopes, together with smaller desert brush. About 20 per cent of it is in cultivation, being used principally in the production of dry-farmed grain. The favorable location with respect to moisture of the area along the drainage channel southwest of Harold insures good yields of wheat and barley.

The price of improved land of this phase varies from $125 to $175 an acre; unimproved land is held at the same figure as other desert soils of this section. Suggestions for the improvement and utilization of the phase are the same as given for the typical Hesperia loamy sand.

Hesperia loamy sand, hummocky phase.—The soil color and profile of the hummocky phase of the Hesperia loamy sand does not vary in any respect from the typical soil; the only difference is that of topography. Hummocks or ridges ranging from 2 to 4 feet in height are found at frequent intervals over the phase, and it would require much labor and expense for leveling to fit the land for farming. These hummocks consist of fine wind-blown sand, upon which many forms of desert vegetation have become established. Between the hummocks or ridges the soil is somewhat heavier than typical, consisting of a sandy loam in many places. Following unusually heavy rainfalls, the run-off of water between the hummocks results in slight surface wash or erosion. The phase is not in cultivation; it supplies a little grazing during the spring months.

Hesperia loamy sand, dark-colored phase.—The surface soil of the Hesperia loamy sand, dark-colored phase, consists of a dull-

brown or dark grayish brown, noncalcareous, rather coarse loamy sand extending to a depth of 12 to 30 inches. The soil is highly micaceous, gritty, and in places gravelly. The subsoil consists of a dull-brown or dark grayish brown slightly compact loamy sand or light sandy loam. This material may continue to a depth of 6 feet or more, or in places may grade into a light reddish brown material of the same texture but less compact. The subsoil is slightly calcareous and locally contains more or less gravel or smaller gritty material. The soil absorbs water readily and is quite retentive of moisture.

Several areas of the phase contain large quantities of angular granite or schist gravel. These areas are shown on the soil map by gravel symbols. The gravel varies in size but the particles generally are less than 2 inches in diameter. It is a hindrance to cultivation and in some cases is sufficient to affect the agricultural value of the soil, as under the local conditions crops suffer more quickly from drought on such areas than on those without gravel.

The topography of the Hesperia loamy sand, dark-colored phase, varies from steeply sloping to gently undulating with only sufficient slope to insure good drainage. The phase is extensively developed in the Leonis Valley and east and west of Elizabeth Lake. Small areas lie southwest and northwest of Del Sur. Areas of gravelly texture occur along the upper fan slopes adjoining Portal Ridge. They also occupy parts of the channels of local drainage ways or occur as wash from the adjacent rocky buttes. The largest areas of this character are found to the south and southwest of Del Sur. Another area is found to the south of the Leonis School and still another 1½ miles northwest of Del Sur.

The Hesperia loamy sand, dark-colored phase, is largely grass covered in its virgin condition and differs in this respect from the typical soils of the Hesperia series, as well as in the darker color of the soil material. The phase is associated with the soils of the Ramona series, and in places approaches the soils of this series in character of subsoil.

About 40 per cent of the phase is in cultivation, the principal crops being wheat and barley, which are grown without irrigation. In the Leonis Valley and in the vicinity of Elizabeth and Hughes Lakes several rather large plantings of pears, apples, and apricots, as well as a few grapes, are found on the phase. In this section the rainfall is more plentiful and fruit trees produce well without irrigation, though provision should be made for water in case of several seasons of drought. The air drainage in this section is good, resulting in a comparative freedom from frost.

Wheat and barley are grown quite often without summer fallowing and produce from 16 to 20 bushels per acre; the yields are higher, however, after summer fallow. The rate of seeding in this section is somewhat heavier than in the vicinity of Del Sur, otherwise the crops are handled the same as on the Ramona loamy sand. Apricots yield from 2 to 3 tons per acre on an average, while apples produce an average of about 8 to 10 tons per acre. Grapes have yielded as much as 4 tons per acre, though the average yield is much lower, ranging about 1 to 1¼ tons.

Land in bearing orchards on this soil is held at $500 to $800 an acre. Improved land devoted to grain production brings $90 to $150, and unimproved land can be bought for $30 to $75 an acre.

The Hesperia loamy sand, dark-colored phase, should prove well adapted to poultry production in connection with the growing of grain. The protection which is now necessary to flocks from predatory animals, would be less necessary with further development. Areas of the phase favorably situated with respect to rainfall should be more extensively developed for tree fruit, grape, and berry production.

HESPERIA SANDY LOAM

The surface soil of the Hesperia sandy loam consists of 15 to 30 inches of light-brown or light reddish brown noncalcareous sandy loam containing an appreciable quantity of grit and in local areas some gravel. The soil is deflocculated and upon drying has a tendency to bake. The upper subsoil is a light-brown or light reddish brown slightly compact sandy loam or fine sandy loam which contains a little lime. A less compact slightly calcareous loam or sandy loam of the same color as the upper subsoil constitutes a third horizon, into which the upper subsoil merges with no definite line of demarcation. In places the material has the same texture to a depth of 6 feet, the only difference between soil and subsoil being the slight compaction and lime content of the subsoil. The soil takes water rather slowly when dry, but while moist absorbs water readily and retains it better than the lighter textured soils of the series.

The Hesperia sandy loam is an old valley-filling soil in the early stage of weathering. The subsoil will in time assume the compact and jointed structure acquired by older soils of this province. The type occurs on the lower slopes of the alluvial fans, and in most cases adjoining the more poorly drained soils of the valley floor. The principal areas are in the vicinity of Littlerock and northeast of Palmdale. Several small areas lie south and east of Lancaster, west of Palmdale, and in the vicinity of Una Lake, Roosevelt School, and Rosamond. The topography is smooth and gently sloping, making the soil well adapted to irrigation. Drainage of surface and subsoil is well developed, and the type is free from alkali.

About 30 per cent of the type is under cultivation and is productive of all crops suited to the climate of this region. In the vicinity of Littlerock several pear orchards in a vigorous state of growth and production are located on the type. Elsewhere it is devoted largely to alfalfa. Vegetables in home gardens produce well, as do a diversity of other crops grown in a small way. Pears yield from 4 to 5 tons per acre on an average, with maximum yields running as high as 15 to 20 tons per acre. Alfalfa yields 4 to 5 tons per acre.

Mature pear orchards in good condition on this type are held at $1,200 to $1,500 an acre; good alfalfa ranches may be had for $200 to $400 an acre. Unimproved land of this type within the Littlerock irrigation district has a value of $200 to $250 an acre. Unimproved land outside of established irrigation districts is held at $30 to $85 an acre, or less if outside the limits of economical pumping.

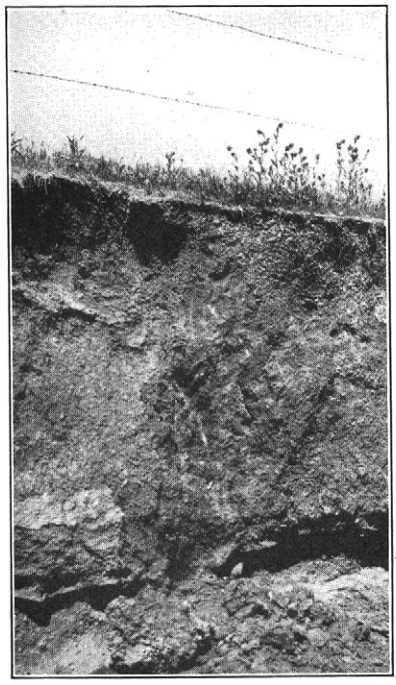

FIG. 1.—SECTION IN THE RAMONA LOAMY SAND SHOWING SOIL PROFILE

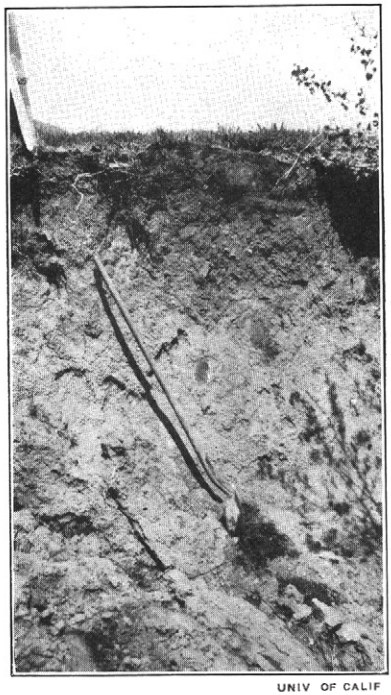

FIG. 2.—SECTION IN THE CHINO FINE SANDY LOAM SHOWING SOIL PROFILE

The soil would be improved by the application of organic matter, especially as affecting its power to absorb and retain water. Where plenty of water is available good results have been obtained in older pear orchards by planting alfalfa between the tree rows. This tends to reduce the summer temperature and helps to maintain a more uniform moisture content, as well as to increase the fertility of the soil. It is advisable, however, to let the trees establish their rooting system before this practice is followed. It is suggested that the soils of this type in the lower valley be utilized more extensively, in connection with general farming, in the production of small fruits and other special crops with a lower water requirement than alfalfa.

ROSAMOND SAND

The surface of the Rosamond sand consists of 8 to 20 inches of friable light-brown or light grayish brown loamy sand. The soil is typically calcareous, but owing to its coarse texture apparent lime may not be encountered in the upper 8 or 10 inches. The subsoil is a light grayish brown or grayish-brown calcareous sand or sandy loam which may continue without change to a depth of 6 feet or more. Locally, however, the subsoil is underlain at 50 inches or less by material of slightly lighter texture. The subsoil ordinarily is only moderately compact, but in places, especially on the east side of Littlerock Creek, it is very compact at 20 inches or more. In the vicinity of Roosevelt School and Littlerock Creek and elsewhere in this same general region the soil often has a pinkish tint, which changes when wet to a light reddish brown. Another slight variation in the type occurs in the northwestern part of the area where the soil is somewhat darker than typical.

The Rosamond sand is developed at the lower margins of the alluvial-fan slopes and normally occupies a position intermediate between the well-drained soils of the fans and the poorly drained soils of the valley trough. The surface is generally smooth and very gently sloping, affording fair drainage of the surface soil; the subdrainage is slow. Alkali salts have accumulated in some of the more poorly drained areas of the type, though not in sufficient quantity to entirely unfit the land for farming.

The Rosamond sand, which is one of the more extensive types of the area, is associated with other old valley-filling soils throughout the lower part of the valley. Some of the largest areas lie in the vicinity of Rogers School, Esperanza School, and south and east of Roosevelt School. Other areas of considerable size are found east of Lancaster and at numerous other places in the northwestern part of the area.

About 10 per cent of the type is in cultivation and is devoted almost exclusively to the production of alfalfa. A few small plantings of fruit trees on the type consist largely of apples, pears, and apricots. Several new vineyards were set out during the past year (1921). Owing to the erratic occurrence of frost, early blooming fruits are not always successful.

The soil is adapted to alfalfa production, though slightly more water is required to mature a crop than on the heavier soils of the

series. The hay is of excellent quality and the average yield about 5 tons per acre. The varieties of alfalfa commonly grown are the hairy and smooth Peruvian and the Chilean; the latter variety apparently being best suited to local conditions. Improved alfalfa ranches on this type bring $200 to $400 an acre, depending on location. Unimproved land is held at $35 to $80 an acre.

The Rosamond sand is adapted to irrigation, but its power to hold water can be improved materially by turning under manuring crops. It is suggested that the type be utilized to a greater extent for poultry raising and dairying, to which it is well suited.

Rosamond sand, hummocky phase.—The soil of the hummocky phase of the Rosamond sand consists of a light-brown or light grayish brown, calcareous loamy sand, overlying a subsoil of the same or of slightly heavier texture. The phase thus does not differ in soil characteristics from the typical Rosamond sand; its separation is based upon a difference of surface, which has been made uneven by hummocks of wind-blown sand. The hummocks vary in size from small mounds to ridges 2 to 4 feet or more in height, and are at present covered to some extent with desert vegetation. The expense of leveling for irrigation is a factor that should be considered in the price of the land.

Several areas of the phase occur along Littlerock Creek, others of larger size lie south and east of Redman School, and small areas are found in the vicinity of Lancaster. The surface drainage is good; subdrainage is somewhat restricted. In its present state land of this type is not used for agriculture, but when leveled it has the same value as the Rosamond sand and is adapted to the same crops.

Rosamond sand, well-drained phase.—The surface soil of the well-drained phase of the Rosamond sand is a brown or light grayish brown, loose and permeable calcareous sand. The subsoil is a light grayish brown, slightly compact, calcareous loamy sand or sandy loam, which continues in most places to a depth of 6 feet or more without change. The phase differs from the typical Rosamond sand in the character of the drainage, both surface and subsoil being well drained. It differs from the Hesperia sand in being calcareous in the soil and subsoil. The phase is developed only in the northwestern part of the area, where it occupies the gently sloping fans included within the boundaries of this part of the survey. In places erosion is active, but for the most part the surface is smooth and well adapted to irrigation.

The native vegetation consists largely of creosote bush (*Covillea tridentata*), which is not found growing to any extent on other soils of the area. Very little of the phase is in cultivation, largely because of a scarcity of water. The principal crops grown consist of alfalfa and milo which yield well with sufficient water for irrigation.

With the development of water for irrigation, the phase should prove well adapted to tree fruits, berries, and alfalfa. At the present time it can best be utilized in the production of poultry, growing grain and milo for feed when possible under dry-farm practices.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Rosamond sand:

Mechanical analyses of Rosamond sand

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
575778	Soil, 0 to 10 inches	19.1	18.4	7.7	13.1	21.1	14.0	5.9
575779	Subsoil, 10 to 72 inches	17.5	15.1	13.1	15.5	11.5	14.2	13.4

ROSAMOND FINE SANDY LOAM

The surface soil of the Rosamond fine sandy loam consists typically of 10 to 30 inches of light-brown or light grayish brown calcareous fine sandy loam. Around the base of the desert shrubs fine wind-blown sand has collected, while in the intervening spaces the texture is locally slightly heavier than typical. The subsoil, which is stratified, consists of grayish-brown calcareous loamy sand, fine sandy loam, or loam. The various strata are generally thick and in some places they continue to a depth of 6 feet or more without change.

In areas of the type lying about a mile south of Roosevelt School the subsoil is more compact than typical. A pinkish tint is generally noticeable in the type in the vicinity of Redman and Roosevelt Schools, and when wet these areas assume a light reddish brown color. An area about 2 miles southwest of Lancaster is underlain by a calcareous hardpan at a depth of about 7 feet, which approaches closer to the surface toward the northwest. Where the hardpan lies at a depth of 4 feet or less the soil has been mapped as of the Sunrise series.

The Rosamond fine sandy loam has been developed from old valley-filling deposits. It is found adjoining the more poorly drained soils of the valley and has a smooth gently sloping surface. Drainage is fairly well developed, though not sufficiently well to prevent the accumulation of alkali salts in local areas.

The largest areas of the type are in the vicinity of Roosevelt School and Redman School. Smaller areas lie south, southeast, and east of Lancaster. Other areas of irregular occurrence and little agricultural importance are associated with other old valley-filling soils through the central part of the survey.

About 35 per cent of the type is under cultivation and has proved well adapted to the production of alfalfa. Five cuttings are generally made each season, yielding about a ton to the cutting. The hay is baled in the field and shipped by truck or rail to Los Angeles, where it commands the top market price. The fields are unusually free of weeds and the fine-stemmed growth of the plant in this section has contributed to a high market value of the crop. A few fruit trees are found on several ranches on this type and yield well in favorable seasons. Fruit crops are not sure, however, on account of late spring frosts.

Improved land of this type in alfalfa is held at $200 to $400 an acre; unimproved land from $35 to $80 an acre, depending on location.

The Rosamond fine sandy loam is well adapted to irrigation and is easily handled under cultivation. The type is probably best adapted to alfalfa, but instead of marketing it from the farm, as is generally done, it is recommended that more livestock be kept and

the hay fed on the ranch, returning the barnyard manure to the soil. With future development more specialized crops with lower water requirements will probably be found adapted to the climate and soils of this region, among which are gooseberries, currants, late-blooming plums, prunes, peanuts, sweet potatoes, squash, beans, and other garden truck. Grain sorghums and millets also do well here and could be grown in connection with other cultivated crops. On ranches devoted to poultry production the greatest profit will generally be realized when the necessary grain feeds are produced at home.

Rosamond fine sandy loam, hummocky phase.—The hummocky phase differs from the typical Rosamond fine sandy loam only in topography. The surface is marked by frequent hummocks or ridges of wind-blown sand, which vary from 2 to 4 feet or more in height. They are generally covered with a spotted growth of desert shrubs and are no longer being shifted about by wind. The phase can be leveled with the expenditure of considerable time and money, and should then prove equally as well adapted to crop production as the typical soil. The cost of leveling varies, depending on the character and frequency of the hummocks, but at present (1922), if done by contract, generally costs from $30 to $60 or more an acre.

ROSAMOND LOAM

The surface soil of the Rosamond loam consists of 8 to 24 inches of light-brown to rather dull grayish brown calcareous loam, containing considerable very fine sand. A very marked pinkish tint is sometimes noticeable in the soil, especially in the areas in the eastern part of the survey. The subsoil is generally stratified and consists of grayish-brown calcareous material ranging in texture from light clay loam to coarse sand. Locally the subsoil continues to a depth of 6 feet or more without change. The lime is quite evenly distributed through the profile with a slight tendency toward concentration in the subsoil.

The upper subsoil is always slightly more compact than the lower subsoil, and in places an extreme compaction has developed, as in a small body of the type about 5 miles west of Rosamond. In several areas in the northwestern part of the survey the surface soil is darker in color than typical.

The topography of the Rosamond loam varies from smooth and gently sloping to almost flat. Surface drainage is moderately well developed, but subdrainage is more or less slow. Alkali salts are present in the flatter areas.

The vegetation, consisting of low-growing bushes or shrubs, has been cleared from about 5 per cent of the type. Alfalfa is grown almost exclusively under irrigation, the yields being practically the same as on the Rosamond fine sandy loam. In the northwestern part of the survey the type furnishes considerable spring grazing, the native grasses consisting of pigeon grass and alfilaria.

Improved and unimproved areas of this type are valued at approximately the same figure as the Rosamond fine sandy loam. Suggestions given for the improvement and utilization of the latter soil are also applicable to this type.

ROSAMOND SILT LOAM

The surface soil of the Rosamond silt loam consists of 8 to 26 inches of light-brown or grayish-brown calcareous silt loam, which in places has a pinkish tint when dry, changing to a light reddish brown when wet. The soil absorbs water readily and retains it well when properly handled. The subsoil consists of varitextured calcareous strata of grayish-brown color, the thickness of the strata ranging from 10 inches to 3 feet or more. The material is generally rather heavy, varying from a loam to a light-textured clay, with occasional deposits of fine sandy loam.

A variation from the typical subsoil condition is found in an area three-fourths mile north of Redman School and in other small areas in the immediate vicinity. The subsoil here contains a layer of very compact or partially cemented grayish-brown clay loam, which begins at a depth of about 40 inches and is usually 10 to 15 inches thick. Though not true hardpan, the layer is sufficiently compact to restrict root development and water penetration to some extent.

The Rosamond silt loam is developed from old valley-filling deposits. It has a smooth and almost flat surface, but the slope is always sufficient to make the soil irrigate well and to promote fair surface drainage. Subdrainage is not generally well developed, and in some of the more poorly drained areas adjoining the soils of the Pond series alkali salts have accumulated in sufficient quantity to interfere seriously with crop production.

The type is most extensive north and west of Roosevelt School and in the vicinity of Redman School. An area of about 3 square miles lies west of Rosamond along the channel of a local drainage way. Two small areas are near Palmdale, one about a mile southwest and the other 3 miles northeast.

About 3 square miles of the type are in cultivation and produce good crops of alfalfa. Two small plantings of fruit, one of apples and one of pears, are found on the type, both of which produce well in favorable seasons. Alfalfa is cut on an average about five times a season and yields about 1 ton per cutting.

The price of improved alfalfa land on this type ranges from $200 to $350 an acre, depending on location, improvements, and depth to water. Unimproved land is held at $20 to $80 an acre, depending on location and drainage conditions.

The type is well adapted to the production of alfalfa and it is recommended that the hay be fed to livestock rather than marketed from the ranch. With good management the production of dairy products, poultry, and other forms of livestock invariably result in a permanent and profitable agricultural development. Of the locally grown fruits the pear appears to be the best adapted to climatic conditions in the interior of the valley, and the pear-growing industry could without doubt be extended on this type.

ROSAMOND CLAY LOAM

The surface soil of the Rosamond clay loam is a light-brown or grayish-brown, calcareous clay loam, 8 to 28 inches deep. The subsoil is similar in color to the surface soil but is stratified and in

places includes silty deposits slightly grayer than the typical material. The strata range in texture from loam or occasionally fine sandy loam to heavy clay loam or silty clay loam. Lime is abundant throughout the soil profile, in most places evenly distributed. Locally the subsoil contains firmly cemented lime carbonate nodules, but continuously cemented hardpan layers are absent.

The type adjoins the more poorly drained soils in the interior of the valley, where it occupies slightly higher elevations of smooth, gently sloping, or almost flat topography. Surface drainage is fair but a restricted subdrainage has resulted in places in heavy accumulations of alkali. The better drained areas are well adapted to irrigation, and where properly handled the soils are absorptive and retentive of moisture.

About 10 per cent of the type is under cultivation. It is devoted largely to the production of alfalfa. Yields, land values, and suggestions for the improvement and utilization of the type are the same as given for the Rosamond silt loam.

SUNRISE SAND

The surface soil of the Sunrise sand consists of 10 to 20 inches of light-brown or light reddish brown calcareous sand, somewhat loamy when moist, which is loose and friable and readily penetrated by water. The soil is generally underlain by 10 inches or less of lighter colored highly calcareous loam or silt loam, which rests upon a soft, or in some places partly cemented, gray hardpan. The substratum below the hardpan consists of gray, highly calcareous clay loam or clay, which contains numerous lime nodules or platy fragments of hardpan.

A notable variation occurs locally throughout the type as mapped, in which the subsoil lacks the cemented hardpan formation and consists of extremely compact gray material containing many cemented lime nodules. Three small areas of the type have a surface soil of somewhat lighter texture than typical. These are in the northwest corner of the survey, one northwest of Rogers School, another a mile north of that point, and a third about 2¼ miles southwest of Willow Springs.

The Sunrise sand has been developed from old valley-filling deposits. During weathering large quantities of lime carbonate have accumulated in the subsoil, resulting in the formation of a lime-cemented hardpan. The surface is smooth and gently sloping or almost flat. The drainage is fair, but not sufficiently thorough to prevent the local accumulation of alkali salts.

The type is inextensive and has little agricultural importance. The largest area, comprising about 2½ square miles, is 2½ miles southwest of Lancaster. An area of about 1 square mile lies one-half mile east of Del Sur. Two other small areas are 1½ miles northwest of Esperanza School and 1½ miles southwest of Willow Springs.

A few acres of the type are planted to alfalfa, which maintains a good stand, but yields rather light crops, owing to the low water-holding capacity of the soil and its tendency to dry out soon after irrigation. Consequently the type has slight agricultural value

aside from the grazing it affords, and when sold alone is held at a lower figure than surrounding soils. When developed for agricultural use the type should prove adapted to dairying and poultry production.

SUNRISE FINE SANDY LOAM

The surface soil of the Sunrise fine sandy loam consists of 6 to 20 inches of light-brown or light reddish brown, calcareous, fine sandy loam sometimes approaching a sandy loam in texture. The subsoil consists of calcareous, gray or drab, moderately compact fine sandy loam, clay loam, or loam, overlying a very compact, calcareous, gray material of sandy loam or heavier texture which is locally underlain by a gravelly clay loam at depths of 45 to 72 inches. Water is readily absorbed by the soil but penetrates the compact subsoil only very slowly. This type of the Sunrise series, as occurring in this survey, has not developed a true cemented hardpan but in places the subsoil is extremely compact or partly cemented and closely resembles a soft hardpan formation.

The Sunrise fine sandy loam is derived from the weathering of old unconsolidated alluvial deposits of mixed origin. In the process of weathering lime has been accumulated in the subsoil, resulting in a gray, highly calcareous, and partly cemented chalklike layer which hinders root development of plants to some extent. It occupies a position intermediate between the poorly drained soils of the valley trough and the slightly better drained soils adjoining the alluvial fans. The topography is smooth and gently sloping, affording fair drainage.

The type is developed in the northwestern part of the survey and embraces a total area of nearly 12 square miles. The largest areas are northeast and northwest of Rogers School and in the vicinity of Willow Springs. Small areas are found at Esperanza School and west of Lancaster.

Less than 80 acres of the type are in cultivation. The rest affords some spring pasturage. Alfalfa produces well where plenty of water for irrigation is available, but owing to the shallow and droughty nature of the soil, frequent irrigations are necessary. Unimproved land of this type is held at $20 to $50 an acre. Under cultivation the type should prove best adapted to early-maturing crops and shallow-rooted vines or bushes. It would also appear to be favorable to poultry production and dairying.

In the following table are given the results of mechanical analyses of samples of the soil, upper subsoil, and lower subsoil of the Sunrise fine sandy loam:

Mechanical analyses of Sunrise fine sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
575743	Soil, 0 to 14 inches	1.5	7.1	13.1	36.7	17.3	12.0	14.0
575744	Upper subsoil, 14 to 36 inches	4.0	7.3	6.1	14.7	21.1	18.6	27.4
575745	Lower subsoil, 36 to 60 inches	9.8	14.3	7.3	14.0	16.2	19.8	18.2

SUNRISE SILT LOAM

The surface soil of the Sunrise silt loam consists of 6 to 24 inches of light-brown, calcareous silt loam. In places it is somewhat lighter in texture than typical. The subsoil consists of a moderately compact, light grayish brown, calcareous fine sandy loam or loam, overlying a very compact, gray, highly calcareous clay loam or clay. In this type the subsoil is very compact and impervious to water movement when dry, but upon becoming moist the percolation of moisture is only slightly retarded. The type has not developed a true cemented hardpan, though the compact layers closely resemble soft hardpans.

The Sunrise silt loam occurs along a drainage way issuing from the older, highly calcareous alluvial-fan slopes at the base of the Tehachapi Mountains. The topography is smooth and gently sloping, affording fair to good surface drainage. No concentrations of alkali are found.

The type occupies one area of about 1,000 acres lying about 1¼ miles south of Willow Springs. None of it is in cultivation, but with future development of water for irrigation it should prove adpated to dairying and poultry production, or to the production of shallow-rooted, early-maturing crops.

The following table gives the results of mechanical analyses of samples of the soil, upper subsoil, and lower subsoil of the Sunrise silt loam:

Mechanical analyses of Sunrise silt loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
5757103	Soil, 0 to 10 inches	0.5	0.5	1.1	9.8	23.3	49.9	16.3
5757104	Upper subsoil, 10 to 40 inches	.9	2.9	2.9	17.8	27.1	21.7	25.4
5757105	Lower subsoil, 40 to 72 inches	3.5	4.1	6.1	14.1	14.1	19.8	36.5

DOMINO SAND

The surface soil of the Domino sand consists of 8 to 20 inches of light brownish gray to brownish-gray, calcareous sand, slightly loamy when moist. This is underlain by a dark-gray, calcareous, cemented hardpan of variable thickness, ranging from 14 to 30 inches or more. Under the hardpan is a gray, compact, and highly calcareous fine sandy loam or loam which locally contains lenses or seams of partially cemented material. The surface soil is of somewhat darker color than is typical of this series, being often a dark-brown color when wet and even when dry retaining a noticeable dark shade. The hardpan has a dark-gray color when dry, and is almost black when wet. In an included area in the center of section 28, and in the east center of section 29, T. 8 N., R. 13 W., the surface soil is heavier than typical, consisting of a loam or clay loam, and the hardpan is nearer the surface than typical, being encountered in places at depths of 6 inches or even less.

The Domino sand has a smooth gently sloping topography, and the surface drainage is fairly well developed. Alkali salts have accumulated locally, though not in high concentrations. Four areas of the type are mapped. Two largest two lie about 1½ miles northwest of Esperanza School, and a third lies 2½ miles north of the same point. The other area is about 3½ miles southwest of Willow Springs.

About 20 acres of the type are included in a planting of alfalfa; the rest supports only a low growth of the more hardy desert brush. Owing to the droughty character of the soil, the yields of alfalfa are lower than on surrounding soils. The type has low agricultural value and under present conditions could not be developed as economically as the deeper soils of the valley.

The following table gives the results of mechanical analyses of samples of the soil and substratum of the Domino sand:

Mechanical analyses of Domino sand

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
575749	Soil, 0 to 18 inches	3.1	10.8	10.6	33.1	32.9	3.8	5.8
575750	Hardpan, 18 to 30 inches							
575751	Substratum, 30 to 72 inches	4.1	9.1	5.5	13.1	25.9	23.4	18.1

DOMINO FINE SANDY LOAM

The surface soil of the Domino fine sandy loam consists of 10 to 30 inches of brownish-gray or gray, highly calcareous fine sandy loam, which is quite absorptive of moisture. This is underlain by a gray calcareous hardpan composed of firmly cemented plates or lenses and nodules of limy material embedded in gray, compact, heavy-textured material. At an average depth of about 40 inches the hardpan is underlain by a grayish-drab or gray, calcareous fine sandy loam, also containing lime nodules or concretions. The hardpan formation is fairly continuous over the areas as mapped out; small areas, 3 to 5 acres in extent, are included in which a firmly cemented hardpan is displaced by a soft hardpan. The firmly cemented hardpan resists root penetration.

Most of the type is developed next to the very poorly drained soils of the interior of the valley, and although slightly higher than the soils of the valley trough it has only fair or in many places poor drainage. One area just west of Willow Springs occupies an old alluvial fan considerably above the soils of the valley and has a more or less eroded surface. Alkali salts are generally present in low concentrations. The type occupies a number of small areas throughout the west-central part of the survey. The largest area is 2 miles south of Willow Springs. Other areas lie west of Willow Springs, about 2 miles southwest of Lancaster and 1½ and 3 miles east of Del Sur.

About 15 per cent of the type is in cultivation and supports a fair stand of alfalfa. Where plenty of water is available and can be applied at frequent intervals, alfalfa produces well, though yields are always lower than on the deeper soils. The type has a low agri-

cultural value and has a depressing influence on land values when sold in connection with other soils.

The type should not be extensively developed while other soils better adapted to agricultural use remain untilled. However, under irrigation it could be utilized for dairying, poultry raising, and the production of early maturing vegetables, small fruits, and other shallow-rooted crops.

Domino fine sandy loam, heavy phase.—The average surface soil of the Domino fine sandy loam, heavy phase, consists of 10 to 24 inches of brownish-gray or gray, calcareous, heavy fine sandy loam or loam. The soil is somewhat stratified and is marked by small mounds in which the texture is a fine sandy loam, while between the mounds it may sometimes be found as heavy as a silty clay loam. The surface soil is underlain by a gray calcareous hardpan, generally firmly cemented but in places consisting of extremely compact and partly cemented material resembling soft hardpan. The cemented material occurs as plates or lenses of varying extent and thickness, several such layers being generally encountered, interbedded with gray loam or clay loam and cemented nodules or concretions, within a depth of 40 inches or more. Below the hardpan is a gray calcareous loam or clay loam containing numerous nodules and a few cemented plates or lenses.

The phase occupies areas slightly elevated above the soils of the valley trough, but drainage is at best only fairly well developed. The surface is smooth, except for low mounds or occasional shallow washes. Both white and black alkali are generally present in low concentrations.

The largest area of the phase occurs about 2 miles southwest of Lancaster. Smaller areas lie east of Del Sur and east and southeast of Esperanza School. In a small area about 2 miles southeast of Willow Springs the hardpan layer consists largely of extremely compact and partly cemented playa material.

About 20 acres of the phase is in alfalfa, which maintains a good stand but gives rather low yields. The soil is poorly adapted to the production of deep-rooted crops or those requiring a great deal of water for maturity, since it has a low water-holding capacity and soon dries out under hot desert conditions. However, the growing of hay for dairy stock and the returning of the barnyard manure to the soil should materially improve the soil. Poultry raising and the growing of shallow-rooted early-maturing fruits and vegetables is also recommended.

POND SAND

The surface soil of the Pond sand consists of 8 to 24 inches of brownish-gray or gray calcareous sand of somewhat loamy texture which, owing to the almost universal occurrence of black alkali, has a deflocculated surface structure. The subsoil consists of brownish-gray or grayish-brown, highly calcareous material of similar or of somewhat heavier texture and of sticky loamy character, underlain at an average depth of 45 inches or less by a brownish-gray, friable, loamy fine sand or loam. This type has not developed the gray chalky layer, high in lime, characteristic of the Pond series, but because of poor drainage conditions and the color of the surface

soil it has been included with this series. If more prominently developed in other areas in this region, it will probably be recognized as a member of a new series.

The Pond sand has developed from old valley-filling deposits in a position where drainage conditions have been poor and the water table has generally stood at a shallow depth. Black and white alkali are present in various concentrations, and where concentrated on the surface they prevent the growth of any but the more hardy desert shrubs and alkali-resistant grasses and herbaceous plants. The surface is smooth except for small mounds or occasional hummocks of fine sand which has collected around the base of scattering bushes.

Less than 1 per cent of the type is in alfalfa, which is grown with fair success on some of the more favorably situated areas slightly above the surrounding soils. In its virgin condition it has very small pasture value and is not valued very highly for agricultural purposes. Unimproved land can be had for $20 to $40 an acre or less.

The chief need of the type is drainage, which could be accomplished only with a great deal of labor and expense. It is doubtful if the areas of this type which are high in alkali content could be profitably reclaimed by drainage under present economic conditions. Probably Rhodes grass, which is quite tolerant of alkali conditions, could be grown on part of the type.

Pond sand, hummocky phase.—The hummocky phase of the Pond sand differs from the typical soil only in the matter of topography. In the interior of the valley, which is often swept by winds of high velocity, fine sand is carried from place to place and accumulates in mounds or low hummocks around the base of desert bushes. Owing to their elevation these are frequently more favorable for plant growth than the surrounding soils, and grasses and shrubs soon find a foothold, preventing further blowing. Additional accumulations and some surface erosion or wash result in an irregular topography, with hummocks or ridges of varying extent attaining elevations of 2 to 4 feet or more above the surrounding soils. Such areas cost from $30 to $60 or more per acre to level for irrigation.

The following table gives the results of mechanical analyses of samples of the soil, upper subsoil, and lower subsoil of the typical Pond sand:

Mechanical analyses of Pond sand

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
575783	Soil, 0 to 12 inches	11.8	11.2	13.1	20.6	24.8	7.5	10.5
575784	Upper subsoil, 12 to 48 inches	16.1	17.8	8.5	18.5	22.7	8.0	7.6
575785	Lower subsoil, 48 to 72 inches	.3	3.5	12.9	47.3	23.9	7.1	4.4

POND SANDY LOAM

The surface soil of the Pond sandy loam consists of 10 to 30 inches of brownish-gray or gray, highly calcareous sandy loam, fre-

quently of light texture, but with a tendency to run together and bake upon drying. The subsoil consists of an upper horizon of brownish-gray, calcareous, sticky sandy loam or loam, overlying a gray or chalky, highly calcareous material of similar or heavier texture. Another horizon generally present within the 6-foot section consists of a loamy coarse sand or loamy sand. The water table is reached in places at depths of 40 inches or less and below that point the subsoil is generally lighter textured. Locally in the northern part of the survey and in the vicinity of Rosamond Lake the subsoil has not developed the gray highly calcareous layer typical of the series, but has a drab or brownish-gray color and less pronounced lime accumulation.

The Pond sandy loam is extensive in the interior of the valley where it occupies areas of poor drainage adjoining the higher soils of the valley floor. The surface is smooth except for occasional low mounds and is in most places covered with an alkali crust. Low-growing alkali-tolerant grasses and desert shrubs grow in scattered clumps over the type.

The largest areas lie south and southwest of Rosamond and border Rosamond Lake on the west, and smaller areas are mapped in the vicinity of Lancaster and Esperanza School. Several abandoned ranches are located on the type. At present less than 40 acres are under cultivation. Some milo is grown on small acreages in which the soil is comparatively free of alkali, also some alfalfa. The type has a low agricultural value and is generally recognized as a poor soil.

Pond sandy loam, dark-colored phase.—The surface soil of the Pond sandy loam, dark-colored phase, consists of 10 to 30 inches of dark grayish brown, calcareous, coarse sandy loam, of sticky plastic character when wet. The subsoil is a brownish-gray or gray, highly calcareous compacted loam or coarse sandy loam, which generally continues to 6 feet or more without change, but in places is underlain by a gray or drab friable loam or silt loam.

The phase is confined to one area slightly more than a square mile in extent, which lies 2 miles east of Del Sur. The topography is smooth and sufficiently sloping to insure fair surface drainage, though subdrainage is poor. In the lower lying part the water table is rather near the surface. Alkali salts are found in varying concentrations over the whole phase.

Only a few acres of the phase adjoining the better drained soils of the Rosamond series are in cultivation. The yields are lower than on the adjoining soils. When sold in connection with other soils, the phase has a depressing influence on their value. The soil is in need of drainage, after which methods to correct the alkali condition should be practiced.

POND FINE SANDY LOAM

The surface soil of the Pond fine sandy loam consists of 8 to 20 inches of brownish-gray or gray highly calcareous fine sandy loam, which, owing to the presence of black alkali, has a deflocculated structure, and upon drying becomes baked and hard. The subsoil is generally composed of three horizons. The upper one consists of

brownish-gray, calcareous fine sandy loam or loam. The second layer is the gray or chalky, highly calcareous material typical of the series, which frequently contains a large quantity of coarse angular sand and in places is of lighter texture than the overlying material. The third horizon is generally encountered at depths of 42 inches or less and consists of loamy sand or coarse sand. Free water is usually present in the lower horizon.

A variation from the typical subsoil occurs throughout the type in the vicinity of Rosamond Lake and as far as Lancaster. The subsoil here consists of grayish-brown or drab material, which is often only mildly calcareous, the gray or chalky material typical of the subsoil being only slightly developed if at all. Drainage conditions and color of the soil are typical of the series, though with greater development of the subsoil variations, these areas would probably have been differentiated as representing a distinct series of soils.

The Pond fine sandy loam is associated with other old valley-filling soils in the central part of the survey, where drainage conditions have contributed to the accumulation of high percentages of both black and white alkali. A high water table, which results in constant capillary movement of water to the surface, has left the salts largely at the surface. The topography is smooth, with scarcely sufficient slope to give run-off.

The type is confined to several small areas, the most typical occurring about 6 miles northwest of Lancaster and along the county line south of Rosamond. Other areas of larger size lie north and northeast of Lancaster and along the south side of Rosamond Lake.

Although several ranches are located on the type, none of it is in cultivation, and it is not regarded favorably for agriculture. It is badly in need of drainage. It is doubtful, however, if this would be feasible under present economic conditions. If an attempt is made to remove excess alkali salts, the application of gypsum or sulphur to the land before draining would probably facilitate the movement of irrigation water through the soil and improve the mechanical and chemical condition. Unimproved land of this type is held at $15 to $25 an acre. In many places throughout the valley flowing wells are left uncapped, resulting in much waste of water and the aggravation of alkali conditions.

Pond fine sandy loam, hummocky phase.—The hummocky phase of the Pond fine sandy loam has been differentiated from the typical soil largely on the basis of topography. The surface soil is typical of the Pond fine sandy loam, but the subsoil resembles more nearly the variation of the type, inasmuch as it lacks the gray chalky material of the typical Pond soils.

The surface of the phase is characterized by hummocks or ridges 2 to 4 feet or more in height, which consist largely of fine and very fine sand. Though carried to their present position by wind, they are no longer being shifted about, owing to the growth of salt grass (*Distichlis spicata*) and shrubs over the surface. The cost of leveling such areas varies with the size and frequency of the hummocks, but when done by contract the cost per acre ranges from $30 to $60 and in some cases much more.

The following table gives the results of mechanical analyses of samples of the soil, upper subsoil, and lower subsoil of the Pond fine sandy loam:

Mechanical analyses of Pond fine sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
5757100	Soil, 0 to 12 inches	3.1	6.7	5.6	27.1	36.8	8.5	12.4
5757101	Upper subsoil, 12 to 20 inches	4.9	6.9	7.1	21.9	25.3	11.4	21.5
5757102	Lower subsoil, 20 to 56 inches	14.9	15.5	8.9	21.6	20.4	10.2	8.1

POND LOAM

The surface soil of the Pond loam consists of 10 to 24 inches of brownish-gray or gray, calcareous, smooth loam which is frequently of light texture. When dry the soil in places has a shade of pink and when moist has a light-reddish tint. The subsoil is a gray or chalky, highly calcareous, compacted fine sandy loam or loam of relatively high clay content, underlain at a depth of 20 to 48 inches by a drab or gray, calcareous fine sandy loam or loam. A lighter textured substratum does not occur as frequently in this type as in the lighter textured members of the series, though where present it generally consists of a drab coarse sand or sandy loam.

In a variation from the typical the subsoil lacks the gray chalky layer characteristic of the series. The largest area of this variation lies west and north of Lancaster, where it occupies a strip a mile or more wide on the east side of the drainage channel in the trough of the valley and extending to within about a mile of Rosamond Lake. Several smaller areas lie south and southeast of Rosamond Lake.

The type occupies the trough of the valley, where drainage conditions are poorly developed, and the soil, owing to a high water table, has a strong concentration of alkali on the surface. The surface is smooth and comparatively flat, though in most cases the slope is sufficient for artificial drainage.

A typical area of large size is the almost continuous body extending from a point about 2 miles west of Lancaster northwestward nearly to the base of the low buttes west of Rosamond. Areas of smaller size occur near this on the west, in the vicinity of Esperanza School, and south and southeast of Rosamond. An area of about 2 square miles lies southeast of Rosamond Lake.

The Pond loam has little agricultural importance at present, less than 100 acres being in cultivation. Alfalfa fields on the type are spotted and the yields obtained are generally about half those on the Rosamond silt loam. Milo is also grown to some extent but generally gives poor yields.

The Pond loam is in need of drainage, which could only be accomplished at great expense, and it is doubtful if this would be advisable in view of the high concentration of black and white alkali over most of the type. Unimproved land of this type is held at $15 to $25 an acre.

Pond loam, well-drained phase.—The Pond loam, well-drained phase, has a surface soil of 8 to 20 inches of grayish-brown or brownish-gray, calcareous, smooth-textured, heavy fine sandy loam or loam. Slight variations in texture occur which are not of agricultural importance. The subsoil is a grayish-brown or brownish-gray, compact, highly calcareous fine sandy loam or loam overlying a gray very compact and calcareous material of sandy loam or heavier texture. In many places this material, when brought up dry on an auger, resembles a gray finely pulverized chalk.

Three small areas of the phase in the Anaverde Valley have small angular gravel on the surface and are shown by gravel symbols on the soil map.

This phase, which was probably formed under conditions similar to those giving rise to the typical Pond loam, now occupies a more elevated position and is well drained and free of alkali. The only body of the phase, aside from the gravelly areas already mentioned, lies about 3 miles south of Willow Springs.

Although drainage conditions are favorable for irrigation, the phase has low agricultural possibilities on account of its compact subsoil which retards percolation of moisture. At present none of the phase is in cultivation, but with future development it should prove suitable for early maturing crops. Unimproved land of the well-drained phase of Pond loam is held at $20 to $45 an acre.

POND CLAY, DARK-COLORED PHASE

The typical Pond clay does not occur in this area in areas of sufficient size to warrant recognition on the soil map, this type being represented only by a dark-colored phase.

The surface soil of this phase of the Pond clay consists usually of 12 to 36 inches of dark grayish brown or dark-brown, calcareous, plastic clay. The subsoil is in two layers, the upper one consisting of a gray or chalky, highly calcareous clay or clay loam, which at depths of 36 to 60 inches overlies a gray or drab, calcareous, gritty fine sandy loam or loam. The soil as mapped includes some areas of rather light texture, especially where considerable wind-blown sand has accumulated as low hummocks over the surface. The water table is high, frequently being found at depths of 20 to 36 inches.

The Pond clay, dark-colored phase, occupies positions of low elevation with respect to surrounding soils. It is found in the central part of the valley, where a flat or only moderately sloping surface provides very poor drainage. It contains black and white alkali salts in high concentrations, and supports only the more alkali-resistant forms of native vegetation.

Only two areas of the phase are included in the survey, comprising in all a little more than 2 square miles. The larger of the two lies 3½ miles west of Lancaster and the other a short distance south of the first. No part of the phase is in cultivation nor is it adapted to cultivated crops in its present condition.

Land of this phase has a lower value than soils with which it is associated. Owing to its heavy texture and the general presence of alkali it offers little inducement for drainage or reclamation. If drained and freed of alkali salts, however, it would probably be adapted to the production of grain and alfalfa.

CAJON SAND

The surface soil of the Cajon sand consists of 14 to 36 inches of brown or light grayish brown, slightly calcareous, friable sand of slightly loamy character when moist. The subsoil consists of brown, grayish-brown, or light brownish gray, variably textured, slightly calcareous deposits, locally somewhat stratified. The lighter textured strata consist of sands or loamy sands and are generally lighter in color than the heavier materials consisting of sandy loam or loam texture. In places the surface soil is somewhat heavier textured than typical, owing to some local difference in topography or to variation in rate of flow of sediment-burdened waters. Near the Littlerock Creek channel gravel and cobblestones are occasionally found embedded in the subsoil, marking a former channel of the creek.

The type is composed of sediments washed from areas of granite or schistose rock and deposited in comparatively recent time, so that they have not suffered any appreciable change as the result of weathering. The areas occupy the upper slopes of alluvial fans or positions in which surface wash from adjacent mountains or from older alluvial deposits is accumulating. Drainage of surface and subsoil is well developed.

The largest areas of the Cajon sand are in the southeastern part of the survey at Littlerock and 3 miles northeast of that point. Only two areas of the type are outside the Littlerock irrigation district, both being located about 5½ miles southeast of Palmdale.

Though of small extent, this type is one of the better developed and more important soils of the valley. About 80 per cent of it is in cultivation and is irrigated by gravity water from Littlerock Creek.

Pears yield on an average 4 to 5 tons per acre from orchards 7 or 8 years old. Maximum yields of 12 to 15 tons per acre are reported, and it is believed that with a more plentiful supply of water and better orchard practices the average yield can be increased. Apples produce a fair quality of fruit, though yields are somewhat low, ranging around 3 to 6 tons per acre. Yields of 15 tons are occasionally obtained, and it is likely that average yields can be materially increased. Other fruits grown include olives, apricots, peaches, plums, grapes, and figs. Grapes produce well and are of good quality, and during the season just passed (1921–22) many new plantings were made. Several old fig trees are found in the district, but owing to a short growing season they produce only a light summer crop. Olives yield on an average about three-fourths ton per acre, though yields as high as 2 tons per acre are reported. Difficulty has been experienced in bringing fruit trees through the first few years of their growth, when the trees are quite susceptible to frost injury, and almonds and other early blooming fruits are frequently frosted.

Improved land in bearing orchards on this type is held at $1,000 to $1,500 an acre, depending on the age of the trees and general condition of the orchard. Unimproved land within the irrigation district is held at $200 or more an acre.

More attention should be given cover crops as a means of maintaining the productiveness of the soil and increasing its water-hold-

ing capacity. Such crops, to be beneficial, should be planted early and plowed under while they are still green. Frequent light irrigations are also recommended to maintain as nearly as possible a uniform moisture content of the soil. Climatic conditions seem most favorable to pears, and this crop is especially recommended, as this section has become known for the fine quality of this fruit. The culture of gooseberries and currants might also be found profitable in connection with other orchard crops.

The following table gives the results of mechanical analyses of samples of the soil, upper subsoil, and lower subsoil of the Cajon sand:

Mechanical analyses of Cajon sand

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
575707	Soil, 0 to 26 inches	6.2	11.3	16.6	27.9	29.8	4.0	5.7
575708	Upper subsoil, 26 to 34 inches	6.1	11.1	7.8	23.6	29.9	12.3	10.4
575709	Lower subsoil, 34 to 72 inches	5.0	6.8	7.8	25.3	30.0	13.8	10.8

CAJON FINE SANDY LOAM

The surface soil of the Cajon fine sandy loam consists of 10 to 36 inches of light grayish brown or brown, friable fine sandy loam, which is slightly calcareous. The subsoil is a light grayish brown or brown, calcareous loamy fine sand, fine sandy loam, or sandy loam. Stratification is often noticeable in the subsoil, but the different strata vary only slightly in color and texture. Occasional areas contain stones or gravel scattered throughout the soil profile. An appreciable amount of mica is present in both soil and subsoil. Locally the texture of the surface material may range to loam or silt loam.

The type is a recent-alluvial soil composed of material washed from granite or schist. It is developed along small drainage channels or on the upper slopes of alluvial fans of the larger streams.

The topography varies from gently sloping to slightly undulating, resulting in good drainage and a complete freedom from injurious accumulations of alkali.

Four areas of the type are in the Littlerock irrigation district. One lies southwest and another lies northeast, and two lie north of Littlerock, along Littlerock Creek and in the northeast corner of the district. A small area is found along Amargosa Creek west of Palmdale.

The Cajon fine sandy loam is absorptive and retentive of moisture and well adapted to irrigation. About 85 per cent of it is in cultivation, being devoted largely to the production of pears and to a less extent to apples and grapes. The yields on this type are similar to those obtained on the Cajon sand.

Improved land of this type in bearing orchards is held at $1,000 to $1,500 an acre; unimproved land within the irrigation district is held at $200 an acre.

The type is well adapted to the production of pears and other fruits and can best be utilized for this purpose. A small acreage of cherries, grapes, gooseberries, or currants in connection with the larger plantings of pears or apples might prove profitable, since a diversity of crops generally provides a more certain income. Recommendations for the improvement and utilization of the Cajon sand are also applicable to this type.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Cajon fine sandy loam:

Mechanical analyses of Cajon fine sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
575705	Soil, 0 to 12 inches	2.6	5.6	8.0	24.2	33.8	12.8	13.3
575706	Subsoil, 12 to 72 inches	2.7	8.6	7.1	24.0	34.3	14.2	7.9

TUJUNGA GRAVELLY SAND

The surface soil of the Tujunga gravelly sand consists of 12 to 24 inches of noncalcareous gray or light grayish brown, loose, gravelly sand, containing a large proportion of the various grades of sand and but little silt and clay. The subsoil consists of light brownish gray noncalcareous coarse sand and gravel. The gravel is more abundant through the soil and subsoil in areas bordering the Littlerock Creek channel than elsewhere. Stones also appear in this vicinity, being especially numerous near the upper slopes of the fans.

The Tujunga gravelly sand is a recent-alluvial soil derived largely from material of granitic origin. It is of comparatively recent deposition and in local areas bordering drainage channels it is overflowed occasionally and new deposits are added to the soil. The type is excessively drained and little adapted to irrigation.

The largest area of the type adjoins the foothills of the San Gabriel Mountains on the west side of Littlerock Creek and extends north in an area varying in width from 1 to 3 miles for a distance of over 7 miles. A small area lies on the east side of Littlerock Creek 2 miles north of Littlerock.

The type is not under cultivation, owing to its loose, porous character, and is not suited to agriculture in its present condition unless abundant water is available for irrigation. With future development, however, it would be adapted to poultry raising and to the production of early maturing or deep-rooted crops. It is held at $20 to $35 an acre.

The results of mechanical analyses of samples of the soil and subsoil of the Tujunga gravelly sand are given in the following table:

Mechanical analyses of Tujunga gravelly sand

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
5757106	Soil, 0 to 14 inches	12.9	19.1	12.2	27.7	22.1	3.4	1.9
5757107	Subsoil, 14 to 72 inches	27.4	22.9	22.3	21.0	4.0	1.4	1.0

TUJUNGA SAND

The surface soil of the Tujunga sand consists of 12 to 24 inches of noncalcareous, brownish-gray, loose, angular sand, made up of the various grades of sand with but a small proportion of silt and clay particles. The subsoil is often stratified and consists of noncalcareous loamy fine sand, sand, or sandy loam. The various strata are quite uniform in color, but are of variable thickness, in places extending to 6 feet or more without textural change. Gravel is present in places on the type, and in other places the texture is somewhat heavier than typical, though not sufficiently different to have any marked agricultural importance.

The type is a recent-alluvial soil composed of material transported by flood waters of Littlerock Creek. It is still in the process of accumulation and is loose and friable throughout the 6-foot section. The surface is smooth and gently sloping, affording good drainage of soil and subsoil and resulting in a complete freedom from alkali.

The Tujunga sand occupies an area of 2½ square miles lying 5½ miles northeast of Palmdale. A part of the type which extends up the Littlerock Creek channel for a short distance is subject to overflow following heavy storms, and is therefore of little agricultural importance. None of the type is in cultivation. With future development it could probably be utilized for fruit and truck as well as alfalfa and grain. It is somewhat droughty, however, and would require considerable water to mature a crop. Unimproved land is held at $30 to $40 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Tujunga sand:

Mechanical analyses of Tujunga sand

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
575761	Soil, 0 to 15 inches	22.1	18.4	17.3	21.7	12.1	4.5	3.2
575762	Subsoil, 15 to 72 inches	17.8	16.2	7.4	14.7	20.8	10.7	11.2

HANFORD GRAVELLY SANDY LOAM

The surface soil of the Hanford gravelly sandy loam consists of 12 to 30 inches of brown or dark grayish brown, noncalcareous gravelly sandy loam. The subsoil is a dark grayish brown, noncalcareous gravelly sandy loam or loamy sand. The gravel, which consists of small angular fragments of granite or schist, increases in quantity with increasing depth. Mica is present in noticeable quantities throughout the soil profile. The material is of recent deposition and is still in the process of accumulation. Areas of this type border the larger drainage ways or occur as outwash from local drainage areas where more or less material is brought down from the adjacent mountains. Drainage is thorough and the type is well adapted to irrigation.

The largest area of the type is in the upper end of the Anaverde Valley. Another small area lies along Amargosa Creek, just above

where it emerges from the foothills. Because of its small extent the type is not of great agricultural importance, although 90 per cent of it is under cultivation. Wheat and barley are the crops grown. The yield averages about 20 bushels per acre. Improved land of this type is held at $60 to $90 an acre.

Under present conditions the type should prove best adapted to the production of dry-farmed grains, together with poultry and livestock. It also appears probable that part of the type in the vicinity of local drainage ways and near the mouths of the small canyons would be adapted to the production of berries and grapes.

CHINO FINE SANDY LOAM

The surface soil of the Chino fine sandy loam consists of 10 to 30 inches of dark brownish gray, or dark-gray to black, calcareous, fine sandy loam, with a high content of organic matter. The subsoil is a dark-gray or gray, calcareous, very fine sandy loam or silt loam, slightly mottled with rusty brown or drab. (Pl. XXI, fig. 2.) The subsoil is locally stratified with various textured materials which do not vary much in color from the typical subsoil and are generally of rather heavy texture. Small areas of a variation from the typical soil are included in the type; this variation consists of brownish-colored calcareous soil and light-brown subsoil and resembles the more recent alluvial soils of the Foster series. Local wash from bordering hill slopes has also resulted in variations in color of the soil. Mica is abundant in both soil and subsoil.

The Chino fine sandy loam is a recent-alluvial soil derived from material washed largely from areas of granitic and schistose rocks. It is developed along stream courses and in areas of flat topography in which the soil material is gradually accumulating. Drainage of surface and subsoil is poorly developed, though in places the streams have cut their channels several feet deep, thus providing a good drainage outlet for seepage water from the bordering hill and mountain slopes. Some areas have rather high concentrations of alkali and are little suited to agriculture.

The type is confined entirely to the valleys along the San Andreas fault line, where recent earth slips or crustal movements have resulted in a much disturbed condition of drainage. The largest areas border Amargosa Creek, while smaller areas occur along the streams that empty into Elizabeth and Hughes Lakes.

About 20 per cent of the type is in cultivation. Wheat and barley are grown principally, though there are small plantings of fruit, largely pears or apples. Where drainage conditions do not allow cultivation the type is used largely for pasture, to which it is well adapted. Wheat and barley yield 20 to 30 bushels per acre on the areas least affected with alkali. Fruit also produces well and is comparatively free from frost injury. The type is generally considered of the same value as the surrounding soils, except in areas of high alkali concentration.

The principal need of the type is drainage, after which it should prove adapted to the production of all crops suited to the climate. Owing to its relatively high content of organic matter, it should be especially valuable for the production of truck crops and small fruits.

The results of mechanical analyses of samples of the soil and subsoil of the Chino fine sandy loam are given in the following table:

Mechanical analyses of Chino fine sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
575766	Soil, 0 to 20 inches	0.0	0.3	0.9	28.1	33.3	18.2	18.2
575767	Subsoil, 20 to 72 inches	.0	.3	.3	16.6	34.1	35.3	12.5

RIVERWASH

Throughout the hot desert regions of the Southwest thunderstorms are of frequent occurrence along the crests of the mountains and points of higher elevation. The storms arise quickly and are of short duration, but large quantities of water fall, which, rushing down the mountain slopes, fill the stream channels and sweep out onto the alluvial fans, carrying with them a great deal of coarse sand, gravel, and bowlders. After escaping from the confines of the canyons the velocity of the water is checked and the coarser materials are quickly deposited. With the recession of the water the stream courses are barren of vegetation and covered with deposits of detritus washed from the hills. Such areas are entirely nonagricultural and have been mapped as Riverwash. But one area of this type is found in the survey, occupying the channel of Littlerock Creek and its lower distributaries.

ROUGH MOUNTAINOUS LAND

Along the southern margin of the survey are areas of mountainous country, which in places attain elevations of over 5,000 feet. Such areas are relatively inaccessible, and because of the steep and broken character of their slopes they are largely nonagricultural. These areas have been mapped as Rough mountainous land. Included in the type, however, there are probably areas a few acres in extent that with future more intensive agricultural development will be found capable of cultivation. Their total area, if separated from the surrounding nonagricultural lands, would be a very small fraction of the type. It was therefore not deemed advisable to map them in detail.

The rocks comprising the mountains in this section are largely such as, upon weathering, give rise to soils of the Holland series. In the area covered by Rough mountainous land, however, weathered soil material is largely removed by surface wash, since the nature of the slopes favors erosion and the scant vegetative covering offers little protection from erosion. Areas protected from the heat of the midday sun, or those in which a mantle of soil has accumulated, support a fair growth of grasses and other forms of native vegetation, some of which have a small grazing value. The more exposed and shallow areas, however, support only low-growing desert brush and a light grass cover in the early spring.

ROUGH BROKEN AND STONY LAND

Associated with the agricultural soils of the survey are found areas which, owing to erosion or to the shallow, stony character of the soil, are nonagricultural. These have been mapped as the miscellaneous type, Rough broken and stony land. This land consists of rough, broken areas and of shallow, stony areas, which are in many places very intimately associated. It occurs largely along the lower foothills of the San Gabriel Mountains and on Portal Ridge. Other areas consist largely of stony outcrops on the Rosamond Buttes in the northern part of the survey. In such areas erosion has removed most of the soil covering, leaving bedrock exposed in many places, and in others only a thin mantle of soil is found where occasional desert shrubs have established a foothold. In other areas in which material had accumulated in time past recent earth movements along the San Andreas fault have altered its position, with the result that erosion has become active, leaving the surface very broken and irregular and entirely unsuited to agriculture. The rocky areas are largely of granite or schist origin, though a great deal of reddish or pinkish rhyolite is also encountered in the Rosamond Butte areas.

The soils of the eroded areas in places resemble those of the Adelanto series, though because of faulting they are very badly mixed. The material comes largely from granitic or schistose rocks, and where erosion is active it is being carried away from year to year and deposited on the fan slopes in the immediate vicinity.

Juniper, greasewood, and sagebrush are common plants in the vegetation. A few other low-growing bushes and a scant growth of grasses afford some pasturage during the spring months. The type is valued chiefly for grazing and for the juniper, which is utilized as fence posts and fuel.

DUNESAND

Winds of high velocity, occasionally sweeping through the Antelope Valley in the early spring months, carry with them a great deal of fine sandy material, which is dropped in places of fluctuation in air currents and built up in low mounds or ridges. Successive windstorms shift them from place to place, accumulating more material with each succeeding storm, until in time they become several feet or more in height, and often cover several acres. Such deposits have been mapped as Dunesand.

Dunesand occurs largely in the eastern part of the survey. The sandy material deposited by Littlerock Creek and picked up and carried by winds before a vegetative covering can protect it, is represented by a number of areas lying south and southwest of Roosevelt School. Other areas lie east of that school and east of Redman School. A long, relatively narrow area of this type borders the southern and eastern margin of Rosamond Lake and consists mainly of dunes and hummocks of sand rising to heights of 10 to 15 feet above the surface of the lake. Included in the eastern part of this body is an area of about 40 acres of dunes of relatively heavy textured material, probably formed of the fine material of the lake bed, or playa, which has been transported by the prevailingly easterly winds.

The material comprising the dunes consists largely of fine or very fine quartz sand. In places bushes or other forms of vegetation have obtained a foothold, and the soil is no longer being shifted about, but these areas generally receive additional deposits of wind-blown material from year to year. The type has no agricultural value in its virgin condition and detracts materially from the value of other agricultural soils with which it is associated.

PLAYA DEPOSITS

In many desert regions are found low, flat sinks or depressions, in which turbid drainage waters, carrying salts in solution and clay in suspension, accumulate in time of storm. Since the waters occupy closed basins, the material is deposited as the waters are evaporated under the hot desert sun. Upon drying, the sink or depression presents a hard, slick surface on which very often no form of vegetation can be found. Such areas are called playas.

Although the surface materials in the playas in this survey consist mainly of clay and other fine-textured particles deposited from suspension, more or less sandy material is present. This has been carried in by an occasional freshet of unusual violence or blown in from adjacent areas of dunes by winds. These lighter textured materials are commonly mixed intimately with clay, but the recurrence of periods of deposition from suspension and of wind-blown materials may give rise to thin, alternating strata of clay and of sandy material. Such deposits are especially likely to occur about the margins of playa flats.

Playa deposits are most extensively developed in the northeastern part of the area, where they occupy the bed of Rosamond Lake, a part of which is included in this survey. Several small bodies of these deposits are found elsewhere in the area. Large areas lying outside the present survey occupy the chain of extensive playa lakes northeast of Rosamond Lake.

The color of the surface material ranges from grayish brown to brown, slightly tinged with pink. The subsoil is extremely compact and consists of thin, alternate strata or lenses of sand and clay. In all the playas occurring in the area a gray, highly calcareous clay loam or clay is encountered at depths of 36 inches or more and this continues to 72 inches or more without change. On the edge of the playas, however, sandy material in many places underlies the surface deposit of clay. The depth to this sandy material increases rapidly with distance from the shore line, until it no longer appears in the 6-foot section. This sandy substratum is especially common in the Rosamond Lake area.

The drainage of the type is poor, as water stands over the surface for a considerable length of time following heavy rains. The material is high in lime and both white and black alkali salts are present. The Playa deposits are practically impervious to water; dry earth is generally reached at depths of 8 to 10 inches even after water has stood on the land continuously for several weeks.

Considered from the standpoint of drainage, alkali, and structure of the soil, the agricultural value of the type is very low. The growing of rice has been attempted, and with later development

some crop may be found adapted to these Playa deposits under specialized agricultural practices.

The results of a mechanical analysis of a sample of the surface soil from the bed of Rosamond Lake are given in the following table. This analysis is interesting because of the unusually high content of clay which it shows.

Mechanical analysis of Lake Rosamond clay

Texture	Size	Per cent
	Millimeters	
Fine gravel	2.000 to 1.000	0.000
Coarse sand	1.000 to .500	.120
Medium sand	.500 to .250	.120
Fine sand	.250 to .100	.012
Very fine sand	.100 to .050	.120
Silt	.050 to .005	3.558
Clay	.005	95.792
		99.722

IRRIGATION AND DRAINAGE

Throughout the greater part of the Lancaster area, hot, dry summers, accompanied by low winter rainfall and frequent seasons of extreme drought, make irrigation essential for the maturing of nearly all crops. Wheat and barley are produced under dry-farm practices in the southwestern part of the area, as are also grapes, almonds, apricots, olives, and apples, though yields are generally low and crop failures are not uncommon in seasons of drought.

A failure to realize the necessity of irrigation in the early development of the valley led to many unnecessary failures, which in some cases involved large sums of money, but the people who remained, profiting by former experiences, laid the basis for future permanent agricultural development.

The discovery of artesian water in 1883 attracted attention to the valley and led to a colonization scheme, which later failed, owing to the occurrence of injurious accumulations of alkali salts throughout the soils of the flowing-well area. About 1900, however, pump irrigation was introduced, and in the same year the first shipment of alfalfa was made from the valley. From 1900 until about 1916 development was slow but generally of a permanent character. In the six years immediately preceding the survey a rapid development has taken place, and at the present time (1922) there are within the area surveyed approximately 10,000 acres irrigated by pumps, and over 2,500 acres irrigated by gravity water in the Littlerock and Palmdale irrigation districts.

Because of the high alkali content of the soils in the flowing-well area of the interior part of the valley, little use is made of this source of supply for irrigation. Bordering this area of artesian flow the soils are less affected with alkali and pumping is practiced where the artesian head is sufficient to lift the water to a level within the limits of economical pumping.

At the present time electrical power has almost entirely supplanted the use of gasoline or distillate engines in pumping. Of the 260 or

more wells in the valley using power for pumping, 235 now use electric power. Improved pumps largely embodying the turbine principle of pumping are in general favor and are efficient.

The amount of lift varies in different sections of the area, and even between adjoining farms, depending largely on local topographic features. The following figures will indicate in a general way the amount of lift in various sections of the valley:[2] Lancaster, 40 to 45 feet; Rosamond, 40 to 45 feet; Redman, 40 feet; Terra Bonita district, southeast of Lancaster, 60 feet; 1½ miles east and 1 mile north of Del Sur, 65 feet; 1½ miles east and 1½ miles north of Palmdale, 125 feet; sec. 4, T. 5 N., R. 11 W. and vicinity, 90 to 125 feet. At the present time alfalfa ranches are being irrigated with lifts of 75 feet, though the ordinary lift is about 40 feet. For fruit, maximum lifts are 200 feet, with an average of 75 feet. The average cost of water for alfalfa per ton produced is estimated at about $2.75. It is thought, however, that this figure will be cut about 10 per cent in the season of 1922 under new rates in effect for electric power. Alfalfa is generally considered to require about 5 acre-feet per season, which is slightly more than three times the water applied to orchard fruits. The cost of irrigating orchards per unit of water is, however, generally high, owing to the location of the orchards on the upper fan slopes where the lift is greater.

In the Littlerock and Palmdale irrigation districts water is generally conveyed to the farm in open concrete ditches but is distributed through the orchards largely by underground pipe lines. Some alfalfa ranches are equipped in the same way, though open ditches are used as well. Formerly reservoirs were used as storage basins for water, but on account of loss from evaporation and seepage they are now seldom used, the water being turned directly into the pipe lines or ditches for immediate distribution.

Orchards are irrigated by the furrow method at intervals of 25 to 35 days, depending on the type of soil and the weather conditions. The first irrigation usually is given in April or early in May, and the last in October or November. Alfalfa fields are generally divided into small checks and irrigated by flooding, two to three irrigations being made per cutting, depending largely on the character of the soil and the season.

The waters used for irrigation are in all cases relatively free of salts and are suitable for domestic purposes.

Natural drainage is well established in the Lancaster area, with the exception of several small areas along the San Andreas fault line and about 80 or 90 square miles of territory in the central and northeastern part. In the last-mentioned area ground water generally is found at shallow depths, which aggravates local alkali conditions and largely precludes the possibility of agricultural development. It is judged, however, from elevations shown on the United States Geological Survey sheets of this area that there is sufficient slope in nearly all sections to make it possible to drain the region artificially. Reclamation would, however, be expensive, especially in view of the concentration of carbonate and other alkali salts in the soils.

[2] The data pertaining to lifts, costs, etc., of pump irrigation were furnished by L. S. Tudor, district manager for the Southern California Edison Co.

The soils of the Chino series in the Leonis Valley are generally poorly drained under natural conditions, but it is believed that, since the lowering of the channel of Amargosa Creek, the greater area of these soils could be very easily drained at small expense. In most cases a cut-off drain along the base of the higher slopes would probably be of material benefit, or in extreme cases lateral drains at distances of 50 feet or less should be found sufficient.

ALKALI

Coincident with the weathering of rocks and formation of soils, soluble chemical salts are formed or liberated. Many of these are utilized by plants in their growth, but when concentrated in large quantities they nearly all become toxic or injurious and in many cases entirely prevent all vegetative growth. In a broad agricultural sense such concentrations of soluble salts are called "alkali," though but few of these are true alkali from the standpoint of chemical reaction.

In the Lancaster area a large proportion of the soils contain more or less alkali. In all cases the affected soils are associated with conditions of poor drainage and frequently with a high water table. Such areas receive drainage waters containing mineral matter in solution from the higher lying soils. Upon evaporation of the water from the surface the soluble salts are precipitated, resulting in the white surface efflorescence so commonly seen in alkali-affected areas.

In this survey field borings were made at frequent intervals for determination of the content of total salts, which were measured approximately in the field, using the electrolytic bridge method. The results are indicated upon the accompanying alkali map on which the location of individual samples has been marked by a dot. The approximate percentage of total alkali salts in the air-dry soil is shown by a fraction, of which the numerator indicates the percentage of alkali salts in the surface 12 inches, and the denominator indicates the average percentage in the 6-foot section. In areas in which sodium carbonate or "black alkali" has been shown to be present by field tests, the fraction is followed by the letter B.

Only one grade of alkali accumulation has been indicated on the map, owing to the difficulty of drawing accurate boundaries between different grades or concentrations of alkali, especially where there are no cultivated crops to indicate the probable boundaries. In this area the alkali-affected soils are shown with the symbol A inclosed within a broken red line which indicates the approximate boundary between soils containing more than 0.20 per cent of soluble salts and those with less than this amount, which are considered free of alkali from the standpoint of crop production.

The greatest concentration of alkali occurs in the central part of the valley, where drainage conditions are poor and a high water table is generally present. As indicated by numerous determinations, this area includes the greater part of the trough of the valley west of Lancaster, extending north to include Oban and most of the territory between Oban and Rosamond. On the west the approximate boundary of the area of high concentration borders the Southern Pacific Railroad between the points mentioned above, at distances of 1 to 3 miles, and on the east at an average distance of 1 mile.

That part of Rosamond Lake included in the survey is also badly affected with alkali. Bordering the lake on the west and south at distances of a mile or less, the soils are comparatively low in soluble salts.

In the Roosevelt and Redman districts alkali is present in various concentrations, but seldom is sufficiently concentrated to interfere seriously with crop production in the developed areas or in any area south of these points. Bordering Rosamond Lake on the southeast and extending south to within about 2 miles of Roosevelt School there is an area which would probably be found dangerous under cultivation.

The following table gives the results, in parts per million, of chemical analyses of alkali crusts collected at four different places:

Chemical analyses of alkali crusts

[Parts per million]

Ions	SE. ¼ sec. 16, T. 7 N., R. 13 W.	1 mi. east, 1 mi. north, Redman School	SW. ¼ sec. 1, T. 7 N., R. 12 W.	South center sec. 33, T. 9 N., R. 12 W.
Calcium (Ca)	80	2,700	50	80
Magnesium (Mg)	24	672	7	14
Sodium (Na)	21,910	48,010	34,570	34,940
Carbonate (CO_3)	6,000	0	5,700	2,400
Bicarbonate (HCO_3)	9,150	976	9,150	3,050
Sulphate (SO_4)	17,300	48,600	39,470	23,440
Chlorine (Cl)	8,250	43,000	19,000	31,500
Nitrate (NO_3)	620	2,790	186	1,736
Total	63,334	146,748	108,133	97,160

A high percentage of calcium and no sodium carbonate or black alkali is found in the sample taken northeast of Redman School. Probably the most common chemical combinations found in the soils are sodium sulphate, sodium chloride, sodium bicarbonate, and sodium carbonate. The calcium is probably combined largely as a sulphate. Black alkali or sodium carbonate is present in all the samples except one. This salt is highly injurious to crop growth and also offers great difficulty in reclamation. Nitrates are present in rather high concentrations in the sample taken near Redman School and in the one taken in section 33, T. 9 N., R. 12 W. Though these salts are found in rather high concentrations in the surface crust, it is doubtful if they are generally present in sufficient quantity to be injurious. On the other hand, they are carriers of nitrogen, one of the fertilizing elements most generally deficient in soils.

The injurious effect of alkali varies, depending on a number of factors, chief of which are the position of the zone of highest concentration of the salts in the soil profile, the kind of salts present, texture of the soil, tillage methods, position of the water table, weather conditions, and crops grown. Without taking these factors into consideration, some of which are controlled by farm operations, it is difficult to say what concentration of alkali will be injurious to certain crops. Of the more common alkali salts it is generally conceded that the sulphate is the least injurious to most crops, followed in order by the chloride, bicarbonate, and carbonate.

A very marked effect may be shown on the growth of crops where alkali is concentrated on or near the surface, while the same concentration at a depth of 3 feet or more below the surface may show no ill effect. For this reason it is important that the water table be sufficiently low to prevent capillary movement of water to the surface, because capillary movement keeps the salts concentrated on the surface, where they are most injurious. The depth at which the water table should be maintained to prevent capillary movement will vary for different textured soils, the kind of salt present, and its concentration; in general, however, it will range between 7 or 8 feet in dry soils.

Crops also differ in their tolerances of or resistance to the total salt content and to the various salts represented. In general, however, it is recognized that with conditions favorable and in the absence of the highly toxic black alkali, alfalfa can be grown on soils containing from 0.30 to 0.40 per cent of alkali without serious injury. The crop is sensitive to alkali in the seedling stage, and care should be exercised to keep the salts below the feeding zone at this time. After a good stand has been obtained and the crop has become more deeply rooted, it will grow well under even higher concentrations than those given. Black alkali will injure the crop at much lower concentrations. Sweet clover is a good legume for alkali soils, being somewhat more resistant than alfalfa. It is especially good as a green-manure crop in reclaiming alkali lands. Vetch, field peas, and beans are very sensitive to alkali and will generally be injured by concentrations of 0.20 to 0.40 per cent.

The grasses are as a whole quite resistant. Of the more tolerant ones, orchard grass, redtop, and brome grass will all withstand successfully between 0.40 and 0.60 per cent of the white alkali salts. Rhodes grass is very resistant to alkali, and under favorable conditions will withstand successfully concentrations of over 1 per cent. Bluegrass is sensitive, and its growth should not be attempted on soils with an appreciable amount of alkali. Sorghums are quite resistant, withstanding 0.60 to 0.80 per cent without great injury. On the more strongly affected alkali soils giant rye grass should be of value.

Of the grains, barley is generally considered the most resistant, followed in order by oats and wheat. Barley will generally withstand successfully 0.60 per cent of alkali, exclusive of the carbonates, while wheat and oats withstand slightly less. Rye is quite resistant and can be grown where most other grain crops fail. Milo is also resistant, being generally considered as having about the same tolerance as barley, or even higher.

Of the vegetables, asparagus, onions, celery, radishes, and sugar beets do well in the presence of moderate amounts of alkali.

Of the various methods of reclaiming alkali lands, none can be permanently successful without drainage, either natural or artificial. In connection with drainage various practices should be observed, such as turning under organic matter, neutralizing carbonates by adding gypsum or sulphur, cropping with alkali-resistant crops, flushing the soils, and observing good cultural practices to reduce evaporation.

In the greater part of the Lancaster area natural drainage is generally sufficient for the reclamation of alkali soils when good cul-

tural practices are observed. An exception is found, however, in the case of the soils of the Pond series, in which artificial drainage would generally be necessary for successful agriculture. Though of comparatively flat topography, the soils of this series generally have a slope of 6 feet or more to the mile, which would in most cases make artificial drainage practicable. The subsoil of this series is generally permeable, and with a series of deep open ditches or underground drains through the trough of the valley draining into Rosamond Lake, the water table might be appreciably lowered throughout the section in which these soils occur.

SUMMARY

The Lancaster area is situated mainly in the Mohave Desert region in what is locally known as Antelope Valley. The city of Los Angeles lies at a distance of 40 miles by air line. The area embraces 530 square miles, or 339,200 acres.

The dominant physiographic feature of the area consists of a broad gently sloping plain, with occasional buttes protruding through the valley fill. The San Andreas fault, one of the well-defined zones of recent earth movement known to geologists, passes through the southern part of the area. Drainage is well developed, except in the central part of the valley, where alkali salts are present in various concentrations.

Except in several localities where water has been developed for irrigation, the area is thinly populated. Transportation facilities are good. A paved road which is part of the Midland Trail offers easy access by automobile to points in the San Joaquin Valley or to Los Angeles.

The climate is characterized by a mean annual precipitation of less than 6 inches in the central part of the area, which increases to 12 inches or more in the mountains and points of higher elevation, and a mean annual temperature of 63.8° F., as recorded at Mohave, lying a short distance outside the area. July and August are the hottest months, maximum temperatures of 117° F. and 118° F. being recorded. The average length of the growing season at Mohave is 264 days. Late spring frosts often do considerable damage to fruit crops.

The early agricultural development of the valley was attended by many failures, due to a lack of understanding of desert conditions. At present the agriculture consists largely of alfalfa and fruit production. Water for irrigation is obtained by pumping for alfalfa and to some extent for fruit, though many orchards are irrigated by gravity water in the Littlerock and Palmdale irrigation districts. Alfalfa is grown on approximately 7,000 acres and produces about 5 tons per acre. It is marketed largely in Los Angeles. The production of pears is important, the Bartlett pear being grown almost exclusively. Grapes, apples, almonds, olives, and apricots are grown in a small way. Dairying is not well established, only a few ranches in the vicinity of Lancaster being devoted to this industry. Farm labor is generally plentiful and largely American born.

The residual soils of the area are derived from the weathering of granite, schist, and related rocks and are classed in the Holland

series. They are confined largely to the southern part of the survey and are of small extent.

The old valley-filling soils are weathered water laid deposits which have undergone marked change in their physical characteristics since deposition. They are extensively developed and have been separated into seven series, mainly on the basis of differences in age of soil material, origin, color, character of subsoil and substratum, lime content, and drainage. Soils of the Adelanto, Ramona, and Hesperia series are developed on the alluvial-fan slopes, and of the Rosamond, Sunrise, Domino, and Pond series in the central part of the valley. The Rosamond soils are utilized largely in alfalfa production. The Adelanto and Hesperia soils are often planted to orchard fruits, because of their position with respect to air drainage. The Ramona soils are somewhat more favored with respect to rainfall, and are utilized in the production of dry-farmed grains.

The recent-alluvial soils consist of unaltered sedimentary deposits and are in process of accumulation or have been deposited in very recent time. They are separated into the Cajon, Tujunga, Hanford, and Chino series. The Cajon soils occur largely in the Littlerock irrigation district and are utilized for fruit production. The Tujunga soils are droughty and little adapted to agriculture. The Chino and Hanford soils are devoted chiefly to grain production and to a less extent to fruit.

The miscellaneous soils, consisting of Riverwash, Rough mountainous land, Rough broken and stony land, Dunesand, and Playa deposits are largely nonagricultural.

Irrigation is necessary for the successful production of nearly all crops grown in this section. Artesian water is available throughout the lower part of the valley, but is not used because of high alkali concentrations in the soils of the flowing-well areas. The average lift on alfalfa ranches is 40 feet, while fruit is produced with an average lift of 75 feet.

Water is distributed through the orchards by underground pipe lines. Both ditches and underground pipe lines are used on alfalfa ranches. Alfalfa is irrigated by flooding, while the furrow system is used in orchards. The irrigation water is comparatively free of salts.

Alkali is present in the soil over a large area in the central part of the survey. High concentrations are found associated with a high water table in the trough of the valley. Areas of less than 0.20 per cent are considered free of alkali and have been separated on the alkali map from areas of higher concentration. Black alkali is of general occurrence in the central part of the area. The sodium sulphate and sodium chloride salts are of most widespread occurrence. Soils with fair drainage can be reclaimed by good agricultural practices. Artificial drainage is necessary for the reclamation of soils with poor natural drainage.

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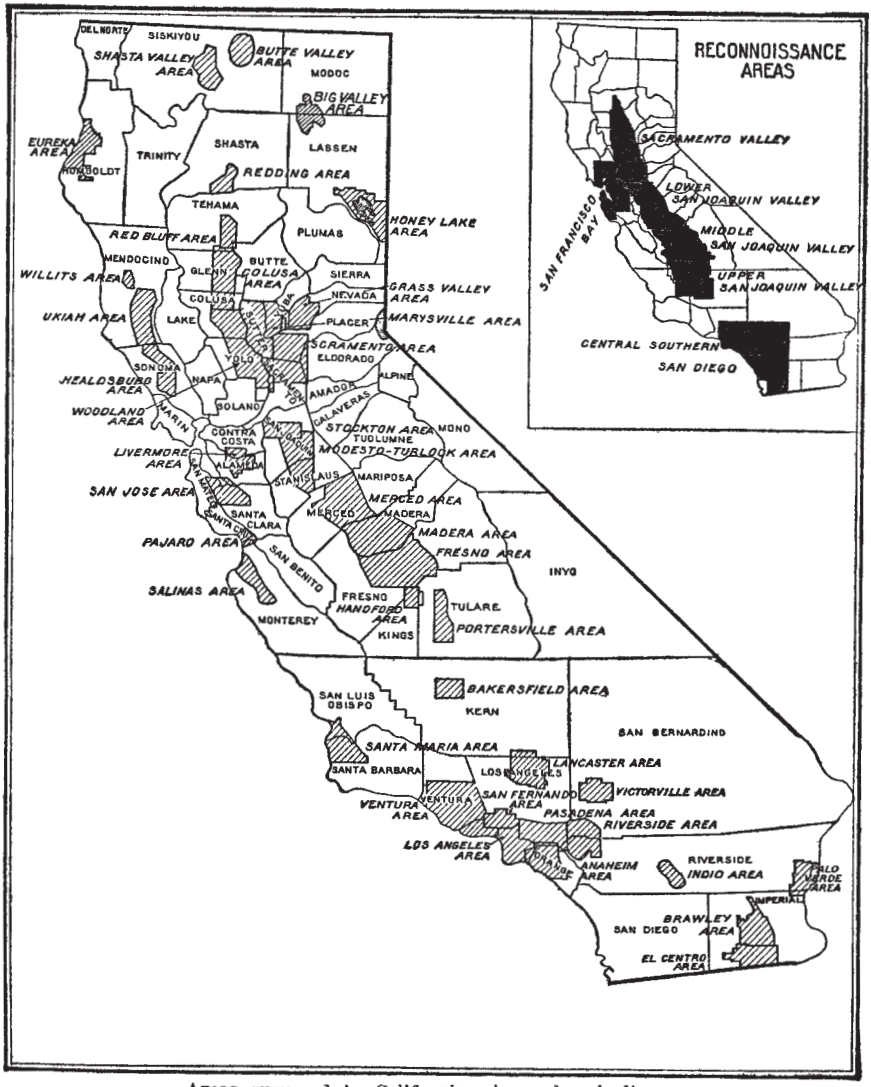

Areas surveyed in California, shown by shading

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