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Pajaro Valley, Looking Northeast

STATE OF CALIFORNIA
EARL WARREN
GOVERNOR

PUBLICATION OF
STATE WATER RESOURCES BOARD

Bulletin No. 5

SANTA CRUZ-MONTEREY COUNTIES INVESTIGATION

August, 1953

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EARL WARREN
GOVERNOR

STATE OF CALIFORNIA
STATE WATER RESOURCES BOARD
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SACRAMENTO 5, CALIFORNIA

August 17, 1953

ADDRESS ALL COMMUNICATIONS TO THE SECRETARY

HONORABLE EARL WARREN, *Governor, and*
Members of the Legislature of the
State of California

GENTLEMEN: I have the honor to transmit herewith Bulletin No. 5 of the State Water Resources Board, entitled "Santa Cruz-Monterey Counties Investigation", as authorized by Chapter 1514, Statutes of 1945, as amended.

The Santa Cruz-Monterey Counties Investigation was conducted and Bulletin No. 5 was prepared by the Division of Water Resources of the Department of Public Works, under the direction of the State Water Resources Board.

Bulletin No. 5 contains an inventory of the surface and underground water resources of Pajaro Valley in both Santa Cruz and Monterey Counties and of other areas in Santa Cruz County, estimates of present and probable ultimate water utilization, estimates of present and probable ultimate supplemental water requirements, and preliminary plans and cost estimates for water development works.

Very truly yours,

C. A. Griffith
Chairman

ACKNOWLEDGMENT

Valuable assistance and data used in the investigation were contributed by agencies of the Federal Government, the State of California, cities, counties, public districts, and by private companies and individuals. This cooperation is gratefully acknowledged.

Special mention is also made of the helpful cooperation of the Boards of Supervisors of the Counties of Monterey and Santa Cruz; Arnold M. Baldwin, County Surveyor of Santa Cruz County; H. F. Cozzens, County Surveyor of Monterey County; Neal D. Smith, City Manager of City of Santa Cruz; John C. Luthin, formerly Superintendent of City of Santa Cruz Water Department; R. E. Fowle, Manager of Watsonville City Water Works; and H. N. Ormsbee, Chairman of Santa Cruz County Water Conservation Committee. Valuable data were contributed by the Coast Counties Gas and Electric Company, Soil Conservation Service of the United States Department of Agriculture, and Corps of Engineers of the United States Army.

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CHAPTER I

INTRODUCTION

The area in Santa Cruz and Monterey Counties under this investigation has recently experienced a substantial increase in water utilization, in common with many other parts of California. As a result, it is confronted with a need for more complete conservation of its water resources. Diversion of surface water in Santa Cruz County has increased until in dry years insufficient summer flow exists in certain streams to meet peak water demands for urban and recreational requirements. Expanding irrigated acreage in Pajaro Valley together with trends toward more intensive agriculture have increased the ground water draft in that valley and have resulted in sea-water intrusion. Concern has been aroused as to the adequacy of surface and ground water resources, as presently developed, to meet water demands.

AUTHORIZATION FOR INVESTIGATION

As a result of the general concern regarding water supply, the Secretary-Manager of the Watsonville Chamber of Commerce addressed a letter to the Board of Supervisors of Santa Cruz County on August 28, 1946, asking that the Board request the State Division of Water Resources to make a survey of surface and underground waters in Pajaro Valley. On September 10, 1946, the Board of Supervisors of Monterey County adopted a resolution requesting the State Water Resources Board to undertake, through the State Division of Water Resources, a survey of the underground waters of Pajaro Valley. On October 23, 1946, a similar resolution was adopted by the Board of Supervisors of Santa Cruz County. As a result of these resolutions the State Water Resources Board, on December 13, 1946, adopted a resolution authorizing a cooperative agreement between the State Water Resources Board, the Counties of Monterey and Santa Cruz, and the Department of Public Works. This agreement became effective on February 13, 1947, and provided that the Department of Public Works, acting through the agency of the State Engineer, would make an investigation and report on the ground water supply of Pajaro Valley in Santa Cruz and Monterey Counties.

Since the foregoing agreement provided only for an investigation of Pajaro Valley and did not include consideration of water problems in other areas in Santa Cruz County, the City of Santa Cruz, by resolution dated April 19, 1948, requested the State Water Resources Board to make a

> "preliminary study to determine the scope, extent and estimated cost of having a complete study made of the ground and surface water resources with recommendations as to the appropriate allocation of the waters in the San Lorenzo and Pajaro River basins and all intervening watersheds and to prepare a contract proposed to be entered into by the State and local agencies to have said study made."

The Board of Supervisors of Santa Cruz County, by resolution adopted April 28, 1948, requested

> "the State Department of Public Works, Division of Water Resources, Sacramento, California, to include the entire unincorporated area of the County of Santa Cruz in the preliminary survey being made by that agency of water sources within the State of California."

At its June 3, 1948, meeting, the State Water Resources Board approved the new and enlarged investigation, subject to consummation of contracts with the local agencies.

The resulting agreement between the State Water Resources Board, the Counties of Santa Cruz and Monterey, and the Department of Public Works was fully executed on October 8, 1948, but did not become effective until January 18, 1949, when funds became available. It provided that the work to be performed was to

> "consist of an investigation and report on the water supplies, surface and underground, of Pajaro Valley in the Counties of Monterey and Santa Cruz, and of the San Lorenzo River Basin, of Soquel Creek Basin, of Aptos Creek Basin, and of Corralitos Creek Basin, and of other streams within Santa Cruz County, including an inventory of the water resources, both surface and underground, of the areas involved; a survey of the location, extent and type of use of water under present development in said areas; an estimate of the future water requirements for all said areas; plans for securing additional water supplies to meet immediate demands and for ultimate development, utilizing both surface and underground storage; estimates of cost of the various plans evolved; and recommendations as to allotments of supply to the respective areas."

Objectives of the Santa Cruz-Monterey Counties Investigation included investigation and study of the nature, occurrence, and amount of water resources, both surface and underground; survey of the location, type and extent of water utilization under present development; estimation of future water requirements for all beneficial uses; evaluation of present and future water problems; development of preliminary plans for securing supplemental water supplies to meet immediate and ultimate needs; and estimates of cost.

Total funds made available for the investigation, under terms of the two authorizing agreements, were $26,000, contributed by the cooperating agencies as follows: State of California, $13,000; Monterey County, $4,000; and Santa Cruz County, $9,000. Of the amount contributed by Santa Cruz County, $1,400 was furnished by the City of Watsonville, and $2,600 by the City of Santa Cruz. In addition to the foregoing, substantial funds were expended in the area by the State Water Resources Board in connection with its current State-wide Water Resources Investigation, certain results of which have been used in connection with the Santa Cruz-Monterey Counties Investigation.

Copies of the two agreements between the State Water Resources Board, the Counties of Monterey and Santa Cruz, and the Department of Public Works are included as Appendix A.

RELATED INVESTIGATIONS AND REPORTS

Prior investigations and reports reviewed in connection with this investigation include the following:

Allen, John Eliot. "Geology of the San Juan Bautista Quadrangle, California." California State Division of Mines. Bulletin 133. March, 1946.

Blaney, Harry F., and Ewing, Paul A. "Irrigation Practices and Consumptive Use of Water in Pajaro Valley, California." United States Department of Agriculture, Soil Conservation Service. December, 1949.

California State Water Resources Board. "Water Resources of California." Bulletin No. 1. 1951.

Hyde, C. G., and Sullivan, G. L., Consulting Engineers. "Santa Cruz County Sewage Disposal Survey." June 30, 1947.

Luthin, John C., Superintendent of the City of Santa Cruz Water Department. "Preliminary Survey of the Water Department's Current Needs and Development of Additional Sources of Water Supply." Memorandum to City of Santa Cruz Water Commission. 1948.

Seventy-eighth Congress, Second Session. "Preliminary Examination and Survey of Pajaro River, California." House Document 505. December 13, 1943.

Storie, R. Earl. "Natural Land Divisions of Santa Cruz County, California: Their Utilization and Adaptation." University of California, Agricultural Experiment Station. Bulletin 368. July, 1940.

Storie, R. Earl, et al. "Soil Survey—Santa Cruz Area, California." United States Department of Agriculture, Bureau of Plant Industry, Soils and Agricultural Engineering. Series 1935, No. 25, January, 1944.

United States Army, Corps of Engineers, San Francisco District. Basic data collected in a flood control study of the San Lorenzo River Basin.

United States Department of the Interior, Geological Survey. "Geologic Atlas of the United States, Santa Cruz Folio, California." Folio 163. 1909.

The Division of Water Resources is presently conducting surveys and studies for the State-wide Water Resources Investigation, authorized by Chapter 1541, Statutes of 1947. This investigation, under the direction of the State Water Resources Board, has as its objective the formulation of The California Water Plan for full conservation, control, and utilization of the State's water resources to meet present and future water needs for all beneficial purposes and uses in all parts of the State, insofar as practicable. Surveys and studies have also been conducted by the Division of Water Resources in connection with its Santa Clara Valley Investigation under a cooperative agreement between the State Water Resources Board, the County of Santa Clara, the City of San Jose, and the Department of Public Works acting through the agency of the State Engineer. This investigation, which is coordinated with the State-wide Water Resources Investigation, has as its objectives the investigation and study of the underground water supply of valley floor lands in Santa Clara County, including quality, replenishment, and utilization thereof, and, if possible, a method or methods of solving the water problems involved. Results of both of the foregoing investigations will have direct bearing on solutions to the water problems of the Santa Cruz-Monterey Area, particularly as regards plans to meet supplemental water requirements of the area under ultimate conditions of development.

SCOPE OF INVESTIGATION AND REPORT

It has been stated that under provisions of the authorizing agreements the general objectives of the Santa Cruz-Monterey Counties Investigation included investigation and study of the water supplies, both surface and underground, of Pajaro Valley in the Counties of Monterey and Santa Cruz, and of other stream basins in Santa Cruz County. These studies included determinations of the utilization of water under present and ultimate development, and plans, with comparative costs, for securing supplemental water supplies to meet immediate and ultimate needs.

Field work in the Pajaro Valley, as authorized by the initial agreement, commenced in February, 1947, and continued until March, 1948. Field work in the expanded investigational area, as authorized by the second agreement, commenced in September, 1948, and with the office studies continued into 1952.

In the course of the investigation, available precipitation and runoff records were collected and compiled in order to evaluate water supplies available to the investigational area. Eight stream gaging stations were installed and maintained to develop additional hydrographic data. These stations were established on the Pajaro and San Lorenzo Rivers, and Corralitos, Green Valley, Zayante, Casserly, and Soquel Creeks.

The effects of draft on and replenishment of the ground water basin of Pajaro Valley were determined by measurements of static ground water levels made at 330 wells during each spring and fall of the period of investigation. These wells were chosen to form a comprehensive measuring grid over the entire area. In addition, monthly measurements were made at 45 key wells to determine fluctuation of ground water levels under varying rates of ground water draft.

Similar measurements were made at a limited number of wells in Soquel Valley.

Geologic investigations were made in the field, and logs of approximately 200 wells in the Pajaro and Soquel Units were collected and studied. Results of these geologic studies were utilized in conjunction with well measurements to determine the areal extent of confined and free ground water. Results of geologic studies are reported in Appendix B.

Present land use in Pajaro Valley was determined from a detailed survey conducted in 1947. This land use survey was extended to the Soquel area in 1949 and to the coastal strip northwest of Santa Cruz in 1950. The total area surveyed in Pajaro Valley comprised about 70,000 acres. In addition, a survey of habitable areas was conducted in 1949 throughout the Santa Cruz-Monterey Area. Data from these surveys were used in conjunction with data obtained on unit water use to determine water utilization.

In order to determine future water utilization in the investigational area, all lands in Pajaro Valley were classified as to their suitability for irrigated agriculture. Similarly, the survey of habitable areas was utilized for evaluation of lands relative to their suitability for urban, suburban, and recreational development.

Current irrigation practices in Pajaro Valley were surveyed in order to determine unit application of water to important crops on lands of various soil types. During the 1947 irrigation season, records of application of water were collected at 126 plots, and during 1949 at 63 plots. The data collected included records of pump discharge, acreage served, crops irrigated, number and period of irrigations, and amounts of water applied.

Studies were made of the mineral quality of surface and ground waters in order to evaluate their suitability for irrigation and other uses, and to locate areas subject to sea-water intrusion. Data used in these studies included 119 partial and 132 complete mineral analyses of water samples collected during the course of the investigation.

Field surveys, including geologic examinations, were made to locate and evaluate the suitability of possible dam and reservoir sites for conservation of surface runoff. Reconnaissance surveys were also made of possible routes for conveyance of water to certain areas of use.

Results of the Santa Cruz-Monterey Counties Investigation are presented in this report in the four ensuing chapters. Chapter II, "Water Supply," contains evaluations of precipitation and of surface and subsurface inflow and outflow. It also includes results of investigation and study of ground water basins, and contains data regarding mineral quality of surface and ground waters. Chapter III, "Water Utilization and Supplemental Requirements," includes data and estimates of present and probable ultimate land use and water utilization, and contains estimates of present and probable ultimate supplemental water requirements. It also includes available data on demands for water with respect to rates and times of delivery. Chapter IV, "Plans for Water Development," describes preliminary plans for conservation and utilization of available water supplies to meet supplemental water requirements, including results of yield studies, design considerations and criteria, and cost estimates. Chapter V, "Conclusions and Recommendations," comprises a summary statement of the conclusions resulting from the investigation and studies, together with recommendations for action relating to solution of water problems on the part of concerned local interests.

AREA UNDER INVESTIGATION

The area under investigation comprises nearly all of Santa Cruz County and that portion of Pajaro Valley lying in Monterey and San Benito Counties. The investigational area has been designated the "Santa Cruz-Monterey Area" and covers about 294,000 acres.

The Santa Cruz-Monterey Area is situated adjacent to the Pacific Ocean and Monterey Bay. Its northern boundary lies about 40 miles south of San Francisco. The area extends southeastward from this boundary along the coastal slopes for approximately 40 miles, and varies in width from about 12 to 25 miles. Location of the Santa Cruz-Monterey Area is indicated on Plate 1, entitled "Location of Santa Cruz-Monterey Area."

In order to facilitate reference to its several parts, the Santa Cruz-Monterey Area was divided into four principal hydrographic units, based on geographical considerations and on respective types of water service and sources of water supply. These were designated "North Coastal Unit," "San Lorenzo Unit," "Soquel Unit," and "Pajaro Unit," and are shown on Plate 2, entitled "Hydrographic Units and Principal Organized Water Agencies." The North Coastal Unit embraces the area draining into the Pacific Ocean from about the San Mateo-Santa Cruz county line south, to and including the Meder Creek drainage area. The San Lorenzo Unit includes the watershed of the San Lorenzo River and the coastal drainage from the Meder Creek watershed easterly to, but not including, the Doyle Gulch drainage area. The Soquel Unit consists of the Doyle Gulch drainage area and the drainage areas of all other streams to the southeast discharging into Monterey Bay to, but not including, the Pajaro River watershed. The Pajaro Unit comprises the drainage area of the Pajaro River below Pajaro Gap, including the northern extremity of Monterey County, a small part of the northwestern corner of San Benito County, and the southern portion of Santa

Cruz County. Its southern boundary is the drainage divide between the Pajaro River and Elkhorn Slough. For purposes of hydrologic analyses, the Pajaro Unit was further divided into the valley floor, comprising the "Valley Floor Pressure Zone" and the "Upper Pressure Zone," and the tributary drainage area, comprising the "Forebay Zone." These subdivisions are shown on Plate 11, "Ground Water Zones in Pajaro Unit."

Drainage Basins

The Santa Cruz-Monterey Area comprises chiefly mountainous terrain, with exception of the floor of Pajaro Valley, the Santa Cruz-Capitola area, and a narrow coastal strip flanking this area. The floor of Pajaro Valley slopes gently from an elevation of about 100 feet above sea level at the base of the Santa Cruz Mountains to the ocean about ten miles to the west. The remainder of the Santa Cruz-Monterey Area is traversed by the Santa Cruz Mountains which reach a maximum elevation of 3,214 feet above sea level along the mountain crest on the county line between Santa Cruz and Santa Clara Counties.

The investigational area is drained by two rivers and a number of creeks. From northwest to southeast the more important streams are Waddell, Scott, San Vicente, and Laguna Creeks in the North Coastal Unit; San Lorenzo River and Branciforte Creek in the San Lorenzo Unit; Soquel and Aptos Creeks in the Soquel Unit; and Corralitos, Green Valley, and Casserly Creeks, Watsonville Slough, and Pajaro River in the Pajaro Unit. Four natural lakes north of Watsonville in the Pajaro Unit contain water throughout the year, and another, College Lake, is drained in the spring to permit growth of crops on its bed.

The Pajaro River is the only stream that contributes substantial surface inflow to the Santa Cruz-Monterey Area. Beside draining a portion of the east slope of the Santa Cruz Mountains through Uvas and Llagas Creeks, the Pajaro River receives runoff from Pacheco Creek and the San Benito River in San Benito County. The total drainage area of the Pajaro River above the Chittenden gaging station is 1,187 square miles. This river is the largest coastal stream between San Francisco Bay and the Salinas River.

The remainder of the streams in the Santa Cruz-Monterey Area head in the Santa Cruz Mountains, and almost entirely within the boundaries of the area. The tributary watersheds are in a zone of relatively heavy precipitation, and their aggregate mean seasonal natural runoff, for the 53-year period from 1894-95 through 1946-47, is estimated to be about 275,000 acre-feet. The San Lorenzo River is the largest of these streams, and ranks second only to the Pajaro River in mean seasonal discharge. Boulder, Bear, and Zayante Creeks are the principal tributaries of the San Lorenzo River.

Climate

The mild and equable climate of the Santa Cruz-Monterey Area is favorable to the productivity of its agricultural lands and to the establishment of homesites and resorts. It is characterized by dry summer and wet winter seasons, with nearly 90 per cent of the seasonal precipitation occurring during the six months from November through April. The growing season is relatively long, and the average for Watsonville, centrally located in the agricultural area, is 237 days between killing frosts. Temperatures at Watsonville have ranged from 15° F. to 110° F., and the monthly average for the period from 1880 through 1947 ranged from 49.9° F. in January to 61.5° F. in July, with a seasonal average of 56.6° F. The average seasonal temperature at Santa Cruz is 57.2° F.

Geology

The geologic formations of the Santa Cruz-Monterey Area include sedimentary, igneous, and metamorphic rock types ranging in age from pre-Cretaceous to Recent. The great bulk of the rocks consists of marine sediments, but some continental and tidal sediments are found on and immediately adjacent to major valley floors. Outcrops of deep-seated igneous rock occur only on the west sides of the San Andreas and Ben Lomond faults. The North Coastal, San Lorenzo, and Soquel Units consist primarily of rugged mountainous regions in the erosional stage of late youth. The principal ground water aquifers occur in the Pajaro Unit and are composed of continental and marine deposits of the late Quaternary period. These aquifers are overlain by blue clay layers, also of late Quaternary age, which act as confining strata causing the ground water below the strata to be under hydrostatic pressure. Thickness of the valley fill to a depth of 600 feet has been reported, although its average thickness is much less than this depth.

Soils

Soils of the Santa Cruz-Monterey Area vary in their chemical and physical properties in accordance with differences in parent material, mode of formation, and age or degree of development since their deposition. The soils may be divided into five groups: (1) hilly and mountainous upland soils, (2) upland coastal plain soils, (3) wind modified coastal plain soils, (4) older valley and coastal terrace soils, and (5) alluvial fan and stream bottom soils.

Hilly and mountainous upland soils have developed in place from underlying consolidated parent rocks. Since the general topography is steep where these soils occur, only small areas have agricultural value.

Upland coastal plain soils have developed upon soft sandstone-like material and mixed sedimentary materials. These soils occupy high rolling terraces that have fairly steep slopes that erode severely, and have little agricultural value owing to their low fertility.

Wind modified coastal plain soils occupy gently undulating terraces bordering the coast line. These soils have developed upon old sand dunes and sandy beach material. They are low in organic matter and lacking in fertility. These soils, with proper fertilization and management, are used extensively for specialized winter crops.

Older valley and coastal terrace soils occupy terraces lying along the coast and just above the recent alluvial soils of the stream valleys. Owing to leaching of their surface horizon, and to the fact that they overlie very heavy textured and relatively impervious subsoils, these soils are limited in their suitability for agricultural use.

Alluvial fan and stream bottom soils have developed from mixed sedimentary materials and occur on smooth, gently sloping alluvial fans and flood plains along streams. Most of these soils have high agricultural value, are used for a wide range of crops, and are the most productive soils in the area.

Present Development

Development of the Santa Cruz-Monterey Area began with the establishment of a Franciscan mission in Santa Cruz in 1791. Increase in population and expansion of agriculture were gradual during the early nineteenth century, but were stimulated in the 1850's by migration of settlers from the mining counties of California. Development of homes, resorts, and irrigated agriculture has been accelerated during the past three decades.

The 1950 federal census showed that the population of Santa Cruz County was 66,534, a substantial increase over the 1940 population of 45,057. The principal urban centers, Santa Cruz and Watsonville, account for some 50 per cent of the total population of the area. The 1950 census enumerated 21,970 persons in Santa Cruz, while 11,572 were counted in Watsonville. Freedom and Capitola are the largest of a number of small communities, and the remainder of the population is distributed along stream canyons and throughout the agricultural areas.

Agricultural development in the Santa Cruz-Monterey Area occurred as early as the 1790's when wheat, corn, and barley, and a small fruit orchard were planted near Mission Santa Cruz. However, it was not until 1851 that the first settlers entered Pajaro Valley for the express purpose of farming. Shortly thereafter, a thousand acres of Salsipuedes Rancho were rented by an enterprising individual who planted 200 acres of potatoes and obtained a large yield. This so stimulated agricultural development that all alluvial bottom lands were soon planted to potatoes and grain. In recent years a gradual change to more intensive types of agriculture has taken place. This transition has continued to this time.

A land use survey of Pajaro Valley conducted in 1947, and later extended to cover the entire Santa Cruz-Monterey Area, showed that irrigated lands in the area totaled about 21,400 acres, while approximately 23,200 acres were dry farmed or fallow. Most of these lands are situated within the Pajaro Unit. Principal irrigated crops, in order of acreages devoted to each crop, were lettuce, apples, sugar beets, tomatoes, and truck. Principal dry-farmed crops were orchard and grain.

Industry in the Santa Cruz-Monterey Area is supported largely by agricultural production, and consists chiefly of the processing and packing of fruit, vegetables, meat, and dairy products. Several plants for dehydrating, freezing, and canning fruits and vegetables are located in the vicinity of Watsonville and Watsonville Junction. A tannery and important commercial fishing enterprises are located at Santa Cruz. Lumber mills are active in the central and northwest portion of Santa Cruz County. A portland cement plant is located at Davenport, sand quarries near Felton, and a granite rock quarry at Pajaro Gap. Exploratory drilling for oil and gas is under way in the area.

(Photo, State Division of Beaches and Parks)

Swanton Natural Bridges Beach, North Coastal Unit

CHAPTER II
WATER SUPPLY

The major source of water supply of the Santa Cruz-Monterey Area is direct precipitation on lands within its boundaries. The only substantial portion of the water supply originating outside the area is the flow of the Pajaro River, which river traverses the floor of Pajaro Valley from east to west, discharging into Monterey Bay. The water supply of the area is considered and evaluated in this chapter under the general headings "Precipitation," "Runoff," "Underground Hydrology," and "Quality of Water."

The following terms are used as defined in connection with the discussion of water supply in this report:

Annual—This refers to the 12-month period from January 1st of a given year through December 31st of the same year, sometimes termed the "calendar year."

Seasonal—This refers to any 12-month period other than the calendar year.

Precipitation Season—The 12-month period from July 1st of a given year through June 30th of the following year.

Runoff Season—The 12-month period from October 1st of a given year through September 30th of the following year.

Investigational Seasons—The three runoff seasons of 1946-47, 1947-48, and 1948-49, during which most of the field work on the Santa Cruz-Monterey Counties Investigation was performed.

Mean Period—A period chosen to represent conditions of water supply and climate over a long series of years.

Mean—This is used in reference to arithmetical averages relating to mean periods.

Average—This is used in reference to arithmetical averages relating to periods other than mean periods.

In studies for the current State-wide Water Resources Investigation, it was determined that the 50 years from 1897-98 to 1946-47, inclusive, constituted the most satisfactory period for estimating mean seasonal precipitation generally throughout California. Similarly, the 53-year period from 1894-95 to 1946-47, inclusive, was selected for determining mean seasonal runoff. In studies for the Santa Cruz-Monterey Area, these periods were considered representative of mean conditions of water supply and climate.

PRECIPITATION

The Santa Cruz-Monterey Area lies within the path of storms which periodically sweep inland from the North Pacific during winter months. Rainfall resulting from these storms ranges from moderate to heavy, and direct precipitation provides a substantial portion of the water supply of the area.

Precipitation Stations and Records

Twenty-three precipitation stations in the Santa Cruz-Monterey Area have unbroken records of 10 years duration or longer. These stations are fairly well distributed areally and their records were sufficient to provide an adequate pattern of precipitation. Locations of the stations are shown on Plate 3, entitled "Lines of Equal Mean Seasonal Precipitation." The stations with their map reference numbers are listed in Table 1, together with elevations of the stations, periods and sources of record, mean seasonal precipitation, and maximum and minimum seasonal precipitation. The map reference numbers for 12 of the stations correspond to those utilized in State Water Resources Board Bulletin No. 1, "Water Resources of California." New map reference numbers were assigned to the remaining stations listed, and are so designated by the prefix "SCM." Hitherto unpublished records of monthly precipitation at these 12 stations are presented in Appendix C. In those instances where it was necessary, precipitation records were extended to cover the 50-year mean period by comparison with records of nearby stations having records covering this period.

Precipitation Characteristics

The general precipitation pattern in the Santa Cruz-Monterey Area is irregular, as indicated on Plate 3, thus making it erroneous to consider any one station as representative of rainfall over the area. However, a comparison of records showed seasonal rainfall at Watsonville to be a suitable index of general precipitation over the Pajaro Unit. Similarly, seasonal precipitation at Santa Cruz was considered to be a representative index of general precipitation over the North Coastal, San Lorenzo, and Soquel Units. Records of precipitation at Santa Cruz and Watsonville are available since 1878-79 and 1880-81, respectively. Recorded seasonal precipitation at these stations is presented in Table 2. Seasonal precipitation at Santa Cruz is shown graphically on Plate 4, entitled "Recorded Seasonal Precipitation at Santa Cruz."

TABLE 1

MEAN, MAXIMUM, AND MINIMUM SEASONAL PRECIPITATION AT SELECTED STATIONS IN OR NEAR SANTA CRUZ-MONTEREY AREA

Map reference number	Station	Elevation, in feet	Period of record	Source of record	Mean seasonal precipitation, in inches	Maximum and minimum seasonal precipitation	
						Season	Inches
	North Coastal Unit						
3-2	Big Creek No. 2	1,230	1897-1948	USWB	41.68	1940-41 1897-98	74.40 16.92
SCM-1	Davenport	60	1910-1952	Private	27.94	1940-41 1923-24	61.02 9.77
	San Lorenzo Unit						
3-3	Boulder Creek	470	1888-1932	USWB	50.32	1889-90 1923-24	123.65 20.15
3-4	Brookdale, Booth	550	1924-1938	Private	50.83	1937-38 1930-31	80.58 24.64
3-5	Ben Lomond	500	1899-1952*	USWB	49.59	1940-41 1938-39	100.18 27.67
3-6	Felton	275	1888-1938*	USWB	44.21	1889-90 1917-18	100.64 19.26
3-15	Santa Cruz	20	1878-1952	USWB	28.24	1940-41 1923-24	61.62 10.85
	Soquel Unit						
3-7	Laurel	910	1891-1937	USWB	48.08	1913-14 1917-18	75.24 19.32
3-8	Soquel Creek	330	1929-1952	Private	32.79	1940-41 1930-31	69.90 19.05
SCM-2	Day	475	1935-1952*	Private	31.30	1940-41 1938-39	54.68 19.81
SCM-3	Valencia	375	1931-1952	Private	31.77	1940-41 1938-39	57.25 19.56
3-16	Aptos	102	1885-1915	USWB	26.72	1889-90 1897-98	49.07 11.51
SCM-4	Aptos-Beth Mar Nursery	50	1928-1952	Private	29.75	1940-41 1930-31	53.65 15.18
	Pajaro Unit						
SCM-5	Bean Hill	1,175	1926-1941	Private	38.80	1940-41 1930-31	62.73 20.88
SCM-6	Eureka Canyon No. 1	1,000	1929-1942	Private	40.91	1940-41 1930-31	68.70 23.03
3-9	Selleck Ranch	297	1918-1948	Private	32.70	1940-41 1923-24	59.30 10.90
SCM-7	Eureka Canyon No. 2	590	1926-1941	Private	33.69	1940-41 1930-31	56.07 16.23
SCM-8	Mt. Madonna-Arano	1,610	1935-1952	Private	31.06	1950-51 1949-50	55.43 19.11
3-0126	Highland	1,350	1940-1952*	USWB	44.09	1950-51 1946-47	62.84 33.51
SCM-9	Hitching's Ranch	550	1935-1952	Private	29.93	1940-41 1946-47	52.43 17.74
3-17	Watsonville	23	1880-1952	Private	20.82	1889-90 1923-24	44.90 8.11
SCM-10	McGrath Ranch	150	1928-1952*	Private	26.28	1940-41 1930-31	44.64 12.80
SCM-11	Larkin Valley	200	1926-1941*	Private	26.46	1940-41 1938-39	43.59 17.54

* Broken record.
USWB—United States Weather Bureau.

TABLE 2

RECORDED SEASONAL PRECIPITATION AT SANTA CRUZ AND WATSONVILLE

(In inches)

Season	Santa Cruz	Watsonville	Season	Santa Cruz	Watsonville	Season	Santa Cruz	Watsonville
1878-79	22.11	-----	1904-05	35.88	24.69	1930-31	13.15	11.02
			05-06	32.26	23.58	31-32	27.45	24.50
1879-80	18.22	-----	06-07	35.85	37.41	32-33	21.65	15.20
80-81	30.64	18.62	07-08	23.47	14.00	33-34	18.25	12.49
81-82	22.83	15.26	08-09	41.63	31.99			
82-83	19.62	13.82				1934-35	29.52	19.87
83-84	30.68	21.20	1909-10	31.25	22.04	35-36	32.91	22.09
			10-11	33.50	28.19	36-37	34.57	26.38
1884-85	16.50	12.73	11-12	19.86	16.73	37-38	42.71	25.97
85-86	32.75	27.00	12-13	14.09	10.79	38-39	20.02	14.71
86-87	17.17	12.85	13-14	34.65	30.61			
87-88	22.91	15.13				1939-40	44.75	24.14
88-89	23.35	14.97	1914-15	42.42	31.49	40-41	61.62	36.59
			15-16	29.57	26.73	41-42	42.15	24.80
1889-90	54.68	44.90	16-17	19.17	18.02	42-43	39.57	20.82
90-91	19.21	20.03	17-18	12.03	11.65	43-44	27.39	18.55
91-92	24.43	17.18	18-19	27.71	23.50			
92-93	34.89	27.64				1944-45	33.19	21.63
93-94	29.90	20.50	1919-20	20.85	18.82	45-46	30.11	18.66
			20-21	29.39	22.78	46-47	19.21	13.28
1894-95	39.91	37.29	21-22	28.73	23.94	47-48	24.57	17.84
95-96	21.90	23.97	22-23	27.47	16.27	48-49	29.90	15.76
96-97	28.77	23.74	23-24	10.85	8.11			
97-98	12.49	12.48				1949-50	31.22	19.36
98-99	25.04	23.45	1924-25	30.20	21.75	50-51	38.67	23.62
			25-26	26.17	18.37			
1899-1900	28.43	19.88	26-27	29.15	24.28	Average for period of record	28.04	20.91
00-01	26.27	24.95	27-28	22.10	14.92			
01-02	29.35	21.35	28-29	17.25	14.40			
02-03	26.70	18.54				Mean	28.24	20.82
03-04	28.40	18.31	1929-30	21.47	16.45			

Precipitation in the Santa Cruz-Monterey Area consists almost entirely of rainfall. The small amount of snowfall at higher elevations melts rapidly and has little effect in retarding runoff. Precipitation, which is lowest near the coast, increases rapidly with rise in elevation to a seasonal average of more than 50 inches along the crest of the Santa Cruz Mountains. Rainfall also varies along the coast, ranging from less than 20 inches seasonally south of Watsonville to more than 27 inches north of Santa Cruz.

Precipitation varies over wide limits from season to season, ranging from less than 40 percent of the seasonal mean to more than 200 percent. Maximum recorded seasonal precipitation at Santa Cruz occurred in 1940-41 when 61.62 inches of rain fell. Minimum recorded precipitation at this station occurred in 1923-24, with only 10.85 inches recorded. Long-term trends in precipitation in the Santa Cruz-Monterey Area are indicated on Plate 5, entitled "Accumulated Departure From Mean Seasonal Precipitation at Santa Cruz."

Nearly 90 percent of the mean seasonal precipitation in the Santa Cruz-Monterey Area occurs during the six months from November through April, and summers are dry. Mean monthly distribution of precipitation as recorded at Santa Cruz is presented in Table 3.

The maximum recorded 24-hour precipitation for each month of the season at Ben Lomond, Santa Cruz,

TABLE 3

MEAN MONTHLY DISTRIBUTION OF PRECIPITATION AT SANTA CRUZ

Month	Precipitation		Month	Precipitation	
	In inches	In percent of seasonal total		In inches	In percent of seasonal total
July	0.03	0.1	January	5.80	20.6
August	0.03	0.1	February	5.24	18.6
September	0.49	1.7	March	4.12	14.6
October	1.41	5.0	April	1.87	6.6
November	2.69	9.5	May	0.98	3.5
December	5.35	18.9	June	0.23	0.8
			TOTALS	28.24	100.0

and Watsonville is presented in Table 4. It will be noted in this table that 11.66 inches of precipitation fell during a 24-hour period at Ben Lomond in February of 1945.

Quantity of Precipitation

Determination of seasonal quantity of precipitation in the Santa Cruz-Monterey Area was limited to the Pajaro Unit. As is discussed later in this chapter, this was the only unit for which determinations of safe

TABLE 4

MAXIMUM 24-HOUR PRECIPITATION IN SANTA CRUZ-MONTEREY AREA

(In inches)

Month	Ben Lomond	Santa Cruz	Watsonville
July	0.27 (1913)	0.53 (1936)	0.30 (1913)
August	0.30 (1904)	0.69 (1935)	0.75 (1935)
September	3.00 (1904)	3.20 (1918)	3.36 (1918)
October	4.30 (1899)	3.15 (1899)	1.53 (1911)
November	6.70 (1903)	5.06 (1942)	4.00 (1900)
December	9.04 (1937)	4.56 (1942)	5.20 (1906)
January	8.97 (1943)	4.26 (1940)	2.60 (1916)
February	11.66 (1945)	5.01 (1945)	3.49 (1927)
March	7.02 (1904)	4.16 (1940)	2.96 (1899)
April	5.75 (1941)	3.75 (1923)	2.14 (1901)
May	4.38 (1906)	1.90 (1925)	1.95 (1905)
June	2.89 (1899)	0.98 (1934)	1.02 (1899)

ground water yield and overdraft were made, both determinations requiring an estimate of the quantity of precipitation. The mean seasonal total quantity of precipitation on the Pajaro Unit was estimated by plotting recorded or estimated mean seasonal depth of precipitation at stations in or near the Pajaro Unit on a map. Lines of equal mean seasonal precipitation, or isohyets, were then drawn, as shown on Plate 3. By multiplying the planimetered areas between these isohyets, in acres, by the average depths of precipitation between these isohyets, in feet, the total quantity of precipitation, in acre-feet, was determined.

In order to determine seasonal quantities of precipitation during the investigational seasons, similar isohyetal maps depicting amounts of precipitation during these seasons were prepared and planimetered. The results of these estimates for the investigational seasons and mean period are presented in Table 5, which also presents the estimated total quantities of precipitation on the valley floor and tributary drainage area subdivisions of the Pajaro Unit. The precipitation index for each of the investigational seasons is also shown in Table 5. The term "precipitation index" refers to the ratio of the amount of precipitation during a given season to the mean seasonal amount, and is expressed as a percentage.

TABLE 5

ESTIMATED TOTAL QUANTITY OF SEASONAL PRECIPITATION ON PAJARO UNIT

Season	Precipitation index	Quantity of precipitation, in acre-feet		
		Valley floor	Tributary drainage area	Total
1946-47	69	42,000	75,000	117,000
1947-48	81	52,000	86,000	138,000
1948-49	74	48,000	78,000	126,000
Mean	100	68,000	102,000	170,000

RUNOFF

The Pajaro River is the only stream contributing substantial surface inflow to the Santa Cruz-Monterey Area. In terms of seasonal runoff, the Pajaro River is the largest of the several major streams in the area. However, under present development, it flows through Pajaro Valley with limited contribution to ground water or surface diversions, and in large part wastes to Monterey Bay. The San Lorenzo River and its tributaries consitute the second largest stream system in the Santa Cruz-Monterey Area, draining almost the entire San Lorenzo Unit, and discharging into the Pacific Ocean at Santa Cruz. Other important streams are Waddell, Scott, San Vicente, and Laguna Creeks in the North Coastal Unit, and Soquel and Aptos Creeks in the Soquel Unit. These streams are to a large extent unregulated and undeveloped, and are a potential source of water to meet future requirements in the Santa Cruz-Monterey Area.

Stream Gaging Stations and Records

Records of stream flow for the Santa Cruz-Monterey Area are few in number and short in length. The longest record is that for the San Lorenzo River at Big Trees, where a gaging station has been continuously maintained by the United States Geological Survey since 1936-37. The only other continuous record of more than five years duration is that for the Pajaro River near Chittenden, which extends back to 1938-39. Records on the remaining streams are confined chiefly to measurements made by the Division of Water Resources during the investigational seasons. For periods during which records were not available, estimates of runoff were made by correlation with flow of Coyote and Uvas Creeks in Santa Clara County, and Arroyo Seco in Monterey County, which have stream flow records of considerable length. Table 6 lists those stream gaging stations pertinent to the hydrography of the Santa Cruz-Monterey Area, together with their map reference numbers, drainage areas above stations, and periods and sources of records. These stations are also shown on Plate 3. The map reference numbers for eight of the stations listed correspond to those used in State Water Resources Board Bulletin No. 1, "Water Resources of California." New reference numbers with the prefix "SCM" were assigned to the remaining stations listed. Those records which have not been previously published by the United States Geological Survey are included in Appendix D.

Periodic and intermittent measurements of the flow of Laguna, Reggiardo, Majors, Liddell, and Branciforte Creeks, and several smaller streams and springs were made by the City of Santa Cruz during the 1921-22 season. These measurements were compiled and presented as basic data accompanying the "Third Report of the City Engineer on the Extension and Improvement of the City Water Supply," published by the City of Santa Cruz in 1922. Additional measurements of the flow of the five named creeks were made by the city during 1932, and with the exception of Liddell and Branciforte Creeks, again during 1941. The San Lorenzo Valley County Water District established measuring weirs on the San Lorenzo River at Waterman Switch and on Newell Creek near Ben Lomond in 1945, and has made periodic measurements at these stations to date. Additional weir measurements of the flow of Kings, Boulder, Fall, and Bear Creeks were made periodically by the district during the period from 1945 through 1948. The Santa Cruz Portland Cement Company has made intermittent measurements of the flow of San Vicente Creek during the period from 1946 to 1951. All of these measurements, with the exception of those published by the City of Santa Cruz for the 1921-22 season, are included in Appendix D.

Runoff Characteristics

Surface runoff from any watershed may be considered under one of two general classifications—either "natural flow" or "impaired flow." The term "natural flow" refers to the flow of a stream as it would be if unaltered by upstream diversion, storage, import, export, or change in consumptive use caused by modification of land use. The term "impaired flow" refers to the actual flow of a stream with any given stage of upstream development.

Runoff originating within the Santa Cruz-Monterey Area closely approaches natural flow. There exist a few small storage reservoirs in the area, but these have little effect on the total quantity of seasonal runoff. There are no importations or exports. Direct diversions of water from streams are generally small, and in the aggregate have little effect on the total seasonal runoff. However, they considerably reduce summer flow during dry seasons.

TABLE 6

STREAM GAGING STATIONS IN OR NEAR SANTA CRUZ-MONTEREY AREA

Map reference number	Stream	Location	Drainage area, in square miles	Period of record	Source of record
	North Coastal Unit				
3-3	Scott Creek	near Davenport	30	1936-37 1938-41	USGS USGS
2-18	Laguna Creek	at State Highway No. 1	7.9	1936-37	USGS
	San Lorenzo Unit				
SCM-1	San Lorenzo River	at Waterman Switch	6.1	1948-50	DWR
SCM-2	Zayante Creek	at Sepz's House	17	1948-49	DWR
3-1	San Lorenzo River	at Big Trees	111	1937-52	USGS
3-2	Branciforte Creek	at Santa Cruz	17	1940-43	USGS
	Soquel Unit				
SCM-3	Soquel Creek	at junction with West Branch	32	1948-50	DWR
3-4	Soquel Creek	at Soquel	39	1936-37 1949-50	USGS DWR
3-5	Aptos Creek	at Aptos	10	1936-37	USGS
	Pajaro Unit				
3-19	Corralitos Creek	at Corralitos	19	1936-37 1946-50	USGS DWR
SCM-4	Casserly Creek	near Casserly Store	6.5	1946-49	DWR
SCM-5	Green Valley Creek	at Connell Road	4.0	1948-49	DWR
3-18	Pajaro River	near Chittenden	1,187	1939-52	USGS
SCM-6	Pajaro River	at McGowan Ranch	1,279	1946-48	DWR

USGS—United States Geological Survey.
DWR—Division of Water Resources.

(Photo, State Division of Beaches and Parks)

Big Basin Redwoods, San Lorenzo Unit

The flow of the Pajaro River as it enters the Santa Cruz-Monterey Area is substantially impaired. The present impairments above the gaging station near Chittenden include utilization of ground water, minor diversion of surface water, and regulation by small reservoirs.

Based upon a comparison of stream flow records, the discharge of the San Lorenzo River at Big Trees was considered characteristic of runoff in other streams originating in the Santa Cruz-Monterey Area. The measured and estimated seasonal runoff at this station for the period from 1894-95 through 1950-51 is presented in Table 7, and depicted graphically on Plate 6, entitled "Recorded and Estimated Seasonal Runoff of San Lorenzo River at Big Trees." The runoff index of each season is also presented in Table 7. The term "runoff index" refers to the ratio of the amount of runoff during a given season to the mean seasonal amount, and is expressed as a percentage.

TABLE 7

RECORDED AND ESTIMATED SEASONAL RUNOFF OF SAN LORENZO RIVER AT BIG TREES

Season	Runoff index	Runoff, in acre-feet	Season	Runoff index	Runoff, in acre-feet
1894-95	216	226,000	1924-25	43	45,100
95-96	146	153,000	25-26	107	112,000
96-97	144	151,000	26-27	122	128,000
97-98	16	16,500	27-28	59	61,600
98-99	60	62,700	28-29	39	40,700
1899-1900	70	73,200	1929-30	43	45,100
00-01	151	158,000	30-31	10	11,000
01-02	80	83,600	31-32	108	113,000
02-03	101	106,000	32-33	20	20,400
03-04	56	58,300	33-34	55	57,200
1904-05	86	89,700	1934-35	72	75,400
05-06	160	168,000	35-36	95	99,200
06-07	252	264,000	36-37	73	76,200
07-08	70	73,700	37-38	176	184,000
08-09	203	213,000	38-39	22	23,000
1909-10	77	80,900	1939-40	165	173,000
10-11	205	215,000	40-41	253	265,000
11-12	29	30,800	41-42	151	158,000
12-13	13	13,200	42-43	114	119,000
13-14	220	230,000	43-44	46	48,600
1914-15	165	173,000	1944-45	83	87,200
15-16	202	212,000	45-46	61	63,500
16-17	130	136,000	46-47	28	29,200
17-18	55	57,500	47-48	30	31,800
18-19	68	71,500	48-49	58	61,100
1919-20	43	45,100	1949-50	53	55,900
20-21	80	83,600	50-51	126	131,900
21-22	147	154,000			
22-23	96	101,000	Mean	100	104,700
23-24	13	13,200			

NOTE: Runoff estimated for seasons prior to 1937-38.

Long-time trends of seasonal runoff considered typical of those for the Santa Cruz-Monterey Area are indicated on Plate 7, "Accumulated Departure From Mean Seasonal Runoff of San Lorenzo River at Big Trees." Average monthly distribution of runoff of the San Lorenzo River at Big Trees, based on the period of record from 1936-37 through 1950-51, is presented in Table 8.

TABLE 8

AVERAGE MONTHLY DISTRIBUTION OF RECORDED RUNOFF OF SAN LORENZO RIVER AT BIG TREES

(For period 1936-37 through 1950-51)

Month	Runoff, in acre-feet	Percent of seasonal total
October	1,400	1.4
November	2,100	2.1
December	7,500	7.3
January	16,500	16.1
February	28,400	27.8
March	21,400	20.9
April	12,900	12.6
May	5,000	4.9
June	2,800	2.7
July	1,800	1.8
August	1,300	1.3
September	1,100	1.1
TOTALS	102,200	100.0

The flow of streams in the Santa Cruz-Monterey Area, other than that of the Pajaro River, is flashy in nature, rising and falling rapidly during and immediately following a storm. This characteristic reflects the intensity of rainfall, relatively small drainage areas, and lack of works retarding flow. The flow of the Pajaro River near Chittenden, however, shows the effects of its large drainage area and upstream impairments, both of which tend to reduce peak flows and extend the duration of runoff. These runoff characteristics are indicated by hydrographs of the San Lorenzo River at Big Trees and of the Pajaro River near Chittenden for the flood of November 16-23, 1950. The two hydrographs, together with the simultaneous hourly precipitation record at Highland, appear on Plate 8, entitled "Runoff Characteristics of San Lorenzo and Pajaro Rivers as Related to Precipitation at Highland, Flood of November, 1950." The precipitation station at Highland was utilized in this comparison since it was the only station at which hourly records were available for this storm. Flow past each station has been expressed in second-feet per square mile of drainage area for comparative purposes.

Quantity of Runoff

Available records of stream flow, including those obtained from measurements made in connection with the investigation, were sufficient to permit estimates of the amount of runoff in the Santa Cruz-Monterey Area. However, the records are so short and the coverage so limited that the estimates may be subject to some error, and should be considered tentative until confirmed by additional future records.

For purposes of required hydrographic and hydrologic analysis, the quantity of runoff in streams of the North Coastal, San Lorenzo, and Soquel Units was considered separately from that in streams of the Pajaro Unit. As has been stated, a major portion of surface inflow to the Pajaro Unit originates from outside the Santa Cruz-Monterey Area, there being nearly 1,200 square miles of drainage area tributary to the Pajaro River near Chittenden. On the other hand, streams of the other units originate within the boundaries of the investigational area and discharge directly into the ocean.

In general, mean seasonal runoff of streams of the Santa Cruz-Monterey Area was estimated from available records, and from correlation with runoff of nearby streams having records over longer periods. Estimates of mean seasonal runoff of the San Lorenzo River, Soquel Creek, and Branciforte Creek were taken from State Water Resources Board Bulletin No. 1. These figures were computed by extending the periods of record back over the remaining seasons of the 53-year mean period by correlation with the recorded runoff of Coyote Creek near Madrone in Santa Clara County and Arroyo Seco near Soledad in Monterey County. Mean seasonal runoff of Scott Creek was estimated by correlation with the San Lorenzo River, while that of remaining streams in the North Coastal Unit was estimated by correlation with Scott Creek. Mean seasonal runoff of Aptos Creek was estimated by correlation with Uvas Creek near Morgan Hill in Santa Clara County. Mean seasonal runoff from unmeasured areas in the San Lorenzo and Soquel Units was estimated from studies of precipitation and consumptive use of vegetation on those areas. The results of the estimates for streams of the North Coastal, San Lorenzo, and Soquel Units are presented in Table 9.

Inflow to the valley floor of the Pajaro Unit was measured during the period of investigation from 1946-47 through 1948-49. Mean seasonal runoff of the Pajaro River near Chittenden was estimated by extending the period of record back to 1894-95. This was done by correcting the seasonal full natural flow, as published in Bulletin No. 1, by the estimated seasonal impairment above Chittenden. Mean seasonal runoff of Corralitos, Casserly, and Green Valley Creeks was estimated by correlation with the Arroyo Seco in Monterey County.

Surface outflow from the Pajaro Unit was partially measured and partially estimated during the investigational seasons. A station on Pajaro River four miles above its mouth was maintained during 1946-47 and 1947-48, but was abandoned after a flood control construction project changed the control of the station. It was necessary to estimate unmeasured outflow from the Watsonville Slough area north of the Pajaro River on the basis of intermittent observations during the investigation. Mean seasonal outflow from the Pajaro Unit was estimated both from records obtained during the investigation, and from hydrologic studies which are discussed later in this chapter.

TABLE 9

ESTIMATED MEAN SEASONAL RUNOFF FROM NORTH COASTAL, SAN LORENZO, AND SOQUEL UNITS

Stream	Drainage area, in square miles	Runoff, in acre-feet
North Coastal Unit		
Waddell Creek, at mouth	22	17,200
Scott Creek, near Davenport	30	23,400
San Vicente Creek, at mouth	12	9,100
Laguna Creek, at State Highway No. 1	8	6,100
Remainder of unit	39	29,900
Subtotals	111	85,700
San Lorenzo Unit		
San Lorenzo River, at Big Trees	111	104,700
Branciforte Creek, at Santa Cruz	17	15,400
Remainder of unit	21	5,000
Subtotals	149	125,100
Soquel Unit		
Soquel Creek, at Soquel	39	45,500
Aptos Creek, at Aptos	10	7,800
Remainder of unit	35	11,000
Subtotals	84	64,300
TOTAL		275,100

TABLE 10

MEASURED AND ESTIMATED SEASONAL SURFACE INFLOW TO AND OUTFLOW FROM VALLEY FLOOR OF PAJARO UNIT

(In acre-feet)

Stream	Gaging station	1946-47	1947-48	1948-49	Mean
Inflow					
Corralitos Creek	at Corralitos	1,250	2,310	4,790	9,500
Casserly Creek	near Casserly Store	290	220	660	2,400
Green Valley Creek	at Connell Road	500	400	1,400	1,500
Pajaro River	near Chittenden	21,500	7,300	24,100	150,000
TOTALS		23,540	10,230	30,950	163,400
Outflow					
Pajaro River	4 miles above mouth	13,800	12,700	30,000*	167,000
Unmeasured outflow*		19,000	16,000	17,000	30,000
TOTALS		32,800	28,700	47,000	197,000

* Estimated.

Measured and estimated seasonal surface inflow to and outflow from the valley floor of the Pajaro Unit during the investigational seasons, as well as the estimated mean seasonal values, are presented in Table 10. It will be noted that surface outflow from the valley floor exceeds inflow. This difference may be attributed in part to return flow from unconsumed applied irrigation water and to precipitation on the valley floor.

UNDERGROUND HYDROLOGY

Detailed studies of underground hydrology in the Santa Cruz-Monterey Area were limited to the Pajaro Unit which overlies the only ground water basin of major extent and yield. Preliminary examination and study revealed that the relatively small yield of ground water obtainable from Soquel Valley and other minor ground water basins along the coastal strip would be of little importance in meeting probable ultimate water requirements of those areas. For this reason the ensuing discussion of underground hydrology is largely limited to the Pajaro Unit, although certain small ground water basins in the North Coastal, San Lorenzo, and Soquel Units are briefly described.

The term "free ground water," as used in this bulletin, generally refers to a body of ground water not overlain by impervious materials, and moving under control of the water table slope. The term "confined ground water," as used herein, refers to a body of ground water overlain by material sufficiently impervious to sever free hydraulic connection with overlying water, and moving under pressure caused by the difference in head between intake and discharge areas of the confined water body. In connection with confined ground water, a free ground water body usually serves as a "forebay" or "intake" to the confined water body and serves as its source of replenishment. In areas of free ground water, the ground water basin provides regulatory storage to smooth out fluctuations in available water supplies, and changes in ground water storage are indicated by changes in ground water levels.

Studies hereinafter described indicate that the ground water basin underlying the Pajaro Unit includes two more or less distinct confined ground water bodies, generally beneath the valley floor, together with a free ground water body, beneath the mountain and bench lands adjacent to the valley floor, that serves as a forebay to the confined ground water. Another free ground water body overlies the confined ground water under the floor of Pajaro Valley. It was found that the confined ground water bodies supply nearly all the water for irrigated lands in the unit and a substantial portion of the water utilized by the City of Watsonville for municipal purposes.

The first step in investigation and study of the ground water hydrology of the Pajaro Unit was a determination of the nature and extent of the free and confined ground water bodies. The next step was a determination of fluctuations in ground water levels throughout the unit. This was necessary in order to evaluate behavior of the free and confined ground water bodies under various conditions of draft and replenishment. Since the forebay is the principal source of water for the economically important confined ground water, the adequacy of the water supply available to the forebay was next determined. This step included evaluation of change in ground water storage in the forebay under various conditions of water supply with present conditions of draft. Finally, it was necessary to determine the adequacy of the confined aquifers to convey water available in the forebay to wells in the valley floor. This final determination permitted an evaluation of safe yield of the Pajaro Unit under stated hydrologic and economic conditions.

Underground hydrology is discussed in this section under the following headings: "Ground Water Zones in Pajaro Unit," "Ground Water Levels in Pajaro Unit," "Safe Ground Water Yield of Pajaro Unit," and "Ground Water Basins in North Coastal, San Lorenzo, and Soquel Units."

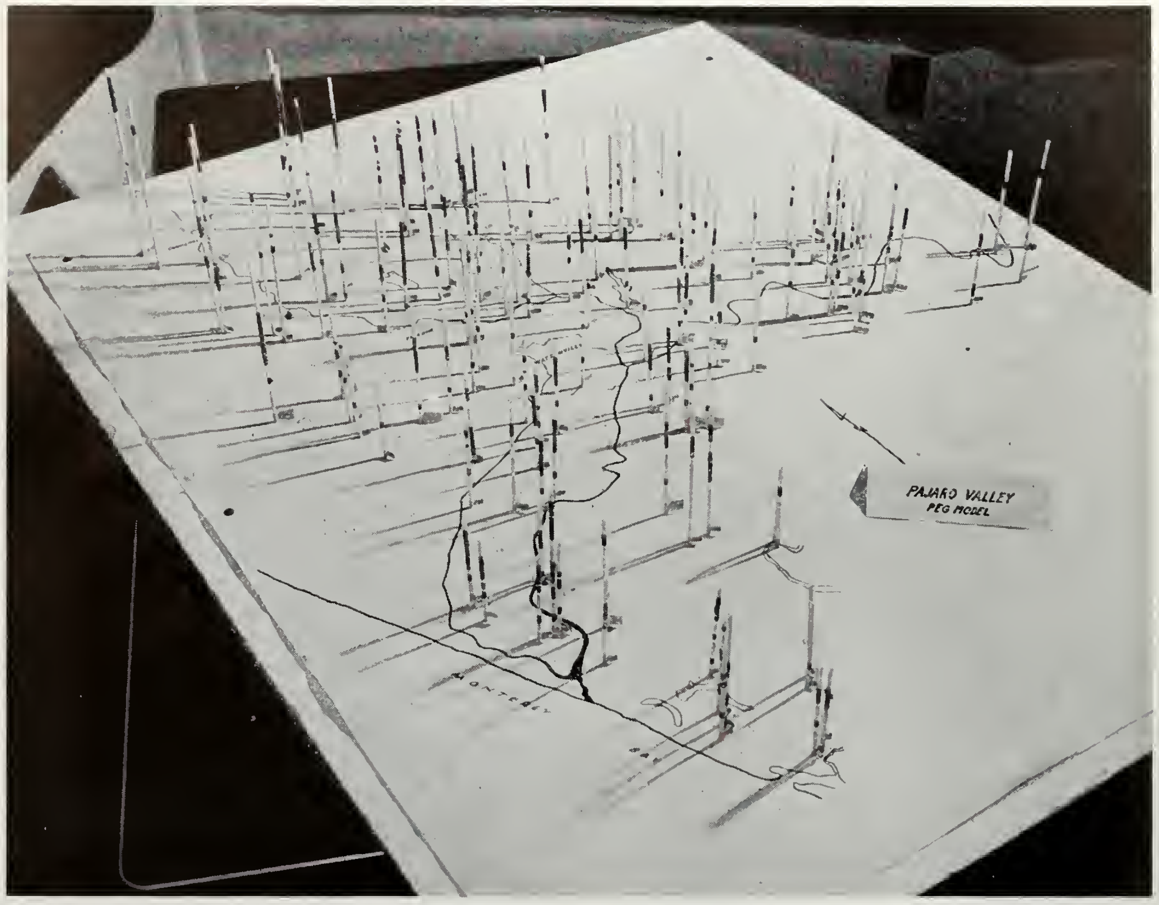
Ground Water Zones in Pajaro Unit

For purposes of hydrologic analysis it was necessary to divide the Pajaro Unit into forebay and pressure zones. This division of the alluvium into ground water zones was based on the results of a geologic survey and on observed ground water behavior.

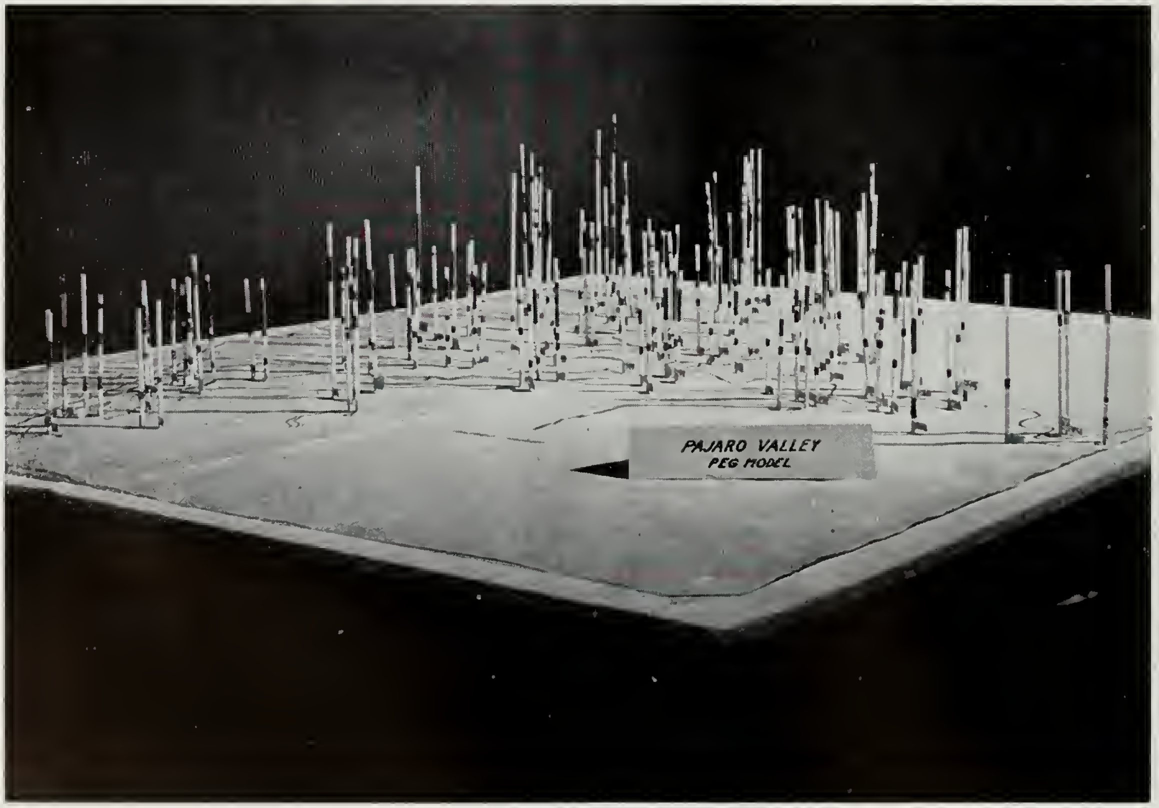
The geologic survey, which is reported in detail in Appendix B, included a determination of the contact of the alluvium of Pajaro Valley with the surrounding highlands, and study of water-bearing formations. The sediments that comprise the principal fill of Pajaro Valley were laid down late in the Quaternary period, and consist of both stream-laid and marine deposits. Important members of the late Quaternary fill are blue clay deposits which overlie and act as confining strata to the primary aquifers of the pressure zones in Pajaro Valley.

A peg model showing locations of approximately 180 wells for which logs were available was constructed to a horizontal scale of one inch equals 1,320 feet and a vertical scale of one inch equals 60 feet. Thickness and elevation of blue clay strata, and elevations of the ground surface and the bottom of the well were depicted on each peg. It was noted from the peg model that the blue clay strata appear to be continuous under most of the valley floor, indicating confinement of aquifers lying below them. Photographs of the peg model are shown on the illustration entitled "Well Log Peg Model, Pajaro Valley."

Water stage recorders were installed and maintained on the following 12 unused wells in the Pajaro Unit to aid in the delineation of zones of confined and free ground water: 11S/1E-24R2, 11S/2E-25E3, 11S/2E-



Looking Northeast From Monterey Bay



Looking Northwest From Bluff Southeast of Watsonville

Well Log Peg Model, Pajaro Valley

33B2, 11S/2E-33F2, 11S/2E-33K1, 12S/1E-25A3, 12S/1E-25H1, 12S/2E-9H1, 12S/2E-16A1, 12S/2E-18J1, 12S/3E-5L1, 12S/3E-6L3. The resulting hydrographs, or graphical representations of the fluctuation of water levels over a period of time, served to indicate whether the wells tapped confined or free ground water. In wells tapping confined aquifers the water stands at the level of the piezometric surface, that is, at the level resulting from the pressure in the aquifers. A typical hydrograph from an unused well in a pressure area characteristically shows a sharp drop in water surface elevation, or pressure relief, immediately after a nearby pumping well starts operating. Similarly, a sharp recovery is observed immediately after the nearby pump is shut off. The daily cycle of such a hydrograph reflects the variation in local pumping draft throughout the day. Maximum recovery usually occurs early in the morning before irrigation pumps start operating, and maximum pressure relief usually occurs late in the afternoon just before irrigation pumping ceases for the day. The daily recovery of pressure head approaches the maximum reached the previous day. This pattern is illustrated on Plate 9, entitled "Fluctuation of Piezometric Surface of Confined Aquifers at Well 12S/1E-25A3."

Another distinguishing characteristic of pressure areas is that water levels rise abruptly after pumping ceases in the fall, with the result that levels measured at that time should be higher than those measured during the summer when pumping is heavy. In contrast, water levels in free ground water areas are generally at their lowest levels in the fall. The map shown as Plate 10, entitled "Lines of Equal Change in Ground Water Elevations in Pajaro Unit, Summer of 1947 to Fall of 1947," indicates in which portions of the Pajaro Unit water levels receded from summer to fall, indicating free ground water conditions, and in which portions it rose, indicating pressure zones.

Based on the foregoing analyses, the Pajaro Unit was divided into the three ground water zones shown on Plate 11, entitled "Ground Water Zones in Pajaro Unit." These zones were designated (1) Forebay Zone, (2) Upper Pressure Zone, and (3) Valley Floor Pressure Zone.

Forebay Zone. Studies indicate that ground water recharge in the Pajaro Unit occurs on the mountain and bench lands west of the San Andreas fault, which lands roughly encircle the floor of Pajaro Valley and constitute a forebay to the confined aquifers underlying the valley floor. The greatest amount of recharge to the confined aquifers stems from the northern portion of the Forebay Zone which is drained on the surface by Corralitos, Brown, Green Valley, and Casserly Creeks. This area is generally underlain by Pliocene Purisima gravels and sands, most of which are sufficiently permeable to permit deep penetration of a high percentage of unconsumed precipitation. Data obtained from the small number of pumped wells tapping the Purisima and other formations of the Forebay Zone indicate that these formations possess free ground water characteristics.

The slope of the Santa Cruz Mountains on the easterly side of the Pajaro Unit and west of the San Andreas fault, as well as the coalescing alluvial fans at the base of the mountains, comprises a second although less important part of the Forebay Zone. Precipitation is from moderate to heavy in this area and stream runoff is light, indicating substantial percolation of unconsumed precipitation.

It is indicated that the San Andreas fault provides an effective barrier against ground water percolation from the higher mountain slopes. However, ground water rises along the fault, flows over the barrier, and contributes to the Forebay Zone lying to the west.

The Aromas red sands formation which bounds Pajaro Valley on the south constitutes the remainder of the Forebay Zone. Because precipitation on this area is moderate, contribution to the Valley Floor Pressure Zone is probably relatively small. Areas of recharge in this formation lie west of Aromas and northwest of Springfield School.

Studies indicate that ground water levels in the Forebay Zone are higher than the levels to which water rises in wells in the pressure zones. It is this differential in head which causes ground water replenishment from the Forebay Zone to the confined aquifers lying beneath the valley floor.

Upper Pressure Zone. The Upper Pressure Zone is situated beneath the valley floor of the Pajaro Unit, lies generally along Corralitos Creek from Corralitos to a line about two miles north of Watsonville, and varies in width from about one to nearly four miles. It is characterized by pressure aquifers which are overlain by unconfined ground water, and which are replenished from the Forebay Zone to the north. Presence of overlying unconfined ground water is indicated by the fact that the few shallow wells that do not pierce the confining blue clay strata have free ground water characteristics. The unconfined ground water body is apparently replenished by percolation of stream flow as well as from direct precipitation and unconsumed irrigation water. The free ground water table generally stands about 50 feet higher than the piezometric water levels in the confined aquifers. Yields from wells perforated in the unconfined ground water are neither as large nor as reliable as from those in the pressure aquifers. Several wells are perforated in both the free and confined aquifers.

Valley Floor Pressure Zone. The Valley Floor Pressure Zone is situated beneath the valley floor of the Pajaro Unit and extends from Monterey Bay on the west to approximately the base of the Santa Cruz Mountains on the east, and from the approximate southern boundaries of the Upper Pressure Zone and Forebay Zone on the north to the edge of the bluffs bordering Pajaro Valley on the south.

Nearly all of the water used on the floor of Pajaro Valley is pumped from one or possibly two underlying pressure aquifers. These aquifers are generally capped by impervious blue clay strata. Geologic studies indicate that the Recent alluvium constituting the northern two-thirds of the floor of Pajaro Valley is underlain by the Purisima formation, and the southern one-third is underlain by the Aromas sands which are, in turn, underlain by the Purisima formation. Both the Purisima and Aromas formations are water-bearing. Maximum depth of the valley fill is known to be as great as 600 feet.

The impervious clay strata capping the aquifers not only confine the water in the aquifers, but prevent percolation into the aquifers from either stream flow, precipitation, or unconsumed irrigation water on the valley floor. This condition has resulted in the existence of a free ground water body above the blue clay strata under a large portion of the Valley Floor Pressure Zone. However, wells of satisfactory yield have not been obtained from this body of free ground water, and it is of little importance as a source of supply to wells. It is important to crops where the water table is close enough to the ground surface to permit the capillary rise of water from the water table to reach the principal root zone of the crops.

Ground Water Levels in Pajaro Unit

Lowering of ground water levels in the Pajaro Unit was indicated in the early 1940's by the pumping of water containing high concentrations of chlorides from wells near Monterey Bay. It was suspected that the source of the chlorides was sea-water intrusion. Information indicates that this condition has become more severe with recent trends toward more intensive irrigation development.

As water levels necessarily were the principal basis for evaluating the ground water hydrology of the Pajaro Unit, considerable time was devoted to the location and measurement of wells. Wells were located in the field and as much data as possible relative to their depth, purpose, size of pump, and quantity and quality of discharge, were compiled. Differential levels were run to the wells to establish the elevations of the ground surface and reference point. Locations of those wells utilized in the studies are shown on Plate 12, entitled "Well Locations."

Wells were numbered by the system utilized by the United States Geological Survey, according to township, range, and section. Under this system each section is divided into 40-acre plots which are lettered as follows:

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

Wells are numbered within each of these 40-acre plots according to the order in which they are located. For example, a well having a number 12S/1E-25A2 would be found in Township 12 South, Range 1 East, and in Section 25. It would be further identified as the second well located in the 40-acre plot lettered A.

Series of measurements of depth to static ground water levels were made at approximately 330 wells in the Pajaro Unit in the spring and fall of each year during the period of investigation, beginning with the spring of 1947 and continuing through 1949. These spring and fall measurements were continued at about 180 wells through 1952. The measurement wells were chosen to form a comprehensive grid covering the entire valley floor. In addition, monthly measurements of depth to ground water were made at approximately 45 control wells during 1948-49, and a special series of midsummer measurements was made at all nonoperating wells in 1946-47 and 1948-49. The purpose of these monthly and midsummer measurements was to observe ground water behavior under varying rates of ground water draft. Records of these measurements are included in Appendix E.

Depths to confined ground water throughout the Pajaro Unit, measured in the fall of 1951, were plotted on a map and lines of equal depth drawn. These are shown on Plate 13, entitled "Lines of Equal Depth to Ground Water in Pajaro Unit, Fall of 1951." Plate 14, entitled "Lines of Equal Elevation of Ground Water in Pajaro Unit, Fall of 1951," was prepared from the data used for Plate 13, the depths to ground water being subtracted from ground surface elevations to obtain the elevations of the water in the wells.

Table 11 shows depths from ground surface to the ground water level at selected wells in each zone of the Pajaro Unit during the spring and fall of 1947, 1948, 1949, 1950, and 1951. The spring measurements were made after winter replenishment of the ground water, but before irrigation draft started, and the fall measurements were made following the summer period of irrigation pumping draft and prior to replenishment from winter rains. The cumulative change in ground water levels from the fall of 1947 to the fall of 1951 is shown on Plate 15, entitled "Lines of Equal Change in Ground Water Elevations in Pajaro Unit, Fall of 1947 to Fall of 1951."

TABLE 11

MEASURED DEPTH TO GROUND WATER AT REPRESENTATIVE WELLS IN PAJARO UNIT

Well number	Depth, in feet									
	1947		1948		1949		1950		1951	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Forebay Zone										
11S/2E- 8L1	168	170	170	174	174	176	177	180	171	178
11S/2E-15Q1	85	95	89	92	82	119	111	114	109	112
12S/3E- 9F1	50	51	51	53	50	57	50	59	52	52
12S/3E-16M2	19	21	21	23	22	33	28	33	21	23
Upper Pressure Zone										
11S/1E-12Q1	94	105	112	110	110	112	105	113	92	105
11S/1E-13G1	94	101	102	104	106	112	104	114	104	110
11S/1E-24J1	32	35	34	37	35	39	36	40	34	35
11S/2E-19D1	------	28	28	30	20	34	28	34	17	28
11S/2E-30L1	21	20	23	30	24	33	26	33	------	30
Valley Floor Pressure Zone										
11S/2E-21C1	161	172	170	173	171	178	------	178	174	170
11S/2E-28P1	68	72	70	74	70	81	73	76	79	75
11S/2E-31Q1	45	51	51	49	------	51	38	------	36	55
11S/2E-33B1	65	65	65	67	66	71	67	73	70	68
11S/2E-35K1	40	46	44	48	48	50	47	52	51	54
11S/2E-36P2	44	52	49	54	50	57	56	59	49	53
12S/1E-24G1	15	3.4	4.6	6.8	2.1	9.0	------	5.2	5.0	5.2
12S/2E- 1D3	28	34	32	36	34	38	37	39	31	35
12S/2E- 3J2	8	12	11	14	17	16	14	17	14	14
12S/2E- 7E1	62	63	65	------	62	66	65	66	64	68
12S/2E- 8K2	16	7	6	11	7	14	13	------	9	11
12S/2E- 9M1	11	27	16	16	11	20	------	22	14	15
12S/2E-10J1	15	17	16	20	19	23	20	22	22	22
12S/2E-11L1	17	20	19	22	23	25	22	26	23	22
12S/2E-12E1	24	28	27	29	36	32	29	33	32	29
12S/2E-19M1	11	6	4	8	4	16	12	9	------	8
12S/2E-30E1	81	82	82	93	81	84	83	82	82	84
12S/2E-31E1	27	26	25	26	24	27	30	29	------	25
12S/3E- 5D1	130	144	140	143	142	148	144	150	------	144
12S/3E- 6L2	37	43	41	45	45	48	43	49	41	44
12S/3E- 7J1	39	44	42	------	44	50	------	50	46	45

The tabulation of wells in the Valley Floor Pressure Zone shown in Table 11 includes only those wells tapping confined aquifers. However, as mentioned previously, there is a considerable area of the Valley Floor Pressure Zone in which a free ground water body overlies the confining clays capping the aquifers. Depths to this overlying free ground water body were determined by the United States Soil Conservation Service in 1943, 1944, and 1946 by boring auger holes at intervals throughout the valley floor and measuring the depth to water. The locations of these auger holes are shown on Plate 12, and recorded depths are included in Appendix E. Similar measurements were made by the Division of Water Resources in the fall of 1951. The locations of auger holes bored by the Division of Water Resources are also shown on Plate 12, and the recorded depths to water are presented in Table 12.

TABLE 12

MEASURED DEPTH TO FREE GROUND WATER OVERLYING CONFINED AQUIFERS IN VALLEY FLOOR PRESSURE ZONE OF PAJARO UNIT

Auger hole number	Depth below ground surface, in feet	Date of measurement
1	2.0	9/25/51
2	3.0	9/25/51
3	3.0	9/25/51
4	2.0	9/25/51
5	2.5	9/25/51
6	9.0	9/26/51
7	5.0	9/26/51
8	4.0	9/26/51
9	3.5	9/26/51
10	7.5	9/28/51
14	7.5	10/ 4/51
17	6.5	9/27/51
19	2.5	9/27/51
20	2.2	9/27/51
21	3.0	9/27/51
22	10.7	10/ 5/51
23	3.5	9/26/51
24	5.9	9/27/51
25	4.5	10/ 3/51

Safe Ground Water Yield of Pajaro Unit

The term "safe ground water yield" refers to the maximum rate of extraction of water from a ground water basin which, if continued over an indefinitely

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long period of years, would result in the maintenance of certain desirable fixed conditions. Commonly, safe ground water yield is determined by one or more of the following criteria:

1. Water levels are not so lowered as to imperil the economy of ground water users by excessive costs of pumping from the ground water basin or by exclusion of users from a supply therefrom.

2. Mean seasonal extraction of water from the ground water basin does not exceed mean seasonal replenishment to the basin.

3. Water levels are not so lowered as to cause harmful impairment of the quality of the ground water by intrusion of other water of undesirable quality, or by accumulation and concentration of degradants or pollutants.

Under the present pattern of water utilization, average pumping lifts in the pressure zones are nominal, varying between 40 and 80 feet and rarely exceeding the latter figure. Insofar as could be determined during the investigation, there is little or no local concern regarding the increasing costs of pumping from the confined aquifers. For these reasons it was considered that only the second and third of the foregoing criteria were of significance in this instance.

Sufficiency of Water Supply to Forebay Zone of Pajaro Unit. Estimates of ground water recharge to the Forebay Zone were made by subtracting estimated values of runoff and consumptive use of water from the estimated precipitation, the runoff constituting the surface outflow from that zone, and both consumptive use and precipitation being that on the entire area within the watershed upstream from the pressure zones, exclusive of Pajaro River drainage. Contribution to the ground water to the Forebay Zone from the river is difficult to evaluate but is believed to be comparatively small. Its omission from consideration is on the conservative side and is therefore justified. Estimates of recharge for the three seasons of investigation, and for conditions of mean water supply and climate are presented in Table 13. The consumptive use values here utilized are derived in Chapter III, "Water Utilization and Supplemental Requirements."

TABLE 13

ESTIMATED SEASONAL GROUND WATER RECHARGE TO FOREBAY ZONE OF PAJARO UNIT

(In acre-feet)

Item	1946-47	1947-48	1948-49	Mean
Precipitation	75,000	86,000	78,000	102,000
Surface runoff	−2,000	−3,000	−7,000	−13,000
Consumptive use	−58,000	−59,000	−59,000	−61,000
RECHARGE	15,000	24,000	12,000	28,000

Subsurface outflow from the Forebay Zone constitutes the demand on the ground water of that zone. It was considered to be equal to the sum of the pumpage of ground water in the pressure zones and subsurface outflow from the pressure zones to Monterey Bay, less subsurface inflow to the pressure zones from the bay. The amount of pumpage in the pressure zones was estimated from use of water studies and from land use survey data, and is discussed in Chapter III. Values for subsurface outflow from the valley floor pressure zone to Monterey Bay, as well as for subsurface inflow from the bay, were estimated by a method described in some detail later in this section. Under present conditions of draft it is estimated that subsurface outflow from the Valley Floor Pressure Zone is approximately 2,000 acre-feet per season, and that subsurface inflow is about 1,000 acre-feet per season, resulting in an estimate of net subsurface outflow to Monterey Bay of approximately 1,000 acre-feet per season. Table 14 presents estimates of subsurface outflow from the Forebay Zone based on the foregoing analysis.

TABLE 14

ESTIMATED SEASONAL SUBSURFACE OUTFLOW FROM FOREBAY ZONE OF PAJARO UNIT

(In acre-feet)

Item	Season			
	1946-47	1947-48	1948-49	3-year average
Pumpage in pressure zones	24,600	24,600	24,700	24,600
Net subsurface outflow from pressure zones to Monterey Bay	1,000	1,000	1,000	1,000
SUBSURFACE OUTFLOW FROM FOREBAY ZONE	25,600	25,600	25,700	25,600

Comparison of the derived value of recharge of 28,000 acre-feet per season under mean conditions of water supply and climate, as shown in Table 13, and 1948-49 conditions of pumping draft of 25,700 acre-feet per season, as shown in Table 14, indicates that the supply to the ground water in the Forebay Zone exceeds the demand on it by some 2,300 acre-feet per season, in addition to an undetermined contribution from Pajaro River. Were the relation between recharge to the Forebay Zone and extractions from the pressure zones the controlling criterion, the estimated safe yield would be about 28,000 acre-feet per season.

Impairment of Quality of Water. With regard to the third of the stated criteria for determination of safe yield, it was found that in the Pajaro Unit a rate of ground water extraction from the confined aquifers has been reached sufficient to induce sea-water intrusion from Monterey Bay. This saline intrusion and its effects on the water supply of the Pajaro Unit are discussed in some detail in a later section entitled "Quality of Water." During periods of heavy pumping draft in summer months the elevation of the hydraulic gradient in the confined aquifers is depressed below sea level near the coast, resulting in degradation of the water supply by sea-water intrusion. For this reason the third of the foregoing criteria was adopted for determination of safe ground water yield in the Pajaro Unit. The limit of safe ground water yield was defined as that maximum rate of pumping extraction from the Valley Floor and Upper Pressure Zones beyond which the hydraulic gradient in the confined aquifers would be depressed below mean sea level.

Fluctuations in water levels in a free ground water body indicate changes in ground water storage, since these levels represent the true ground water surface. In contrast, fluctuations of water levels in a confined ground water body reflect only variations in the piezometric surface elevation, or pressure head, and do not indicate changes in ground water storage unless the water surface drops below the impervious strata overlying the aquifers. In the Pajaro Unit the piezometric surface elevation remained above the confining clays in the Valley Floor and Upper Pressure Zones throughout the period of investigation.

The yield of water-bearing formations in a confined ground water body is dependent both on the capacity of the aquifers to conduct water from the forebay, and on the hydraulic gradient from the forebay through the confined ground water body. The hydraulic gradient, in turn, is influenced by the areal extent, storage capacity, and seasonal recharge of the forebay, and draft from aquifers in the confined ground water body.

It was observed during the investigational seasons that a trough condition, in which the elevation of the hydraulic grade line was depressed below sea level, occurred in the Valley Floor Pressure Zone of the Pajaro Unit during the summer months. The trough first appeared near the coast about April 15th, moving slightly inland and deepening as the pumping season progressed. The trough receded as pumping draft decreased in the fall, and finally disappeared about October 15th. In the 1948-49 season the trough was at its most inland position on July 17th, at which time its axis was about 1.5 miles inland from and parallel to the coast, and about 15 feet below mean sea level. A ground water map was prepared showing elevations of the pressure surface in the Pajaro Unit in July, 1947, at the time of the maximum trough condition. This map is included as Plate 16, entitled "Lines of Equal Elevation of Ground Water in Pajaro Unit, July of 1947."

A typical trough condition in the Valley Floor Pressure Zone is illustrated on Plate 17, entitled "Diagrammatic Cross Section of Pajaro Unit," which shows the indicated relationships of the Forebay Zone and Monterey Bay to the confined aquifers of the pressure zones. Formation of the trough in the Valley Floor Pressure Zone indicates that the rate of pumping extraction from the confined aquifers, during the months of heavy irrigation draft, exceeded the rate at which the aquifers could convey water from the Forebay Zone under conditions of safe yield as previously defined. Also, marine intrusion in the confined aquifers during the summer pumping season is indicated by the hydraulic gradient from Monterey Bay inland to the trough. Since ground water flows in the direction of the hydraulic gradient, it is evident that pumping draft between the coast and the trough must be supplied by flow through the confined aquifers from the direction of Monterey Bay. Similarly, pumping draft on the inland side of the trough must be furnished by flow down the aquifers from the direction of the Forebay Zone.

It will be noted that Plate 17 also illustrates a position of the hydraulic grade line with a rate of pumping draft equal to or less than the safe yield of the confined aquifers. Under this condition, the elevation of the hydraulic grade line would never be depressed below the mean sea level, and the only source of flow in the confined aquifers would be from the Forebay Zone.

It was observed in the Valley Floor Pressure Zone that a change in rate of pumping draft was followed by an appreciable period of changing position and configuration of the hydraulic grade line, until stabilization of the gradient was reached. This period has been termed the "effective lag." Evaluation of the effective lag was necessary for proper correlation of observed pumping draft and hydraulic gradient. The maximum rate of draft on the aquifers in the 1948-49 season was reached in mid-June and the resultant maximum depth of the trough occurred on July 17th. This indicates that the effective lag in the Valley Floor Pressure Zone of the Pajaro Unit is approximately 30 days.

In light of the foregoing, the rate of safe ground water yield in the Pajaro Unit was derived by estimating the rate of flow through the confined aquifers immediately prior to or subsequent to existence of a trough, taking into consideration the effective lag. Since the Forebay Zone is the only source of ground water to the confined aquifers under conditions of safe yield, the rate of pumping draft from the aquifers under these conditions equals the flow in the aquifers.

Rate of flow in the confined aquifers was evaluated by the application of the equation $Q = TAS$, based on fundamental hydraulic principles, where:

Q = rate of flow in the confined aquifers, or continuous flow equivalent of the quantity of draft on the aquifers, during the period considered, in second-feet,

T = average coefficient of transmissibility of the confined aquifers, under a hydraulic gradient of unity, in second-feet per square foot of cross-sectional area,

A = effective cross-sectional area of the confined aquifers, in square feet,

S = average slope of the hydraulic gradient of the confined aquifers. This was taken as the distance, in feet, through which flow in the aquifers was considered to occur, divided by the difference in elevation, in feet, of the hydraulic gradient over the distance of flow.

In the use of this equation, the terms "T" and "A" were determined as a unit (TA), making it unnecessary to evaluate independently the obscure factors comprising each term. This was possible since the cross-sectional area of flow in the aquifers remained unchanged at all times, being always under pressure, and transmissibility of an unchanged cross-sectional area is likewise constant. For this reason, derived values of (TA) were assumed to be constant within the observed range of draft on the confined aquifers.

It was necessary to apply the equation independently for conditions of draft and hydraulic gradient existing on the inland and the bayward sides of the ground water trough because of their different sources of water supply. This was accomplished by setting up an equation of draft on the inland side of the trough, $Q_i = (TA)_i S_i$, and one for the bay side, $Q_b = (TA)_b S_b$. In these equations Q_i and Q_b were taken to represent the continuous flow equivalent of monthly pumping draft on the inland and the bay sides of the trough, respectively. Estimates were made of values for Q_i and Q_b for one position of the trough in 1946-47 and for four positions in 1948-49. These estimates of draft were based on the results of studies of monthly application of water for irrigation on each side of the trough, which studies are described in some detail in Chapter III. Direct observations were made of values for S_i and S_b by measuring depth to water in selected wells. Values of the unknowns $(TA)_i$ and $(TA)_b$ were computed for each of the trough positions after giving consideration to the effective lag. The average value for $(TA)_i$ was thus determined to be about 140,000, and that for $(TA)_b$ about 10,000.

In order to evaluate the flow in the aquifers under conditions of safe yield, the hydraulic gradient was determined from well measurements made at the times of appearance and disappearance of the trough in the 1948-49 season. The average slope at these times was 0.00042. Using the predetermined $(TA)_i$ value of 140,000 and the average inland slope (S_i) of 0.00042, it was found by the equation $Q_i = (TA)_i S_i$ that the rate of yield of the aquifers underlying the valley floor of the Pajaro Unit, under conditions corresponding to those defined for safe yield, was about 60 second-feet.

Based on the previously cited studies of application of irrigation water, it was estimated that the rate of pumping draft at the peak of the 1947 irrigation season was about 83 second-feet. This rate increased during the 1949 irrigation season to a maximum of about 98 second-feet. Rates of pumping draft in 1946-47 and 1948-49, therefore, were substantially greater than the estimated safe yield of 60 second-feet. It is indicated that the portion of pumping draft in excess of safe yield comprised flow from Monterey Bay and the increase in flow from the Forebay Zone induced by the steepening of the hydraulic gradient beyond that prevailing under conditions of safe yield. Based on the observed position of the trough and on the results of the application of water studies, it was estimated that the 98 second-foot maximum 1948-49 rate of draft was supplied from the following sources: 8 second-feet on the bay side of the trough, from Monterey Bay, and 90 second-feet on the inland side of the trough, from the Forebay Zone. It is apparent that the 90 second-feet from the Forebay Zone was composed of the safe ground water yield of 60 second-feet and of 30 second-feet of flow induced by the steepened hydraulic gradient beyond the safe yield gradient.

The relatively small $(TA)_b$ value determined for the bay side of the trough indicates that ground water outflow from the confined aquifers to the bay, or inflow from the bay to the aquifers, is restricted as compared to ground water flow through the aquifers on the inland side of the trough. Under 1948-49 conditions of ground water draft in the Pajaro Unit, a trough existed for about six months, from April 15th to October 15th, during which time sea-water intrusion occurred. The hydraulic gradient was reversed during the remaining six months of the season, and subsurface outflow to the bay occurred. In the winters of both 1946-47 and 1948-49, the slope of the hydraulic gradient from the position of the preceding summer's trough to the shore line was estimated to be about 0.0005. The indicated winter rate of outflow through the aquifers to the ocean, using the $(TA)_b$ value of 10,000, was about five second-feet. The estimated rate of flow through the aquifers from Monterey Bay inland ranged from zero early in the irrigation season to a maximum of about eight second-feet.

Studies indicate that the rate of pumping draft at the peak of the irrigation season exceeded that for safe yield by a maximum of 23 second-feet in 1946-47, and 38 second-feet in 1948-49. In terms of quantity, and based on these rates, it is estimated that total draft exceeded safe yield by about 3,600 acre-feet in 1946-47, and about 3,700 acre-feet in 1948-49. Of these values, it is indicated that approximately 1,000 acre-feet constituted sea-water intrusion each season. It is further indicated that the remainders of 2,600 and 2,700 acre-feet in 1946-47 and 1948-49, respectively, were furnished by increased inflow down the aquifers from the Forebay Zone induced by the steepened hydraulic gradient beyond the safe yield gradient.

As derived in Chapter III on the basis of studies of application of irrigation water, estimated total pumpage from the confined aquifers was about 24,600 acre-feet in 1946-47, and about 24,700 acre-feet in 1948-49. Based on derived rates of flow in the confined aquifers, pumping draft exceeded safe ground water yield by an estimated 3,600 acre-feet in 1946-47 and 3,700 acre-feet in 1948-49. Therefore, under the present pattern of irrigation draft, safe ground water yield of the confined aquifers serving the Valley Floor and Upper Pressure Zones is estimated to be about 21,000 acre-feet per season.

Ground Water Basins in North Coastal, San Lorenzo, and Soquel Units

Several small ground water basins are located along the coastal strip in the Santa Cruz-Monterey Area northwest of the Pajaro Unit. These minor basins support wells of small draft for local domestic and irrigation use. Total yield of the basins is probably small, and will be of little importance in meeting the ultimate water requirements of the coastal strip. For these reasons, study of the underground hydrology of most of these basins was not attempted. An exception was made in the case of the Soquel Valley ground water basin in the Soquel Unit. Limited study was given this basin because it is probably the largest of the minor basins, and because of the possibility of its development as an emergency municipal supply.

Water-bearing formations underlie the floor of Soquel Valley and terraces along the coast of the Soquel Unit. The principal pumping area is adjacent to Soquel Creek, extending from north of Soquel to Monterey Bay. The areal extent of the pumping zone is approximately five square miles.

Geologic studies indicate that the floor of Soquel Valley is a thin fill composed chiefly of stream-laid silts, sands, and gravels. Marine sediments of the Pliocene Purisima formation underlie the valley floor at a shallow depth. Rocks of this formation are locally permeable, with exception of occasional thin strata of well-cemented "hard shell" fossiliferous sandstone. The latter beds, despite their thinness, occur persistently over large areas, and form a capping which confines ground water in the underlying aquifer. The confined aquifer consists of a black to gray uncemented sand member of the Purisima formation, described by well drillers as "black sand" or "blue sand." Well logs indicate that this aquifer is probably not more than 60 feet thick, although similar water-bearing strata may be found at greater depths. A body of free ground water occurs above the confining strata of the pressure aquifer, and receives direct recharge from percolation of rainfall and stream flow. The forebay of the confined aquifer probably includes most of the watershed tributary to the floor of Soquel Valley.

Information obtained during the investigation, although not detailed, indicates that overdraft on ground water in Soquel Valley does not exist at the present time. Ground water levels rose about 0.6 foot during the period from the fall of 1948 to the fall of 1950. This rise in water levels indicates that inflow to the forebay of the confined aquifer, during this period of relatively low rainfall, exceeded the sum of pumping draft and outflow from the aquifer. Under these conditions, it appears that draft on the aquifer could be increased from the present estimated rate of about 600 acre-feet per season, derivation of which is discussed in Chapter III, without exceeding mean seasonal replenishment. The amount of this possible increase in draft was not estimated.

QUALITY OF WATER

The principal objectives of the water quality investigation of the Santa Cruz-Monterey Area were determination of: (1) quality of the surface and ground waters with respect to their suitability for irrigation use; (2) the extent to which ground waters are affected by excessive concentrations of chlorides; and (3) the source or sources of excessive chlorides.

It is desirable to define certain terms commonly used in connection with discussion of quality of water:

Quality of Water—This refers to those characteristics of water affecting its suitability for beneficial uses.

Mineral Analysis—This refers to the quantitative determination of inorganic impurities or dissolved mineral constituents in water.

Degradation—This refers to any impairment in the quality of water due to causes other than disposal of sewage and industrial wastes.

Contamination—This refers to impairment of the quality of water by sewage or industrial waste to a degree which creates a hazard to public health through poisoning or spread of disease.

Pollution—This refers to impairment of the quality of water by sewage or industrial waste to a degree which does not create a hazard to public health, but which adversely and unreasonably affects such water for beneficial uses.

Hardness—This refers to a characteristic of water which causes curdling of soap, increased consumption of soap, deposition of scale on boilers, injurious effects in some industrial processes, and sometimes objectionable taste, and which is due in large part to the presence of salts of calcium, iron, and magnesium.

Complete mineral analysis included a determination of four cations, consisting of calcium, magnesium, sodium, and potassium; five anions, consisting of carbonate, bicarbonate, chloride, sulphate, and nitrate; total soluble salts; boron; and computation of percent sodium. Partial analysis included determination of chlorides and total mineral solubles only.

With the exception of boron, the concentrations of cations and anions have been expressed in terms of "equivalents per million." This was done because ions combined with each other on an equivalent basis, rather than on the basis of weight, and a chemical equivalent unit of measurement provides a better and more convenient expression of concentration. This is especially true when it is desired to compare the composition of waters having variable concentrations of mineral solubles. In the case of boron, concentrations are expressed on a weight basis of "parts per million" of water. In order to convert equivalents per million to parts per million, the concentration, expressed in equivalents per million, should be multiplied by the equivalent weight of the cation or the anion in question. Equivalent weights of the common cations and anions are presented in the following tabulation:

Cation	Equivalent weight	Anion	Equivalent weight
Calcium (Ca)	20.0	Carbonate (CO_3)	30.0
Magnesium (Mg)	12.2	Bicarbonate (HCO_3)	61.0
Sodium (Na)	23.0	Chloride (Cl)	35.5
Potassium (K)	39.1	Sulphate (SO_4)	48.0
		Nitrate (NO_3)	62.0

Data utilized in the determination of quality of water included 17 complete mineral analyses of surface water samples, 83 complete mineral analyses of water samples from the confined aquifers in the Pajaro and Soquel Units, 19 complete mineral analyses of ground water in the zone overlying the confined aquifers in the Pajaro Unit, and 132 partial analyses of water collected from 105 wells in the Pajaro Unit. The water samples analyzed were collected from 1947 through 1951.

An additional and more detailed investigation of the quality of the water resources of Pajaro Valley is in progress under the provisions of Section 229 of the Water Code. This work is being conducted by the Division of Water Resources in connection with its assigned responsibilities for a state-wide survey of quality of surface and ground waters, the results of which will be published in subsequent bulletins.

Standards of Quality for Water

Investigation and study of the quality of surface and ground waters of the Santa Cruz-Monterey Area were largely limited to consideration of mineral constituents of the waters, with particular reference to their suitability for irrigation use. However, it may be noted that, within the mineral analyses herein reported, a water which is determined to be suitable for irrigation may also be considered as being either generally suitable for municipal and domestic use, or susceptible to such treatment as will render it suitable for that purpose.

The criteria which were used as a guide to judgment in determining suitability of water for irrigation use comprised the following: (1) chloride concentration, (2) total soluble salts, (3) boron concentration, and (4) percent sodium.

1. The chloride anion is usually the most troublesome element in most irrigation waters. It is not considered essential to plant growth, and excessive concentrations will inhibit growth.

2. Total soluble salts furnishes an approximate indication of the over-all mineral quality of water. It may be approximated by multiplying specific electrical conductance ($Ec \times 10^6$ at 25° C.) by 0.7. The presence of excessive amounts of dissolved salts in irrigation water will result in reduced crop yields.

3. Crops are sensitive to boron concentration, but require a small amount (less than 0.1 part per million) for growth. They usually will not tolerate more than 0.5 to 2 parts per million, depending on the crop in question.

4. Percent sodium reported in the analyses is the proportion of the sodium cation to the sum of all cations, and is obtained by dividing sodium by the sum of calcium, magnesium, potassium, and sodium, all expressed in equivalents per million, and multiplying by 100. Water containing a high percent sodium has an adverse effect upon the physical structure of the soil by dispersing the soil colloids, making the soil "tight," thus retarding movement of water through the soil, retarding the leaching of salts, and making the soil difficult to work.

The following excerpts from a paper by Dr. L. D. Doneen of the Division of Irrigation of the University of California at Davis may assist in interpreting water analyses from the standpoint of their suitability for irrigation.

"Because of diverse climatological conditions, crops, and soils in California, it has not been possible to establish rigid limits for all conditions involved. Instead, irrigation waters are divided into three broad classes based upon work done at the University of California, and at the Rubidoux, and Regional Salinity laboratories of the U. S. Department of Agriculture.

"Class 1. *Excellent to Good*—Regarded as safe and suitable for most plants under any condition of soil or climate.

"Class 2. *Good to Injurious*—Regarded as possibly harmful for certain crops under certain conditions of soil or climate, particularly in the higher ranges of this class.

"Class 3. *Injurious to Unsatisfactory*—Regarded as probably harmful to most crops and unsatisfactory for all but the most tolerant.

"Tentative standards for irrigation waters have taken into account four factors or constituents, as listed below.

Factor	Class 1 *Excellent to good*	Class 2 *Good to injurious*	Class 3 *Injurious to unsatisfactory*
Conductance ($Ec \times 10^6$ at 25° C.)	Less than 1000	1000–3000	More than 3000
Boron, ppm	Less than 0.5	0.5–2.0	More than 2.0
Percent sodium	Less than 60	60–75	More than 75
Chloride, epm	Less than 5	5–10	More than 10

(End of quotation)

Hardness of water is caused principally by compounds of calcium and magnesium, although other mineral constituents such as iron, manganese, aluminum, barium, silica, and strontium, may contribute to the hardness. In this bulletin total hardness is expressed in parts per million in terms of calcium carbonate hardness. It was computed by adding calcium and magnesium, expressed in equivalents per million, and multiplying this sum by 50. Water having a total hardness of less than 50 parts per million is rated as soft water for nearly all purposes except the most exacting of industrial uses, and seldom requires treatment for reduction or elimination of hardness. Water having a range of total hardness up to 150 parts per million is suitable for most household uses. However, in the case of such water, reduction of hardness by softening processes would reduce soap consumption and deposits of scale in plumbing systems, thus enhancing the suitability of the water for laundries and other industrial

TABLE 15

COMPLETE MINERAL ANALYSES OF REPRESENTATIVE SURFACE WATERS OF SANTA CRUZ-MONTEREY AREA

Source of sample	Date of sample	Conductance ($Ec \times 10^6$ at 25° C.)	Boron, in ppm	Percent sodium	Mineral constituents in equivalents per million						
					Ca	Mg	Na*	$HCO_3 + CO_3$	Cl	SO_4	NO_3
North Coastal Unit											
Waddell Creek, 1 mile upstream from ocean	3/30/49	177	0.02	36	0.68	0.50	0.64	0.83	0.43	0.55	trace
Scott Creek, 1.5 miles upstream from ocean	3/16/49	133	0	36	0.52	0.37	0.44	0.71	0.39	0.32	trace
San Lorenzo Unit											
San Lorenzo River, at Santa Cruz	3/30/49	309	0.3	22	1.79	0.77	0.76	1.69	0.43	1.13	trace
Soquel Unit											
Soquel Creek at junction with West Branch	3/15/49	392	0.08	18	2.40	1.23	0.85	2.07	0.43	1.99	trace
Soquel Creek at high bridge above junction with West Branch	3/15/49	361	0.05	18	2.27	1.15	0.80	2.05	0.21	1.80	trace
Pajaro Unit											
Corralitos Creek near Grizzly Flat	3/17/49	200	0	24	1.34	0.65	0.64	1.72	0.20	0.45	trace
Corralitos Creek at Corralitos	3/17/49	311	0	22	2.01	1.10	0.75	2.31	0.31	1.02	trace
Corralitos Creek at Corralitos	2/25/47	499	0.08	16	3.6	0.9	0.8	3.5	0.5	1.3	-------
Corralitos Creek near Corralitos	5/28/48	498	-------	20	2.84	1.48	1.09	3.72	0.39	1.27	0.03
Brown Valley Creek near Corralitos	5/28/48	508	-------	24	2.80	1.40	1.34	3.96	0.54	1.00	0.04
Green Valley Creek at Three Corners	2/25/47	534	0.19	26	3.1	1.0	1.4	3.4	1.2	0.9	-------
College Lake	4/28/47	496	0.16	26	2.8	1.0	1.3	2.9	1.0	1.2	-------
Pajaro River near Chittenden	3/29/49	556	0.30	22	2.28	2.48	1.42	3.38	0.93	2.06	0.06
Pajaro River near Pajaro Gap	2/25/47	816	0.28	24	3.7	3.0	2.1	4.8	1.4	2.6	-------
Pajaro River, 0.5 mile east of Watsonville	7/21/47	1,050	0.36	22	5.1	4.1	2.7	8.7	1.5	1.7	-------
Pajaro River at mouth	9/26/51	31,700	2.95	78	14.1	66.9	292.9	6.4	335.6	34.8	0.32
Watsonville Slough, 4 miles west of Watsonville on Beach Road	9/25/51	6,680	1.45	74	4.09	13.9	52.8	14.8	46.8	8.8	0.04

* Includes potassium.

purposes. Where total hardness in water exceeds from 150 to 200 parts per million, water softening processes are usually resorted to in order to render the water more acceptable for domestic, municipal, and industrial uses. However, objections to hardness in water may depend on local opinion, and a water considered too hard in certain localities might be considered satisfactory in others.

Quality of Surface Water

Analyses of surface water samples collected during the investigational seasons and in 1951 indicate that the waters of the major streams of the Santa Cruz-Monterey Area were of good mineral quality and well suited for irrigation use and other beneficial purposes. The waters were moderately low in total mineral solubles, chlorides, boron, and percent sodium. This was especially characteristic of waters collected from Waddell Creek, Scott Creek, San Lorenzo River, Soquel Creek, Corralitos Creek, and from Pajaro River near Chittenden. The analysis of a sample collected from College Lake indicates that its waters contained moderately low concentrations of mineral solubles and were within the limits for Class 1 irrigation water. Results of complete mineral analyses of samples of surface waters collected in the Santa Cruz-Monterey Area are presented in Table 15.

Results of determination of total hardness in water samples collected from representative streams of the Santa Cruz-Monterey Area during the month of March, 1949, are presented in Table 16. This table indicates that at that time the waters of Waddell, Scott, and Boulder Creeks had considerably less total hardness than did waters of the other streams sampled. The values of total hardness determined indicate that sof-

TABLE 16

TOTAL HARDNESS OF REPRESENTATIVE SURFACE WATERS OF SANTA CRUZ-MONTEREY AREA

(Waters sampled in March, 1949)

Source of sample	Total hardness, in parts per million
North Coastal Unit	
Waddell Creek, 1 mile upstream from ocean	59
Scott Creek, 1.5 miles upstream from ocean	44
San Lorenzo Unit	
Boulder Creek, 1.2 miles above Jamison dam site	70
San Lorenzo at Waterman Switch	136
San Lorenzo River at Santa Cruz	128
Kings Creek, 1.5 miles above San Lorenzo River	185
Bear Creek, 2.5 miles above San Lorenzo River	152
Newell Creek, 1 mile above San Lorenzo River	180
Zayante Creek, 0.75 mile above San Lorenzo River	135
Soquel Unit	
Soquel Creek at junction with West Branch	181
Soquel Creek at high bridge above junction with West Branch	171
Pajaro Unit	
Corralitos Creek near Grizzly Flat	99
Corralitos Creek at Corralitos	155
Pajaro River near Chittenden	238

tening treatment might be desirable for water from streams other than Waddell, Scott, and Boulder Creeks, particularly if such waters are used for domestic, municipal, and some industrial purposes. All surface waters used for domestic and municipal purposes should be treated and purified to meet sanitary requirements for such use.

Quality of Ground Water

The survey of mineral quality of the ground waters of the Santa Cruz-Monterey Area was limited to the valley floor of the Pajaro Unit and to Soquel Valley in the Soquel Unit, since ground water is not of major significance in other portions of the area.

Water in Confined Aquifers, Pajaro and Soquel Units. The water quality survey in the Pajaro Unit indicated the existence of from good to excellent quality water throughout the confined aquifers underlying the valley floor, except near Monterey Bay where several wells produced water having comparatively high concentrations of chlorides. With the exception of water from these wells, water from the confined aquifers had low to moderate concentrations of total mineral solubles, chlorides, and boron, and low percent sodium, and would be classed as well within the limits of Class 1 irrigation water. Calcium and magnesium were the predominant cations, and bicarbonate the predominant anion in these waters.

The survey in Soquel Valley indicated that the confined ground waters were moderately low in mineral content, and that they were generally well suited for irrigation and other uses. However, although not indicated in the analyses, many of the wells in Soquel Valley produced water which contained significant amounts of iron and manganese. These mineral constituents render the water undesirable for general domestic and some industrial uses unless removed by appropriate treatment.

Results of complete mineral analyses of samples of confined ground water obtained from wells in the Pajaro and Soquel Units are presented in Table 17. Results of partial mineral analyses of confined ground waters obtained from wells in the Pajaro Unit are included in Appendix F.

Water Overlying Confined Aquifers, Pajaro Unit. Ground water overlying the confined aquifers in Pajaro Valley was sampled during 1951 at 19 different locations in order to determine its quality. Samples were obtained from auger holes dug to depths of from 5 to 18 feet. The location of these holes is shown on Plate 12, and the results of complete mineral analyses of the samples are presented in Table 18. It is indicated that the mineral quality of the overlying ground water was markedly inferior to that of water from the confined aquifers. Water samples numbered 1 and 19 were obtained from auger holes located in the vicinity of Monterey Bay and contained waters characterized by high concentrations of chlorides. It is probable that ground water overlying confined aquifers and situated adjacent to Monterey Bay derives its high chloride content in part from ocean water, inasmuch as the area involved borders sloughs subject to tidal action.

Degradation of Confined Ground Water, Pajaro Unit. Several irrigation wells located in the Pajaro Unit near Monterey Bay yielded ground water from the confined aquifers containing relatively high concentrations of chlorides. Water from Well No. 12S/1E-25B1, located about one-half mile east of the shore line of the bay, showed a marked increase in chloride concentration during the 1946-47 pumping season. Analyses presented in Table 17 indicate that between the months of April and July, 1947, chloride concentration increased from 9.6 to 14.1 equivalents per million. In July, 1949, water from this well contained 19.6 equivalents per million of chlorides. Water from Well No. 12S/2E-30E3, located about one mile east of the shore line of Monterey Bay, also showed an increase in chloride concentration during the 1948-49 pumping season. Between April and July of 1949, chloride concentration increased from 58.5 to 72.2 equivalents per million. Certain other wells located near Monterey Bay also yielded waters of high chloride concentration. It is indicated that the area affected by high concentration of chlorides in the underlying confined ground water is approximately 1,000 acres of agricultural land adjacent to Monterey Bay.

It is indicated that the principal source of this degradation of the confined ground water is sea water drawn into the confined aquifers from Monterey Bay. However, it is possible that the degradation may have been due in part to interchange with poorer quality ground water overlying the confined aquifers through defective or abandoned wells. Conditions favorable to intrusion of sea water into the confined aquifers prevailed during a portion of each pumping season during the period of investigation. This is evidenced by measurements of depth to ground water showing that the hydraulic gradient was lowered below sea level. In July, 1947, when Well No. 12S/1E-25B1 yielded water of high chloride concentration, the elevation of the water surface in the well was 15 feet below sea level.

TABLE 17

COMPLETE MINERAL ANALYSES OF CONFINED GROUND WATERS IN SANTA CRUZ-MONTEREY AREA

Well number	Date of sample	Conductance Ec x 10^6 at 25° C.	Boron, in ppm	Percent sodium	Mineral constituents, in equivalents per million								
					Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3
Pajaro Unit													
11S/1E-24J1	10/18/51	428	0.08	22	2.24	1.31	1.00	0.04	0.0	3.21	0.62	0.66	0.01
11S/1E-25R1	10/18/51	437	0.06	20	2.04	1.80	0.95	0.06	0.0	3.80	0.39	0.52	0.01
11S/1E-36L1	10/18/51	463	0.0	25	1.44	2.22	1.26	0.06	0.0	3.74	0.79	0.35	0.0
11S/2E-21C1	6/23/50	470	0.02	22	2.65	1.83	1.32	-----	-----	4.00	0.45	0.99	0.09
11S/2E-25N4	6/23/50	680	0.06	26	4.55	2.46	1.65	-----	-----	5.70	0.70	1.26	0.59
11S/2E-31J1	10/17/51	480	0.04	23	2.30	1.64	1.22	0.06	0.0	3.83	0.48	0.68	0.06
11S/2E-31P2	10/17/51	520	0.05	20	2.40	2.22	1.17	0.06	0.0	4.59	0.51	0.58	0.0
11S/2E-32K1	5/28/48	644	-----	18	2.99	2.38	1.19	-----	0.0	3.84	0.73	1.52	0.47
12S/1E-12Q1	10/19/51	303	0.10	30	0.79	1.48	1.00	0.05	0.0	2.09	0.27	0.59	0.30
12S/1E-13R1	10/18/51	518	0.03	21	2.15	2.38	1.22	0.08	0.0	4.36	0.62	0.73	0.0
12S/1E-23R1*	9/14/51	548	0.91	35	1.05	2.55	2.09	0.31	0.53	3.67	0.85	1.08	0.01
12S/1E-24G1	10/18/51	545	0.13	20	1.85	2.71	1.13	0.08	0.0	4.49	0.59	0.71	0.0
12S/1E-24J2	10/17/51	620	0.0	20	2.79	2.80	1.43	0.08	0.0	5.08	0.56	1.21	0.0
12S/1E-24L1	9/14/51	610	0.71	21	2.69	2.80	1.48	0.06	0.80	4.72	0.73	0.85	0.0
12S/1E-24M1	9/14/51	548	0.91	35	1.05	2.55	2.09	0.31	0.53	3.67	0.85	1.08	0.01
12S/1E-24R1	10/16/51	642	0.15	18	3.09	2.71	1.30	0.06	0.0	5.41	1.17	0.62	0.01
12S/1E-24R2	12/ 4/51	673	0.14	19	3.04	2.96	1.39	0.06	0.0	5.15	1.07	1.17	0.01
12S/1E-25A3*	9/13/51	2,170	0.22	12	9.23	10.36	2.74	0.10	0.67	4.33	15.23	1.79	0.05
12S/1E-25B1*	4/21/47	1,570	0.18	16	8.30	5.10	2.20	-----	-----	4.50	9.60	1.50	-----
12S/1E-25B1*	7/15/47	2,100	0.16	12	10.9	7.2	2.4	-----	-----	4.7	14.1	1.7	-----
12S/1E-25B1*	7/29/49	2,470	0.17	16	11.30	11.53	4.06	-----	-----	4.60	19.62	2.10	0.10
12S/1E-25B1*	10/ 2/51	1,260	0.29	48	6.29	0.26	6.17	0.19	0.0	6.16	6.46	0.12	0.0
12S/1E-25B2*	9/13/51	459	0.88	40	1.10	1.89	2.04	0.05	0.80	2.79	0.39	1.04	0.0
12S/1E-25Q1*	9/15/47	714	0.13	62	1.7	0.7	3.7	-----	-----	2.7	1.8	1.6	-----
12S/1E-25Q1*	9/14/51	677	0.33	53	1.55	1.56	3.65	0.08	0.40	2.69	1.69	1.60	0.56
12S/2E- 1G1	9/26/51	877	0.13	15	5.24	3.29	1.52	0.04	0.0	7.54	0.85	1.15	0.47
12S/2E- 2H1	7/30/49	1,177	0.13	18	7.55	4.51	2.67	-----	-----	10.59	1.00	2.60	0.14
12S/2E- 5D1	10/17/51	607	0.18	18	2.54	2.96	1.21	0.06	0.0	4.98	1.13	0.40	0.02
12S/2E- 6L1	10/16/51	485	0.08	21	2.15	1.97	1.13	0.06	0.0	3.90	0.62	0.62	0.01
12S/2E- 6P1	10/16/51	538	0.08	19	2.69	1.97	1.09	0.07	0.0	4.23	0.85	0.60	0.0
12S/2E- 7B1	10/17/51	522	0.14	17	2.69	2.06	0.96	0.07	0.0	4.03	0.71	0.85	0.06
12S/2E- 7H1	9/27/51	508	0.16	19	2.69	1.73	1.04	0.06	0.0	4.41	0.45	0.71	0.05
12S/2E- 7K1	10/17/51	492	0.20	16	2.45	2.06	0.87	0.05	-----	4.16	0.48	0.75	0.02
12S/2E- 8C1	10/18/51	935	0.03	16	4.59	3.62	1.57	0.08	0.0	4.36	3.50	1.10	0.37
12S/2E- 8E1	10/16/51	524	0.17	16	2.89	1.97	0.96	0.06	0.0	4.59	0.45	0.77	0.01
12S/2E- 8F1	10/17/51	512	0.15	17	2.59	2.14	0.96	0.05	0.0	4.56	0.56	0.56	0.0
12S/2E- 8F3	10/18/51	441	0.11	20	2.29	1.48	0.95	0.05	0.0	3.80	0.45	0.50	0.01
12S/2E- 8G1	10/ 2/51	604	0.13	20	2.79	2.47	1.35	0.07	0.0	4.92	0.79	0.73	0.04
12S/2E- 8G2	9/27/51	554	0.21	21	2.59	2.14	1.30	0.06	0.0	4.59	0.65	0.75	0.01
12S/2E- 8K1	4/21/47	614	0.19	20	3.7	1.6	1.3	-----	-----	4.9	0.8	0.9	-----
12S/2E- 8K2	10/16/51	620	0.29	20	3.34	2.14	1.35	0.06	0.0	5.15	0.87	0.73	0.09
12S/2E- 8L3	11/ 5/51	667	0.22	19	2.89	2.30	1.20	0.04	0.0	4.79	0.71	1.00	0.01
12S/2E- 8N1	10/16/51	558	0.20	18	2.94	2.06	1.13	0.05	0.0	4.72	0.75	0.62	0.01
12S/2E- 8P1	10/16/51	945	0.21	22	4.54	3.95	2.44	0.07	0.0	7.60	1.58	1.73	0.01
12S/2E- 8Q1	10/17/51	1,480	0.35	20	3.29	10.61	3.57	0.03	0.0	8.82	1.47	3.62	3.29
12S/2E- 9C1	5/28/48	719	-----	22	3.84	2.38	1.77	-----	0.0	5.56	0.85	1.21	0.37
12S/2E- 9C1	10/17/51	535	0.05	19	2.54	2.22	1.13	0.05	0.0	4.00	0.65	0.98	0.08
12S/2E-11K1	6/23/50	1,080	0.35	20	4.50	6.10	2.66	-----	-----	9.8	1.7	1.47	0.05
12S/2E-12E1	7/15/47	1,260	0.44	20	11.2	0.3	2.7	-----	-----	9.6	2.2	2.4	-----
12S/2E-16N1	10/17/51	933	0.47	26	3.29	4.69	2.78	0.06	0.0	8.26	1.21	1.21	0.07
12S/2E-17D2	10/ 2/51	664	0.20	19	3.34	2.63	1.39	0.04	0.0	5.57	0.73	0.94	0.03
12S/2E-17K1	4/21/47	739	0.12	18	4.5	2.4	1.5	-----	-----	6.3	0.9	1.2	-----
12S/2E-17L1	10/18/51	696	0.13	20	3.09	3.21	1.57	0.08	0.0	5.70	0.96	1.17	0.0
12S/2E-17Q1	6/23/50	770	0.20	22	3.75	3.39	2.07	-----	-----	7.15	1.0	0.91	trace
12S/2E-17R1	4/28/47	739	0.20	26	3.7	1.7	1.9	-----	0.6	4.6	1.0	1.1	-----
12S/2E-18A1	10/ 2/51	588	0.32	19	3.04	2.22	1.26	0.07	0.0	4.98	0.62	0.83	0.0
12S/2E-18D1	10/ 5/51	422	0.16	21	1.49	2.05	0.96	0.05	0.0	3.49	0.45	0.60	0.01
12S/2E-18G1	10/18/51	440	0.11	22	1.45	2.30	1.08	0.07	0.0	3.57	0.33	0.83	0.01
12S/2E-18G2	10/ 2/51	453	0.20	22	2.04	1.64	1.04	0.04	0.0	3.62	0.39	0.75	0.0
12S/2E-18L1	10/18/51	466	0.04	22	1.70	2.30	1.13	0.07	0.0	3.87	0.42	0.77	0.01

TABLE 17—Continued

COMPLETE MINERAL ANALYSES OF CONFINED GROUND WATERS IN SANTA CRUZ-MONTEREY AREA

Well number	Date of sample	Conductance Ec x 10^6 at 25° C.	Boron, in ppm	Percent sodium	Mineral constituents, in equivalents per million								
					Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3
12S/2E-19A1	10/16/51	612	0.26	20	3.09	2.38	1.39	0.08	0.0	5.21	0.56	1.02	0.0
12S/2E-20A1	9/26/51	862	0.38	22	3.49	4.11	2.13	0.04	0.0	7.34	1.24	1.10	0.02
12S/2E-20L1	10/10/51	665	0.21	24	2.89	2.80	1.87	0.08	0.0	5.97	0.65	0.73	0.0
12S/2E-25Q1	9/15/47	714	0.13	61	1.7	0.7	3.7	--	0.3	2.4	1.8	1.6	--
12S/2E-29H1	10/17/51	597	0.22	29	2.30	2.22	1.91	0.09	0.0	4.72	1.02	0.65	0.06
12S/2E-30F1	9/14/51	519	0.25	25	1.70	2.63	1.48	0.05	0.67	3.46	0.42	1.29	0.01
12S/2E-30F2*	4/14/49	6,400	--	22	22.2	29.0	15.7	--	--	3.4	58.5	5.0	--
12S/2E-30F2*	7/29/49	7,300	0.09	24	27.13	37.35	20.40	--	--	2.95	72.20	6.60	0.09
12S/2E-30R2	10/19/51	644	0.13	20	2.20	3.45	1.39	0.06	0.0	4.33	1.69	1.04	0.0
12S/2E-31E1	9/14/51	699	0.34	39	1.70	2.47	2.74	0.05	0.47	2.20	2.26	1.77	0.50
12S/2E-32K1	11/ 9/51	483	0.0	43	1.15	1.40	1.96	0.08	0.0	1.90	2.14	0.27	0.11
12S/3E-17M3	9/26/51	875	0.10	20	2.94	4.69	1.91	0.04	0.0	5.38	1.47	1.37	1.13
12S/3E-18B1	6/23/50	1,110	0.32	21	3.9	6.89	2.84	--	--	9.1	1.6	1.74	0.66
13S/1E- 1A1*	7/29/49	1,240	0.23	35	4.25	4.89	4.95	--	--	3.43	6.95	2.44	0.43
13S/1E- 1A1*	9/14/51	1,460	0.26	34	4.54	5.26	5.09	0.09	0.67	3.08	8.04	2.50	0.52
13S/2E- 7B1*	7/29/49	1,390	0.27	34	4.32	5.78	5.20	--	--	3.99	9.41	1.40	0.10
13S/2E- 7B1*	9/14/51	1,190	0.24	27	4.14	4.36	3.17	0.09	0.47	2.52	7.19	1.39	0.39
13S/2E- 7B2*	9/14/51	1,800	0.28	33	5.24	6.99	6.09	0.09	0.93	3.44	11.85	1.64	0.05
Soquel Unit													
10S/1W-26E1	10/ 2/51	1,080	1.30	58	2.64	1.97	6.44	0.07	0.0	5.21	2.40	3.73	0.01
10S/1W-34A1	1/24/50	465	0.10	16	2.65	2.47	1.00	--	--	3.10	0.7	1.94	0.04
11S/1W-15E1	10/ 3/51	744	0.04	14	4.84	2.06	1.17	0.09	0.0	3.00	0.93	4.18	0.0
11S/1W-21H1	1/23/50	578	0.12	30	2.90	2.21	2.12	--	--	2.60	1.70	2.43	0.04
11S/1W-21K1	10/ 3/51	651	0.10	29	2.99	1.64	1.96	0.12	0.0	2.52	1.64	2.52	0.0

* Wells located near Monterey Bay.

TABLE 18

COMPLETE MINERAL ANALYSES OF GROUND WATERS OVERLYING CONFINED AQUIFERS IN PAJARO UNIT

Hole number	Date of sample	Conductance, Ec x 10^6 at 25° C.	Boron, in ppm	Percent sodium	Mineral constituents, in equivalents per million							
					Ca	Mg	Na	K	HCO_3	Cl	SO_4	NO_3
1	9/25/51	32,400	6.3	80	13.72	54.28	300.47	4.76	17.21	310.24	47.26	0.19
2	9/25/51	1,580	0.47	50	2.79	5.67	8.91	0.01	7.60	1.83	5.18	2.82
3	9/25/51	1,720	0.59	21	5.99	10.44	4.52	0.02	7.67	1.64	8.20	3.52
4	9/25/51	2,400	1.5	52	2.20	12.41	15.65	0.02	14.52	3.24	11.72	1.23
5	9/25/51	950	0.5	24	4.29	3.95	2.70	0.01	5.97	1.47	2.91	0.40
6	9/26/51	1,540	0.66	20	5.09	8.80	3.61	0.03	8.62	1.97	4.27	2.55
7	9/26/51	1,630	0.81	18	4.99	11.10	3.65	0.02	10.16	1.55	6.58	1.56
8	9/26/51	1,520	0.53	19	5.74	8.55	3.48	0.16	10.42	1.69	4.64	1.32
9	9/26/51	2,240	1.29	69	2.45	5.51	17.83	0.04	11.80	2.96	6.35	4.71
10	9/28/51	830	0.29	22	3.59	3.95	2.13	0.02	7.08	0.96	1.48	0.01
14	10/ 4/51	1,760	0.38	14	6.54	11.27	2.87	0.24	9.83	2.14	4.83	4.03
17	9/27/51	820	0.21	11	4.74	2.71	0.96	0.03	2.95	1.30	2.33	1.68
19	9/27/51	3,750	1.68	89	1.20	2.96	34.79	0.07	17.80	18.19	4.01	0.06
20	9/27/51	2,500	0.83	50	6.34	7.73	14.35	0.08	16.95	8.04	3.25	0.03
21	9/27/51	2,900	0.62	7	22.11	16.86	2.78	0.14	0.21	1.41	39.97	0.01
22	10/ 5/51	530	0.12	38	1.85	1.56	2.09	0.01	2.56	0.85	1.83	0.23
23	9/26/51	1,290	0.42	19	3.79	8.22	2.74	0.03	8.10	1.27	3.50	1.71
24	9/27/51	1,000	0.31	16	4.74	5.18	1.87	0.03	9.18	0.76	1.64	0.06
25	10/ 3/51	1,090	0.35	20	4.99	4.93	2.39	0.03	5.90	0.76	3.54	1.97

CHAPTER III

WATER UTILIZATION AND SUPPLEMENTAL REQUIREMENTS

The nature and extent of water utilization and of requirements for supplemental water in the Santa Cruz-Monterey Area, both at the present time and under probable conditions of ultimate development, are considered in this chapter. In connection with the discussion, the following terms are used as defined:

Water Utilization—This term is used in a broad sense to include any employments of water by nature or man, either consumptive or nonconsumptive, as well as those irrecoverable losses of water incidental to such employment, and is synonymous with the term "water use."

Demands for Water—Those factors pertaining to specific rates, times, and places of delivery of water, losses of water, quality of water, etc., imposed by the control, development, and use of the water for beneficial purposes.

Water Requirement—The amount of water needed to provide for all beneficial uses and for irrecoverable losses incidental to such uses.

Supplemental Water Requirement—The water requirement over and above the sum of safe ground water yield and safe surface water yield.

Consumptive Use of Water—This refers to water consumed by vegetative growth in transpiration and building of plant tissue, and to water evaporated from adjacent soil, from water surfaces, and from foliage. It also refers to water similarly consumed and evaporated by urban and nonvegetative types of culture.

Applied Water—The water delivered to a farmer's headgate in the case of irrigation use, or to an individual's meter in the case of urban use, or its equivalent, and does not include direct precipitation.

Ultimate—This refers to an unspecified but long period of years into the future when development will be essentially stabilized. (It is realized that any present forecasts of the nature and extent of such ultimate development, and resultant water utilization, are inherently subject to possible large errors in detail and appreciable error in the aggregate. However, such forecasts, when based upon best available data and present judgment, are of value in establishing long-range objectives for development of water resources. They are so used herein, with full knowledge that their re-evaluation after the experience of a period of years may result in considerable revision.)

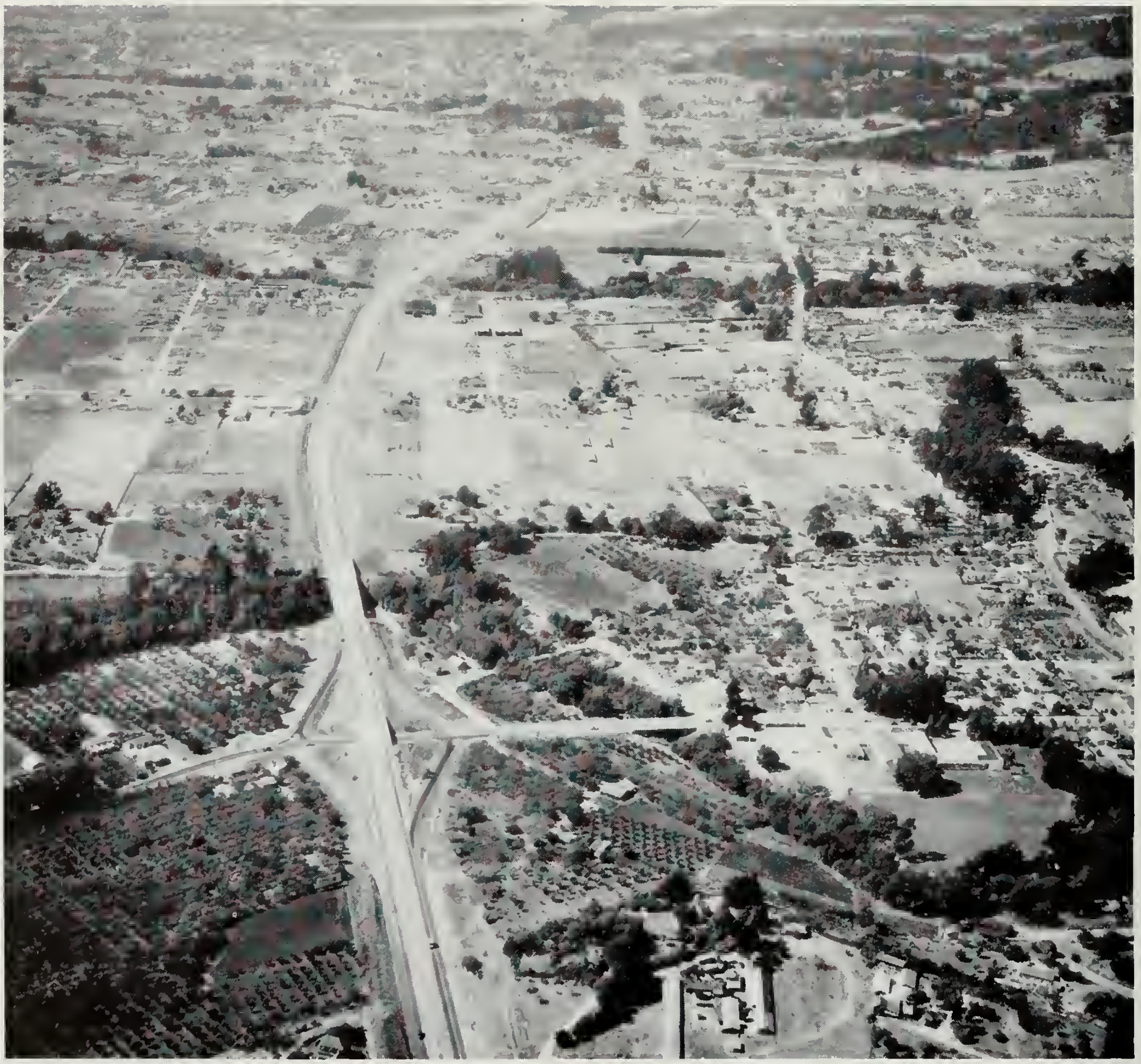
Present water utilization in the Santa Cruz-Monterey Area was estimated by the application of appropriate factors of unit water use to the present land use pattern as determined from survey data. Probable ultimate water utilization was similarly estimated, by the use of an ultimate pattern of land use projected from the present pattern on the basis of land classification data, the assumptions being made that under ultimate conditions all irrigable lands would be irrigated and all potential urban and recreational lands would be developed. As indicated by the foregoing definition, supplemental requirements for water were estimated as the differences between derived values of safe yield of the local water supply, as presently developed, and water requirements under both present and ultimate conditions of development.

Certain possible nonconsumptive requirements for water, such as those for flood control, conservation of fish and wildlife, etc., will be of varying significance in the design of works to meet supplemental consumptive requirements for water in the Santa Cruz-Monterey Area. In most instances the magnitudes of such nonconsumptive requirements are relatively indeterminate, and dependent upon allocations made in design after consideration of factors of economics. For these reasons, water requirements for flood control and conservation of fish and wildlife are discussed in general terms in this chapter, but are not specifically evaluated.

Water utilization is considered and evaluated in this chapter under the general headings "Present Water Supply Development," "Land Use," "Unit Use of Water," "Present Water Utilization," "Probable Ultimate Water Utilization," "Demands for Water," and "Nonconsumptive Water Demands." Supplemental water requirements are similarly treated under the two general headings "Present Supplemental Requirement" and "Probable Ultimate Supplemental Requirement."

WATER UTILIZATION

Of the total amount of water presently served for beneficial use in the Santa Cruz-Monterey Area, approximately 73 percent is utilized in the production of irrigated crops, while the remainder is utilized for urban and recreational purposes. Of the total of about 290,000 acres in the area, it is indicated that approximately 96,000 acres ultimately will require water service. The remainder of approximately 194,000 acres comprises mountainous forest, brush, and grass lands. In general, water utilization on these lands was not studied in the present investigation, since their water requirements have been and will continue to be met from rainfall, regardless of present or future water



(Photo, State Division of Highways)

Soquel Unit, Soquel at Right

development works. However, water utilization on the tributary watershed of the Pajaro Unit was evaluated, insofar as it concerned the hydrology of the Forebay Zone of that unit. Lands of the Santa Cruz-Monterey Area developed at the present time and those forecast to be developed under ultimate conditions are generally limited to the valley floor and bench lands of the Pajaro Unit, and to the coastal strip, small valleys near highways, stream canyons, and areas topographically suitable for development at higher elevations in the remainder of the area.

Present Water Supply Development

Approximately three-fourths of all water developed and used in the Santa Cruz-Monterey Area is presently supplied by water pumped from underlying ground water basins. Lands utilizing ground water are generally served by individually owned wells and pumps. Because of these facts the amount of water developed for use by individuals is larger than by organizations. In 1949 there were about 600 wells and pumping plants of heavy draft. A number of additional wells of light draft supplied limited amounts of water for noncommercial gardens and orchards, and for domestic purposes. Lands served principally with ground water comprise the Pajaro Unit and the coastal strip northwest of the Pajaro Unit.

Surface diversions are made from numerous streams rising in the Santa Cruz Mountains, principally for urban and recreational uses.

Water Service Agencies. Water for urban, industrial, and recreational use in the Santa Cruz-Monterey Area is furnished by numerous water service agencies which obtain their water supply principally by surface diversion from numerous streams in the area.

The North Coastal Unit is supplied largely from surface water sources, with the exception of a small area near the westerly boundary of the City of Santa Cruz for which water is pumped from wells. The Santa Cruz Portland Cement Company at Davenport diverts surface flow from San Vicente Creek and from one of its small tributaries. The water is used by the cement company, the town of Davenport, and the Southern Pacific Company.

The largest water service agency in the San Lorenzo Unit is the Water Department of the City of Santa Cruz which diverts surface water from Liddell, Laguna, and Majors Creeks in the North Coastal Unit, and from the San Lorenzo River. The diverted water from the North Coastal Unit is conveyed by means of two pipe lines of 10-inch and 14-inch diameter, respectively, to a distributing reservoir in Santa Cruz. These three creeks furnish most of the water required by Santa Cruz during the winter, but only a minor portion during the summer. The summer flow available from this source in the drier years is only about one-half of the 3,000,000 gallon per day capacity of the pipe lines. The summer deficiency in water supply is made up by pumping surface and subsurface flow of the San Lorenzo River from a point near the northern city limits of Santa Cruz and conveying it to the distributing reservoir. The capacity of the system diverting from the San Lorenzo River is about 9,000,000 gallons per day. The city's water from the San Lorenzo River is treated with activated carbon, and is pressure filtered and chlorinated, while treatment of that from the North Coastal Unit streams is limited to chlorination.

In addition to its incorporated area, the City of Santa Cruz provides water service to a considerable area outside its limits, and in 1949 had about 10,100 service connections. The coastal strip westerly from Santa Cruz to a point approximately one-half mile west of Laguna Creek is served by the city. The southern portion of Graham Hill and a strip along Branciforte Creek north of Santa Cruz are also served from the city system, as is an area to the east of Santa Cruz extending to within about one mile of Soquel.

The portion of the San Lorenzo Unit lying north of Felton is served with domestic water by two public utilities and by 22 small private or mutual water companies. Their principal sources of water supply are direct surface diversions from the San Lorenzo River or its tributaries. In many instances the diversions are made at elevations permitting gravity distribution, while others are accomplished by pumping from the local streams. The San Lorenzo Valley County Water District, organized in 1941, includes most of the area served from the San Lorenzo River north of Felton. The district has purchased two dam and reservoir sites and plans additional water developments, but does not serve water at this time.

Scott Valley and vicinity, situated in the San Lorenzo Unit, is served by several small water supply agencies which divert from a tributary of Branciforte Creek. Water for domestic purposes is obtained by a number of the residents from individually owned wells drilled in the small local ground water basin.

In the Soquel Unit, the coastal strip between Santa Cruz and La Selva Beach is served by five water service agencies which obtain their supply from ground water. Of these, the three principal agencies are the Monterey Bay Water Company serving Capitola, Soquel, Aptos, and La Selva Beach, the Beltz Water Company serving a small area between Santa Cruz and the service area of the Monterey Bay Water Company, and the Seacliff Water Company serving several subdivisions west of Aptos.

The Pajaro Unit is served with domestic and municipal water by three water service agencies, the principal of which is the Watsonville Municipal Water Department which had about 5,200 service connections in 1949. Of this total, about 1,800 connections were outside the city limits of Watsonville. Water is diverted by the department from Corralitos Creek by means of a small diversion structure about one mile above the town of Corralitos. The diverted water passes through a short tunnel, and is conveyed in a steel pipe line to a treatment plant located at Corralitos. A minor diversion is also made from Browns Valley Creek and this water is also conveyed to the Corralitos treatment plant. After treatment, the water is conveyed by means of two steel pipe lines to a storage reservoir located between Freedom and Watsonville, and is distributed from this reservoir to areas of use. Four wells, pumping from ground water, provide supplemental water to the city as required.

Table 19 lists the principal water service agencies of the Santa Cruz-Monterey Area, together with notations on their source of water supply and number of services in 1949. Areas included within the boundaries of those agencies having more than 100 services are shown on Plate 2.

Appropriation of Water. Since the effective date of the Water Commission Act on December 19, 1914, 56 applications to appropriate water of streams of the Santa Cruz-Monterey Area have been filed with the Division of Water Resources or its predecessors. These applications are listed in Appendix G, together with pertinent information on the proposed diversions and uses of water and present status of the applications.

The applications listed in Appendix G should not be construed as comprising a complete or even partial statement of water rights in the Santa Cruz-Monterey Area. They do not include appropriative rights initiated prior to December 19, 1914, riparian rights, correlative rights of overlying owners in ground water basins, nor prescriptive rights which may have been established on either surface streams or ground water basins, none of which are of record with the Division of Water Resources. In general, water rights may only be firmly established by court decree.

Dams Under State Supervision. The Department of Public Works, acting through the agency of the State Engineer, supervises the construction, enlargement, alteration, repair, maintenance, operation, and removal of dams, for the protection of life and property within California. All dams in the State, excepting those under federal jurisdiction, are under the juris-

TABLE 19

PRINCIPAL WATER SERVICE AGENCIES, SANTA CRUZ-MONTEREY AREA

Agency	Source of water supply	Number of services in 1949
North Coastal Unit		
Davenport	San Vicente Creek	75
San Lorenzo Unit		
Assemblies of God (mutual)	Carbonero Creek, tributary to Branciforte Creek	15*
Bauer Water Company	Gold Gulch, tributary to San Lorenzo River	30
Ben Lomond Redwood Park Water Company	Springs	107
Beulah Park Mutual Water Company	Carbonero Creek, tributary to San Lorenzo River	17
Big Basin Water Company	Springs	45
Big Redwood Park Mutual Water Company	Bean Creek	24
Bracken Brae Corporation	Springs	25
California Conference of the Free Methodist Church	Ground water	6*
Cathedral Woods Mutual Water Company	Soquel Creek	4
Citizens Utilities Company of California	Pee Vine, Forman, Clear, Marshall, and Thaler Creeks, all tributary to San Lorenzo River	1,938
City of Santa Cruz	Liddell, Laguna, Majors Creeks, San Lorenzo River	10,100
Felton Water Company	Fall, Bull, Bennett Creeks, all tributary to San Lorenzo River	620
Forest Lakes Mutual Water Company	Gold Gulch, tributary to San Lorenzo River	150
Forest Springs Mutual Water Company	Springs	108
Gold Gulch Mutual Water Company	Ground water	27
Hacienda Mutual Water Company	Carbonero Creek, tributary to Branciforte Creek	22
Larita Woods Mutual Water Company	Citizens Utilities Company of California	24
Lompico Cooperative Water Association	Lompico Creek, and springs	171
Lorenzo Water Works	Springs	130
Love Creek Heights Mutual Water Company	Springs	25
Manana Woods Mutual Water Company	Ground water	6
Mission Springs Water Company	Spring, and ground water	100*
Monterey Bay Water Company (Zayante)	Zayante Creek	167
Mountain Springs Water Company	Marshall Creek, tributary to San Lorenzo River	11
Mt. Hermon Association	Springs	400
Olympia Mutual Water Company	Springs	27
Paradise Park Water Company	Eagle Creek, tributary to San Lorenzo River	355
Riverside Grove Water Company, Inc.	Big Basin Water Company	108
Ramona Woods Mutual Water Company	San Lorenzo River	21
San Lorenzo River Park Mutual Water Company	San Lorenzo River	60
San Lorenzo Woods Mutual Water Company	San Lorenzo River	45
San Lorenzo Valley County Water District		0
Soquel Unit		
Beltz Water Company	Ground water	635
Forest Glen Water Company	Ground water	41
Monterey Bay Water Company (La Selva Beach)	Ground water	144
Monterey Bay Water Company (Soquel, Aptos, Capitola)	Ground water	1,909
Seacliff Water Works	Ground water	280
Valencia Water Works		18
Pajaro Unit		
Highland Park Water Service	Corralitos Creek	12
New Freedom Mutual Water System	Ground water	85
Watsonville Municipal Water Department	Corralitos Creek, Browns Valley Creek, tributary to Corralitos Creek, and ground water	5,200

* Greatly increased during summer months.

TABLE 20

DAMS UNDER STATE SUPERVISION, SANTA CRUZ-MONTEREY AREA

Item	Mill Creek Dam	Sempervirens Dam	Cowell Dam
Owner	Santa Cruz Land and Water Development Association	Division of Beaches and Parks, State Department of Natural Resources	City of Santa Cruz
Stream	Mill Creek	Sempervirens	
Location	SE. ¼, Sec. 29, T. 9 S., R. 3 W., M. D. B. & M.	Sec. 32, T. 8 S., R. 3 W., M. D. B. & M.	Sec. 11, T. 11 S., R. 2 W., M. D. B. & M.
Type	Timber and rockfill	Earthfill	Earthfill
Use	Recreation	Domestic	Not used (dam breached)
Date of completion	1889	1951	1890
Height above stream bed, in feet	50	44	51
Elevation of crest, in feet	1,360	1,233	430
Storage capacity, in acre-feet	223	52	175

diction of the Department. ''Dam'' means any artificial barrier, together with appurtenant works, if any, across a stream, watercourse, or natural drainage area, which does or may impound or divert water, and which either (a) is or will be 25 feet or more in height from natural stream bed to crest of spillway, or (b) has or will have an impounding capacity of 50 acre-feet or more. Any such barrier, which is or will be not in excess of six feet in height, regardless of storage capacity, or which has or will have a storage capacity not in excess of 15 acre-feet, regardless of height, is not considered a dam. Three dams in the Santa Cruz-Monterey Area are presently under state supervision. Pertinent data relating to these dams are presented in Table 20.

Land Use

As a first step in estimating the amount of water utilization in the Santa Cruz-Monterey Area during the investigational seasons, determinations were made of the nature and extent of land use prevailing during the seasons. Similarly, the probable nature and extent of ultimate land use, as related to water utilization, was forecast on the basis of data obtained from a land classification survey and from a survey of habitable areas. The land classification survey segregated lands of the area in accordance with their suitability for irrigated agriculture, while the survey of habitable areas segregated lands in accordance with their suitability for urban and recreational development.

Present Land Use. A comprehensive land use survey was made in the Pajaro Unit in the season of 1946-47 as a part of the current investigation. This survey was extended in 1949-50 to include irrigated lands in the remainder of the Santa Cruz-Monterey Area. Inhabited and potentially habitable lands in the North Coastal, San Lorenzo, and Soquel Units were surveyed relative to general types of land use in 1948-49. Data obtained from these surveys were considered representative of ''present'' conditions of land use and development in the area, and are so referred to in subsequent discussion.

Areas classified as agricultural are largely confined to the valley floor of the Pajaro Unit, and to the relatively narrow coastal strip and numerous small and widely scattered areas in the North Coastal, San Lorenzo, and Soquel Units. Principal irrigated crops in the Pajaro Unit consist of lettuce, orchards, sugar beets, and tomatoes, while dry farming is limited mostly to field crops and orchards. Irrigated lands in other units of the area are devoted almost entirely to truck crops, while orchard and grain crops predominate on the dry-farmed lands.

The largest and most important areas classified as urban and suburban are those in and around the Cities of Santa Cruz and Watsonville. Smaller urban areas include Davenport, Boulder Creek, Ben Lomond, Felton, Soquel, Aptos, La Selva Beach, Corralitos, Freedom, and Watsonville Junction.

Areas classified as recreational are largely confined to canyons along major and minor streams in the North Coastal, San Lorenzo, and Soquel Units that support only seasonal habitation. A considerable area along the San Lorenzo River was classified as urban and suburban rather than recreational, due to its permanent year-around habitation and commercial enterprise, even though it is supported largely by recreational development. Ordinary considerations governing the selection of homesites elsewhere do not necessarily apply to the areas classified as recreational in the Santa Cruz-Monterey Area. Recreational habitations may be found along any continuously flowing stream wherever access is possible. Such homes and cabins are sometimes built on slopes as steep as 45 degrees, and in locations which can be reached only by narrow and steep one-way roads. Many of these dwellings are inhabited throughout the summer, and usually all are crowded during weekends.

Results of the land use survey of 1946-47 in the Pajaro Unit are presented in Table 21. Summaries of the results of the habitable area survey made in the remainder of the area in 1948-49, and the extended survey of irrigated lands in 1949-50, are shown in Table 22. Present land use in the Santa Cruz-Monterey Area is shown on Plate 18, entitled ''Present and Probable Ultimate Water Service Areas.''

Probable Ultimate Land Use. The forecast of the probable ultimate land use in the Santa Cruz-Monterey Area was based on the results of surveys conducted to

TABLE 21

PRESENT LAND USE IN PAJARO UNIT

(In acres)

Class and type of land use	Valley Floor and Upper Pressure Zones	Forebay Zone		Totals
		Bench lands	Tributary watershed	
Irrigated lands				
Alfalfa	180			180
Artichokes	560			560
Beans	840	10		850
Berries	380	330		710
Lettuce, 2-crop	3,300			3,300
Lettuce, 3-crop	200			200
Lettuce and truck	3,960			3,960
Miscellaneous	550	60	60	630
Orchard	3,110	70	10	3,190
Pasture	630	30		660
Strawberries	130	10		140
Sugar beets	1,450			1,450
Tomatoes	1,230	70	10	1,310
Truck	830	40		870
Guayule	10			10
Subtotals	17,360	620	40	18,020
Dry-farmed lands				
Dry-farmed field crops	3,610	1,990	1,700	7,300
Fallow land	350	40	10	400
Orchard (old)	2,950	4,010	460	7,420
Tomatoes (dry-farmed)	10			10
Orchard (young)	420	50		470
Holly		110		110
Subtotals	7,340	6,200	2,170	15,710

Class and type of land use	Valley Floor and Upper Pressure Zones	Forebay Zone		Totals
		Bench lands	Tributary watershed	
Native vegetation				
Native grass	3,260	3,710	5,040	12,010
Medium brush	910	1,270	90	2,270
Chapparal, etc.	180	2,000	4,550	6,730
Swamp, tules	90	20		110
Forest	20	30	9,320	9,370
Subtotals	4,460	7,030	19,000	30,490
Miscellaneous				
Airport	240			240
Roads and railroads	210	10		220
Town and farm lots	1,790	70		1,860
Waste land	890			890
Water surface	620	10		630
County and farm roads	1,120	440	230	1,790
Subtotals	4,870	530	230	5,630
TOTALS	34,030	14,380	21,440	69,850

TABLE 22

PRESENT LAND USE IN NORTH COASTAL, SAN LORENZO, AND SOQUEL UNITS

(In acres)

Class of land use	North Coastal Unit	San Lorenzo Unit	Soquel Unit	Totals
Urban	100	6,900	1,100	8,100
Recreational		6,200	700	6,900
Irrigated lands	2,040	460	900	3,400
Subtotals	2,140	13,560	2,700	18,400
Dry-farmed lands	460	640	6,400	7,500
Mountain lands and other undeveloped areas	68,700	80,800	44,800	194,300
TOTALS	71,300	95,000	53,900	220,200

determine suitability of the lands for the several prevailing classes of land use involving water utilization. A land classification survey was conducted in the Pajaro Unit in the season of 1950-51, segregating lands in accordance with their suitability for irrigated agriculture. This survey was limited to the Pajaro Unit, since most of the agricultural lands in the Santa Cruz-Monterey Area are in this unit. Furthermore, little or no future increase in irrigated acreage is anticipated in the remainder of the Santa Cruz-Monterey Area, because of the present and indicated future trend toward predominantly urban and recreational development. Lands in the North Coastal, San Lorenzo, and Soquel Units were classified relative to their suitability for urban, suburban, recreational, and minor irrigation development, during a survey conducted in 1948-49. The classification was generalized and limited to the classes indicated, without further subdivision into types of land use.

During the land classification survey of 1950-51, lands in the Pajaro Unit were segregated into the following four classes:

Unsegregated Irrigable. This classification combined all lands with smooth lying alluvial soils having more or less similar crop adaptabilities. These soils are considered desirable for continuous irrigated agriculture. No attempt was made to delineate various classes of irrigable valley floor lands. These lands are easily leveled and are well-suited to basin and furrow irrigation practices.

Class 4(2). These lands have less desirable topographic features than the Unsegregated Irrigable class, yet are suitable for the production of climatically adapted crops irrigated by sprinkler or other special methods.

Class 4(3). These lands, in general, have steeper or more rolling topography and shallower soil depths than Class 4(2), yet are suitable for the production of climatically adapted crops. Because of their less favorable topography these lands are more susceptible to erosion, and greater care must be taken in irrigating and in maintaining a cover crop.

Class 6. This class comprises all valley floor and bench lands that do not meet the minimum requirements of suitability for irrigation use.

About 950 acres of land in Watsonville were classified as urban, as were an additional 850 acres of land comprising small scattered communities and farm lots, or a total of 1,800 acres. Mountain forest lands which cover some 19,600 acres of the tributary watershed in the Pajaro Unit were considered to be nonirrigable. A summary of the results of the land classification made for the Pajaro Unit in the season of 1950-51 is presented in Table 23.

TABLE 23

CLASSIFICATION OF LANDS IN PAJARO UNIT

Land class	Area, in acres
Irrigable	
Unsegregated	17,450
4(2)	10,140
4(3)	7,810
Subtotal	35,400
Nonirrigable	
6	13,000
Mountain forest	19,600
Subtotal	32,600
Urban	1,800
TOTAL	69,800

It was assumed that under an increasing pressure of demand for agricultural products all irrigable lands in the Pajaro Unit, except those lands which will be absorbed by urban development, will ultimately be irrigated. Based on independent forecasts of population and density, it was estimated that urban development in the Pajaro Unit will increase to about 4,800 acres under ultimate conditions of development. The projected ultimate pattern of land use in the Pajaro Unit, summarized by general classes of such use, is presented in Table 24. The location and extent of probable ultimate water service in the Pajaro Unit are shown on Plate 18.

TABLE 24

PROBABLE ULTIMATE LAND USE IN PAJARO UNIT

Class of land use	Area, in acres
Irrigated lands	32,400
Sloughs, lakes, stream beds, airports, etc.	13,000
Mountain forest	19,600
Urban area	4,800
TOTAL	69,800

The estimate of 32,400 acres of irrigated lands in the Pajaro Unit under probable ultimate development, as shown in Table 24, represents gross area. However, the more significant area, as it relates to water utilization, is that area which will be irrigated during any one season. It was estimated that this net seasonal irrigated area in the Pajaro Unit under probable ultimate development will be about 26,900 acres. This estimate was based on the assumption that about one-half of the approximately 3,000 acres expected to be absorbed by future urban development will consist of presently irrigated lands, while the remainder will consist of presently dry-farmed but irrigable lands. The estimate was also based on the assumptions that about 85 percent of the present gross irrigated area will be irrigated in any one season under ultimate development, and that about 80 percent of the gross area of the presently dry-farmed lands that will be irrigated under ultimate development will be irrigated in any one season, which assumptions were predicated on information resulting from the land classification survey. The derivation of the ultimate net seasonal irrigated acreage is presented in Table 25. It should be noted that the figure of 18,000 acres shown in Table 21 for presently irrigated lands represents net acreage, and that, based on survey information, it constitutes about 85 percent of the gross irrigated acreage, estimated to be about 21,200 acres.

TABLE 25

PROBABLE ULTIMATE NET SEASONAL IRRIGATED AREA IN PAJARO UNIT

(In acres)

Item	Presently irrigated lands	Presently dry-farmed irrigable lands	Totals
Gross irrigable area	21,200	14,200	35,400
Less ultimate increase in urban area	1,500	1,500	3,000
Ultimate gross irrigated area	19,700	12,700	32,400
Percent irrigated in any one season	0.85	0.80	......
Estimated ultimate area irrigated in any one season	16,740	10,160	26,900

In the survey of inhabited and habitable areas in the North Coastal, San Lorenzo, and Soquel Units, conducted in 1948-49, lands were segregated into the following five classes on the basis of their suitability for various types of use under ultimate development:

1. Urban
2. Recreational
3. Suburban and rural
4. Irrigated
5. Undeveloped mountainous.

The lands classified as potentially urban are those which probably will have a moderate to dense population, and are situated chiefly along the coast from Santa Cruz to Aptos and along the San Lorenzo River. The potential recreational areas are mainly in the mountains along major highways and along stream canyons accessible by permanent roads. Several narrow strips of beach were also classified as recreational. Lands classified as potentially suburban and rural include those lands which are suitable for low density urban development. Although some of these lands are irrigable, it was indicated that suburban and rural development will predominate. Little or none of the lands included in this class are developed to suburban and rural use at the present time. Lands classified as irrigated under ultimate development are scattered throughout the three units, and comprise very little increase over the lands presently irrigated. The lands classified as undeveloped mountainous were considered as not likely to be developed because of unfavorable characteristics of slope, elevation, accessibility, location, and vegetative cover.

The probable ultimate pattern of land use in the North Coastal, San Lorenzo, and Soquel Units, based on the 1948-49 survey information, is presented in Table 26. The location and extent of probable ultimate water service areas in these units are shown on Plate 18.

TABLE 26

PROBABLE ULTIMATE LAND USE IN NORTH COASTAL, SAN LORENZO, AND SOQUEL UNITS

(In acres)

Class of land use	North Coastal Unit	San Lorenzo Unit	Soquel Unit	Totals
Urban	1,500	15,400	6,000	22,900
Recreational	200	6,100	1,100	7,400
Suburban and rural	10,300	5,200	8,100	23,600
Irrigated	3,900	100	900	4,900
Subtotals	15,900	26,800	16,100	58,800
Undeveloped mountainous	55,400	68,200	37,800	161,400
TOTALS	71,300	95,000	53,900	220,200

A comparison of Table 22 and Table 26 indicates that lands classified as recreational will show little areal increase from present to probable ultimate development. However, the density of this class of development is sparse at present, and a large increase in density was anticipated under conditions of ultimate development. An increase in the density of development of urban areas, as well as of their areal extent, was also anticipated.

Unit Use of Water

The second step in the evaluation of water utilization involved the determination of unit values of water use appropriate for the several units of the Santa Cruz-Monterey Area. Since the method used in the determination of such unit values of water utilization for the Pajaro Unit differed from that used for the other units, the methods are discussed separately hereinafter.

Pajaro Unit. Although consumptive use of water is a correct measure of water utilization in the Forebay Zone, it is not significant in the Valley Floor and Upper Pressure Zones. In the pressure zones nearly all water utilized is pumped from confined aquifers and the unconsumed portion constitutes an irrecoverable loss. For this reason, the amount of ground water pumped, or the applied water, is the significant measure of water utilization in the pressure zones.

During the investigation, measurements were made of the amount of water applied for irrigation of selected plots of principal crops grown on various soil types in the Pajaro Unit. Records of such application of water pumped from wells were obtained for 126 plots irrigated from 43 wells during 1947, and for 63 plots irrigated from 23 wells during 1949. For each well the pump discharge, acreage of each type of crop irrigated, number of irrigations, periods of irrigation, and amounts of water applied in each irrigation were recorded. From these data, supplemented by additional information collected by the United States Soil Conservation Service, monthly and total seasonal applications of water to each crop were determined. Results of these studies, which may be considered representative of prevailing irrigation practices in the Pajaro Unit, are summarized in Table 27. Detailed results of the plot studies are presented in Appendix H, and location of the plots is indicated on Plate 18.

TABLE 27

MEASURED AVERAGE SEASONAL APPLICATION OF IRRIGATION WATER ON REPRESENTATIVE PLOTS OF PRINCIPAL CROPS IN PAJARO UNIT

Crop	Number of plots			Applied water, in feet of depth		
	1947	1949	Total	1947	1949	Weighted average for the two seasons
Alfalfa	3	3	6	1.65	2.57	2.10
Artichokes	3	1	4	1.12	1.62	1.31
Beans	10	6	16	0.99	0.84	0.93
Berries (Bush)	7	6	13	1.09	2.00	1.42
Hops		1	1		2.90	2.90
Lettuce and truck	8	8	16	1.83	1.91	1.86
Lettuce 2-crop	37	7	44	1.78	1.66	1.77
Lettuce 3-crop	9		9	3.08		3.08
Orchard	14	11	25	0.68	0.56	0.63
Pasture	3	1	4	1.60	0.88	1.52
Strawberries	4	2	6	1.91	1.99	1.93
Sugar Beets	8	3	11	1.08	1.73	1.15
Tomatoes	5	4	9	1.03	0.42	0.77
Truck	11	10	21	1.07	1.34	1.18
Vetch	4		4	0.31		0.31

The present weighted average unit application of water to irrigated lands in the Pajaro Unit was estimated to be 1.33 feet of depth per season, based on records of 1946-47 land use and on records of unit application of water obtained during the 1947 and 1949 irrigation seasons. Estimates of probable ultimate unit application of water to irrigated lands were based on the assumptions that presently irrigated lands will maintain their present crop pattern, that about one-half of the increase in irrigated acreage will have a crop pattern similar to the present, and that the remainder of the increase in irrigated acreage will be devoted to irrigated pasture and strawberries. Based on these assumptions it was estimated that the ultimate weighted average unit application of water to irrigated lands will be about 1.46 feet of depth per season.

Present unit urban water utilization in the Pajaro Unit was derived from 1948-49 records and estimates obtained from local water service agencies. The average unit urban water use factor was estimated to be 0.15 acre-foot per capita per season, which is equivalent to a unit use of 1.5 feet of depth in the present urban area. Estimates of probable ultimate urban water utilization were based on the average per capita consumption in 1948-49, adjusted in accordance with an indicated trend of increasing per capita use, and on a forecast of ultimate urban population and density. It was estimated that under ultimate conditions of development, unit urban per capita water use will average about 0.17 acre-foot per season, and that the equivalent unit use of water will be about 1.8 feet of depth per season in the urban area, approximately the same as the present use in the City of Watsonville.

Unit values of consumptive use of water were determined for the Valley Floor and Upper Pressure Zones of the Pajaro Unit in order to derive irrigation efficiency, and were determined for the Forebay Zone in order to evaluate ground water recharge to that zone. Seasonal unit consumptive use values for land use types existing in the Pajaro Unit were obtained generally from a report published by the Soil Conservation Service of the United States Department of Agriculture in December, 1949, and prepared in cooperation with the Division of Water Resources. This report, entitled "Irrigation Practices and Consumptive Use of Water in Pajaro Valley, California," by Harry F. Blaney and Paul A. Ewing, is included in this bulletin as Appendix I. Unit values of consumptive use for irrigated crops, dry-farm crops, and miscellaneous land use in the Pajaro Unit were assumed not to have varied for the three seasons of the investigation. This assumption was based on the facts that growing season temperatures during each season varied only slightly from the mean, and that precipitation during each winter season was more than sufficient to furnish the winter consumptive use of these classes of land use. However, estimates of unit seasonal values of consumptive use by chaparral and forest were varied, depending upon the amount of available rainfall during the investigational seasons as related to the amount that would occur under mean conditions of water supply and climate.

Estimated mean seasonal unit values of consumptive use of water in the Pajaro Unit, including consumption of precipitation, are presented in Table 28.

North Coastal, San Lorenzo, and Soquel Units. In these units of the Santa Cruz-Monterey Area, applied water is the appropriate measure of water requirement, since the unconsumed portion of water applied for the several uses largely wastes to the ocean. Unit values of present seasonal application of water in the North Coastal, San Lorenzo, and Soquel Units were determined for the most part from records obtained from local water service agencies. These agencies were canvassed and data and estimates relative to quantity of water delivered, number of services, and extent of service area, were obtained where available. Unit values of water deliveries per acre were derived from these data and estimates, and were assigned to similar areas for which insufficient data were available.

Estimated unit values of present seasonal application of water by classes of land use for the North Coastal, San Lorenzo, and Soquel Units are presented in Table 29. It should be noted that the value for unit urban application of water in the North Coastal Unit, shown in the table, reflects the relatively high use in Davenport by industry.

TABLE 28

ESTIMATED UNIT VALUES OF MEAN SEASONAL CONSUMPTIVE USE OF WATER IN PAJARO UNIT

Class and type of land use	Growing season	Consumptive use, in feet of depth		
		Applied water	Precipitation	Total
Irrigated lands				
Alfalfa	4/1 to 10/31	1.73	1.42	3.15
Artichokes	5/20 to 10/15	0.71	1.00	1.71
Beans	5/15 to 9/1	0.75	0.75	1.50
Beans with spring lettuce	6/18 to 10/1	0.90	0.70	1.60
Bush berries	4/1 to 10/31	0.55	0.95	1.50
Lettuce and truck[1]	2/1 to 10/31	0.86	0.93	1.79
Lettuce 2 crop[1]	2/1 to 9/1	0.52	0.98	1.50
Lettuce 3-crop	2/1 to 10/31	0.71	1.00	1.71
Orchard	4/1 to 10/31	0.35	1.29	1.64
Pasture	4/1 to 10/31	1.52	1.23	2.75
Strawberries		0.70	0.90	1.60
Sugar beets	4/15 to 10/1	0.92	0.87	1.79
Tomatoes	5/15 to 9/15	0.87	0.92	1.79
Truck	6/15 to 10/31	0.91	0.75	1.66
Miscellaneous		0.50	1.00	1.50
Dry-farmed lands				
Dry-farmed (field crops)				1.30
Fallow				0.70
Orchard (old)				1.40
Orchard (young)				1.30
Holly				1.50
Native vegetation				
Grass				1.30
Sparse brush				1.30
Medium brush				2.80
Dense trees-grass (on valley floor)				4.80
Swamp (tules)				4.50
Chaparral[2]				1.42
Forest[3]				2.00
Miscellaneous				
Roads and railroad				0.60
Town and farm lots				2.00
Waste land				0.60
Water surface				3.60

[1] With winter cover crop.
[2] In rainfall zones of over 20 inches seasonally, consumptive use is estimated to increase 0.84 inch for each 4-inch increase in precipitation up to seasonal consumption of 1.85 feet.
[3] In rainfall zones of over 32 inches seasonally, consumptive use is estimated to increase 2.0 inches per 4-inch increase in precipitation, up to seasonal consumption of 2.66 feet.

Pajaro Unit, Looking North From Bluff Southeast of Watsonville

TABLE 29

ESTIMATED UNIT VALUES OF PRESENT SEASONAL APPLICATION OF WATER IN NORTH COASTAL, SAN LORENZO, AND SOQUEL UNITS

(In feet of depth)

Class of land use	North Coastal Unit	San Lorenzo Unit	Soquel Unit
Urban	8.0	0.7	1.3
Recreational	0.0	0.05	0.14
Irrigated	0.7	0.9	1.0

Values of probable ultimate unit seasonal application of water in the North Coastal, San Lorenzo, and Soquel Units were estimated from the present unit values, modified in accordance with anticipated increase in densities of development. These estimates are presented in Table 30.

TABLE 30

ESTIMATED UNIT VALUES OF PROBABLE ULTIMATE SEASONAL APPLICATION OF WATER IN NORTH COASTAL, SAN LORENZO, AND SOQUEL UNITS

(In feet of depth)

Class of land use	North Coastal Unit	San Lorenzo Unit	Soquel Unit
Urban	2.0	1.1	1.1
Suburban and rural	0.2	0.2	0.2
Recreational	0.5	0.5	0.5
Irrigated	0.7	0.9	1.0

Present Water Utilization

The total amount of water utilized in the Santa Cruz-Monterey Area was estimated by multiplying the area of each type of land use by its appropriate unit value of water utilization. The determinations of seasonal water use in the Pajaro Unit and in the North Coastal, San Lorenzo, and Soquel Units, are discussed separately hereinafter.

Pajaro Unit. Water requirement in the Pajaro Unit comprises agricultural and urban uses, and is measured as the total amount of applied water. Water applied for irrigation is exclusively served from wells pumping from the underlying confined aquifers, whereas that served for urban use is partially pumped from the confined ground water and partially diverted from surfaee sources.

In order to estimate the amount of water applied for irrigation in 1946-47 and in 1948-49, crop acreages as mapped in the land use survey of 1946-47 were multiplied by 1947 and 1949 unit seasonal values of depth of applied water for the several erops as listed in Table 27. Water applied to irrigated crops in 1948 was considered equal to that estimated for 1947 because of the similarity in prevailing conditions of water supply and climate during the two seasons. Present seasonal application of water to irrigated crops, under mean conditions of water supply and climate, was estimated by multiplying crop acreages for 1946-47 by the weighted average unit values of applied water shown in Table 27.

Water presently used for urban purposes was estimated by multiplying the acreage devoted to urban development in 1946-47 by the average unit values of urban application of water determined for 1948-49. The estimates of seasonal water utilization in the Pajaro Unit, as measured by applied water, during the investigational seasons, and for present development under mean conditions of water supply and climate, are presented in Table 31.

TABLE 31

ESTIMATED SEASONAL APPLICATION OF WATER IN PAJARO UNIT

(In acre-feet)

Class of land use	1946-47	1947-48	1948-49	With present land use under mean conditions of water supply and climate
Irrigated lands, served by ground water	23,800	23,800	23,900	23,900
Urban lands				
Served by ground water	800	800	800	800
Served by surface water	1,800	1,800	1,800	1,800
Subtotals, urban lands	2,600	2,600	2,600	2,600
TOTALS	26,400	26,400	26,500	26,500

Estimates of the amount of seasonal consumptive use of water in the Pajaro Unit were necessary in order to permit determination of irrigation efficiency, and in order to evaluate ground water recharge to the Forebay Zone as discussed in Chapter II. These estimates, which include consumptive use of both precipitation and applied water, were made by multiplying the area of each type of land use by its value of unit seasonal consumptive use of water, and the results are presented in Tables 32 and 33. Table 32 segregates the estimates of consumptive use by general classes of

TABLE 32

ESTIMATED SEASONAL CONSUMPTIVE USE OF WATER BY LAND USE CLASSES IN PAJARO UNIT

(In acre-feet)

Class of land use	Area, in acres	1946-47	1947-48	1948-49	With present land use under mean conditions of water supply and climate
Irrigated lands	18,020	31,000	31,000	31,000	31,000
Dry-farmed lands	15,710	18,000	18,000	18,000	18,000
Native vegetation	30,490	54,000	57,000	56,000	59,000
Miscellaneous	5,630	8,000	8,000	8,000	8,000
TOTALS	69,850	111,000	114,000	113,000	116,000

use, while in Table 33 the segregation is by zones of the Pajaro Unit. Both tables present estimates for consumptive use during the three investigational seasons, and with present development under mean conditions of water supply and climate.

TABLE 33

ESTIMATED SEASONAL CONSUMPTIVE USE OF WATER IN ZONES OF PAJARO UNIT

(In acre-feet)

Zone	Area, in acres	1946-47	1947-48	1948-49	With present land use under mean conditions of water supply and climate
Valley Floor and Upper Pressure Zones	34,030	53,000	55,000	54,000	55,000
Forebay Zones					
Bench lands	14,380	19,000	20,000	20,000	22,000
Tributary watershed	21,440	39,000	39,000	39,000	39,000
Subtotal, Forebay Zone	35,820	58,000	59,000	59,000	61,000
TOTALS	69,850	111,000	114,000	113,000	116,000

Consumptive use of water by irrigated lands, as shown in Table 32, is comprised of two components: consumptive use of applied water and consumptive use of precipitation. In order to estimate irrigation efficiency, which is discussed in a subsequent section, an estimate of the amount of consumptive use of applied irrigation water was required. This estimate was made by multiplying unit values of consumptive use of applied irrigation water, presented in Table 28, by the areas of the irrigated crops included in the present land use pattern. On this basis it was estimated that with present development and under mean conditions of water supply and climate, consumptive use of applied irrigation water in the Pajaro Unit totals about 11,800 acre-feet per season.

North Coastal, San Lorenzo, and Soquel Units. Water requirement in the North Coastal, San Lorenzo, and Soquel Units is primarily by urban areas. However, there are significant agricultural and minor recreational uses. Water requirement was measnred as the total amount of applied water.

Present seasonal application of water in the North Coastal, San Lorenzo, and Soquel Units was estimated by multiplying areas of the present land use pattern by appropriate unit values of seasonal application of water, presented in Table 30. Table 34 presents these estimates for present development under mean conditions of water supply and climate, segregated by the predominant classes of land use.

Probable Ultimate Water Utilization

The total seasonal amount of water requirement in the Santa Cruz-Monterey Area was estimated as it would be with probable ultimate conditions of land use and under mean conditions of water supply and climate. This was accomplished by multiplying acreages of each type of land use derived in the forecast of the ultimate land use pattern by corresponding average unit seasonal values of applied water. Applied water was considered to be the significant measure of ultimate water requirement. This was based on the fact that only a very small portion of the unconsumed applied water probably will be available for re-use. The estimate of probable ultimate application of water is summarized in Table 35 by general types of land use and by the four units of the Santa Cruz-Monterey Area.

TABLE 34

ESTIMATED MEAN SEASONAL APPLICATION OF WATER IN NORTH COASTAL, SAN LORENZO, AND SOQUEL UNITS, WITH PRESENT LAND USE

(In acre-feet)

Unit	Class of land use			
	Irrigation	Urban	Recreational	Total
North Coastal	1,300	800	0	2,100
San Lorenzo	400	4,700	300	5,400
Soquel	900	1,400	100	2,400
TOTALS	2,600	6,900	400	9,900

TABLE 35

PROBABLE ULTIMATE MEAN SEASONAL APPLICATION OF WATER IN UNITS OF SANTA CRUZ-MONTEREY AREA

(In acre-feet)

Class of land use	North Coastal Unit	San Lorenzo Unit	Soquel Unit	Pajaro Unit	Totals
Urban	3,000	17,000	6,600	8,800	35,400
Suburban and rural	2,100	1,000	1,600	0	4,700
Recreational	100	3,000	500	0	3,600
Irrigated	2,700	100	900	39,300	43,000
TOTALS	7,900	21,100	9,600	48,100	86,700

Demands for Water

As earlier defined, the term "demands for water" refers to those factors pertaining to rates, times, and places of delivery of water, losses of water, quality of water, etc., imposed by the control, development, and use of the water for beneficial purposes. Irrigation practice in the Santa Cruz-Monterey Area, as determined by irrigation efficiency, monthly demands, and permissible deficiencies in applications of water, must be given consideration in preliminary design of works to meet supplemental water requirements. Similar consideration must be given to monthly demands and permissible deficiencies in urban and recreational water supply development. Furthermore, consideration must be given to the preservation and enhancement of fish and wildlife values. These demand factors, which were not measured or considered in the foregoing estimates of water utilization, are discussed in the following sections.

Irrigation Efficiency. Studies were made to determine approximate irrigation efficiency realized from the application of ground water in the Pajaro Unit. ''Irrigation efficiency'' is defined as the ratio of consumptive use of applied water to the total amount of applied water, and is commonly expressed as a percentage.

It has been estimated that the mean seasonal consumptive use of applied irrigation water in the Pajaro Unit is about 11,800 acre-feet, based upon the present pattern of land use. It has also been estimated that the total amount of applied irrigation water under like conditions is about 23,900 acre-feet per season. It is indicated that the irrigation efficiency realized from application of ground water in the Pajaro unit is about 49 percent.

Monthly Demand for Water. Irrigation demands for water in the Santa Cruz-Monterey Area are seasonal in nature, being confined chiefly to the period from April through September. The maximum rate of demand occurs during the months of June and July, when nearly one-half of the total seasonal demand occurs. Although little information is available on the subject, it is indicated that monthly demands for water for recreational use are similar to those for irrigation, with the greater part of the seasonal total occurring in the summer months. On the other hand, the demand pattern for urban water is continuous throughout the season, with a relatively small variation between the maximum and minimum monthly rates.

Estimated monthly irrigation and urban demands for water in the Santa Cruz-Monterey Area, in percentages of the seasonal totals, are presented in Table 36. The values for monthly irrigation demands were based on the previously discussed application of water studies, made in 1947 and 1949. Values for urban monthly demands were based on the averages of four seasons of records of the City of Santa Cruz and three seasons of records of Watsonville.

Permissible Deficiencies in Application of Water. Studies to determine deficiencies in the supply of irrigation water that may be endured without permanent injury to perennial crops were not made in connection with the Santa Cruz-Monterey Counties Investigation. However, the results of past investigation and study of endurable deficiencies in the Sacramento River Basin may be of interest insofar as they may relate to the Santa Cruz-Monterey Area. In this respect the following is quoted from Division of Water Resources Bulletin No. 26, ''Sacramento River Basin,'' 1931.

"* * * A full irrigation supply furnishes water not only for the consumptive use of the plant but also for evaporation from the surface during application and from the moist ground surface, and for water which is lost through percolation to depths beyond the reach of the plant roots. Less water can be used in years of deficiency in supply by careful application and by more thorough cultivation to conserve the ground moisture. In these ways the plant can be furnished its full consumptive use with much smaller amounts of water than those ordinarily applied and the yield will not be decreased. If the supply is too deficient to provide the full consumptive use, the plant can sustain life on smaller amounts but the crop yield will probably be less than normal.

"It is believed from a study of such data as are available that a maximum deficiency of 35 percent of the full seasonal requirement can be endured, if the deficiency occurs only at relatively long intervals. It is also believed that small deficiencies occurring at relatively frequent intervals can be endured. * * *"

The average seasonal urban demand for water in the Santa Cruz-Monterey Area, which is largely obtained from surface diversions, is considerably less than the total seasonal water supply presently available. However, in many of the water systems supplying urban and recreational service the peak demand rates roughly coincide with and may exceed minimum flows in the streams. As an example, if the draft by the City of Santa Cruz on the San Lorenzo River during 1947 had followed the average pattern into September, the city would have been required to ration water. In design of works to meet urban water demands it is common practice to provide for a full water supply without deficiency at any time. However, it has been the experience of many communities in California that substantial deficiencies may be endured for extended periods of time by rationing the limited water supplies at hand. No information is available regarding the economic effects of such rationing of urban water.

TABLE 36

ESTIMATED AVERAGE MONTHLY DISTRIBUTION OF SEASONAL DEMAND FOR WATER IN SANTA CRUZ-MONTEREY AREA

(In percent of seasonal total)

Month	Irrigation demand			Urban demand
	1946-47	1948-49	Average	
October	2	2	2	11
November	0	0	0	8
December	0	0	0	5
January	0	0	0	5
February	0	0	0	5
March	1	1	1	5
April	11	11	11	6
May	16	15	15	5
June	20	24	22	10
July	21	22	24	13
August	20	17	17	13
September	9	8	8	14
TOTALS	100	100	100	100

Nonconsumptive Water Demands

As has been stated, certain nonconsumptive requirements for water, such as those for flood control, and conservation of fish and wildlife, will be of significance in the design of works to meet consumptive requirements for water in the Santa Cruz-Monterey Area. In most instances the magnitudes of the nonconsumptive requirements are relatively indeterminate, and are dependent upon allocations made during design of the works and after consideration of economic factors. Water requirements for flood control and conservation of fish and wildlife are discussed in general terms in this section, but not specifically evaluated.

Flood Control. Results of the State-wide Water Resources Investigation to date indicate that if California is to attain growth and development commensurate with her manifold resources, nearly all of the potential reservoir storage capacity of the State must be constructed and dedicated to operation for water conservation purposes. This in itself will result in a substantial increase in downstream flood protection. However, any portion of the available reservoir storage capacity that is operated wholly or partially for flood control purposes will correspondingly reduce the capacity available for conservation.

Damages from floods in the Santa Cruz-Monterey Area occur periodically on flatlands adjacent to the lower reaches of the San Lorenzo and Pajaro Rivers. However, the construction of levees on the lower reaches of the Pajaro River and channel clearing therein provide substantial flood protection to the adjacent flatlands and the City of Watsonville. Flood control surveys and studies are presently in progress on the San Lorenzo River by the Corps of Engineers, United States Army.

In preliminary design of works to meet the present and probable ultimate supplemental water requirements of the Santa Cruz-Monterey Area, no consideration was given to additional provisions for flood control and protection, although such might be desirable in certain instances. The provision of reservoir storage space in such new works, operation of the reservoirs for flood control, and channel improvement for flood protection purposes were considered to be outside the scope of the current investigation.

Fish and Wildlife. Of considerable importance among the employments of water for recreational purposes are those associated with the preservation and propagation of fish and wildlife. So far as is known, no artificial lakes in watersheds of the Santa Cruz-Monterey Area are utilized exclusively for fish life, such use being incidental to the primary purposes for which the reservoirs were constructed. It is considered probable, however, that in the future reservoir storage space will be allocated to this purpose, and in some instances reservoirs will be constructed exclusively to augment natural low summer and fall stream flows in the interests of fish life.

Water released down a stream to maintain the minimum flow required for fish life does not constitute a consumptive use of the water. The demands of fish life, however, are frequently incompatible with diversion and use of the water for other beneficial purposes. Nevertheless, it is believed that an improved and adequate stream fishery can be developed and maintained by the construction of upstream storage to improve low stream flow conditions. In addition, reservoirs constructed to regulate stream flow for other purposes will provide a greatly increased lake fishery.

In connection with reservoir yield studies made for the Santa Cruz-Monterey Counties Investigation, a portion of the safe yield was allocated to the interests of fish and wildlife. Releases of such water would provide downstream flows during critical summer months in excess of historical flows during those months.

SUPPLEMENTAL WATER REQUIREMENTS

The previously presented data, estimates, and discussion regarding water supply, utilization, and requirement in the Santa Cruz-Monterey Area indicate that water problems of the area concern both ground water and surface water supplies, and that their effects relate to both irrigated agriculture and urban development. With respect to irrigated agriculture the principal problem is the limited capacity of the confined aquifers in the Pajaro Unit to convey the available water supply to points of use, together with resultant degradation of the ground water by intrusion of sea water. With respect to urban culture, water problems are caused by the inadequacy of surface supplies as presently developed to meet peak summer water demands. It is indicated that water problems of the area may be eliminated or prevented if adequate supplemental water supplies are developed and utilized.

The estimated present and probable ultimate requirements for supplemental water in the Santa Cruz-Monterey Area are discussed and evaluated in the following sections. As previously defined, requirement for supplemental water refers to the requirement over and above the sum of safe ground water yield and safe surface water yield.

Present Supplemental Requirement

The present requirement for supplemental water in the Pajaro Unit was evaluated as the difference between safe yield and present application of ground water. In the North Coastal, San Lorenzo, and Soquel Units the present requirement for supplemental water was evaluated as the difference between safe monthly yield of the surface water sources and corresponding monthly demands. Present supplemental water requirements are discussed and derived separately for the Pajaro Unit and for the North Coastal, San Lorenzo, and Soquel Units.

Pajaro Unit. The safe yield of the Pajaro Unit, as defined in Chapter II, is limited by the maximum rate of pumping draft which can be sustained during the height of the irrigation season without inducing sea-water intrusion into confined aquifers underlying the Valley Floor Pressure Zone. On this basis the seasonal safe yield was estimated to be about 21,000 acre-feet, with the monthly pumping demand pattern that existed during the 1949 irrigation season. Present mean seasonal application of ground water, or pumpage from the confined aquifers, was estimated to be about 24,700 acre-feet. Under the stated conditions, therefore, safe ground water yield is not adequate to meet present pumpage from the confined aquifers. The estimated present seasonal requirement for supplemental water in the Pajaro Unit is the difference between safe yield and application of ground water, and amounts to about 3,700 acre-feet per season.

North Coastal, San Lorenzo, and Soquel Units. Safe yield of the ground water basin in Soquel Valley appears to be somewhat greater than the estimated present draft, and no present requirement for supplemental water is indicated. At the present time significant requirements for supplemental water in the North Coastal, San Lorenzo, and Soquel Units are limited to Santa Cruz and neighboring suburbs served by the City of Santa Cruz Water Department. The present water problem is not due to a shortage of total seasonal supply, but rather to lack of facilities for regulating that supply. Peak demands occur at times of minimum stream flow, although a large amount of runoff wastes to the ocean at other times.

The amount of summer flow in streams of the Santa Cruz Mountains is a function of the amount of precipitation during the spring months. A severe deficiency in spring rains probably would necessitate water rationing by the City of Santa Cruz Water Department under its present monthly demand pattern. Such deficiencies in spring rains have occurred in five seasons since 1894-95. An estimate of the present deficiency, or present supplemental water requirement, of the City of Santa Cruz was made by comparing present monthly water demands with available monthly stream flow during an extremely dry season. Recorded monthly demands during 1949 were considered representative of present conditions, and 1931 was chosen to represent critical stream flow conditions since it was the driest year during the mean period. Although runoff records of the San Lorenzo River and the North Coastal Unit streams, from which Santa Cruz diverts its water supply, were not available for 1931, estimates were made by correlation with flow of Uvas Creek in Santa Clara County. The derivation of the present seasonal deficiency, or supplemental water requirement, of the City of Santa Cruz Water Department, estimated to be about 600 acre-feet, is presented in Table 37.

TABLE 37

ESTIMATED PRESENT SEASONAL SUPPLEMENTAL WATER REQUIREMENT IN AREA SERVED BY CITY OF SANTA CRUZ WATER DEPARTMENT

(In acre-feet)

Month	Demand in 1949	Available runoff in 1931	Waste to ocean	Supplemental water requirement
January	280	3,770	3,490	0
February	220	1,610	1,390	0
March	250	2,060	1,810	0
April	520	1,150	630	0
May	570	910	340	0
June	630	630	0	0
July	670	610	0	60
August	700	510	0	190
September	730	460	0	270
October	520	460	0	60
November	350	950	600	0
December	320	28,160	27,840	0
TOTALS	5,760	41,280	36,100	580

Probable Ultimate Supplemental Requirement

The probable ultimate requirement for supplemental water in the Santa Cruz-Monterey Area was evaluated as the difference between present and probable ultimate water requirement, plus the present requirement for supplemental water. Development and utilization of a supplemental water supply in the amount of this forecast would assure an adequate supply of water for lands presently irrigated in the area, as well as for those irrigable lands not presently served with water, and for all lands considered susceptible of urban or recreational development. Furthermore, present problems resulting from sea-water intrusion in the Pajaro Unit and from deficiencies in late summer stream flow in the North Coastal and San Lorenzo Units would be eliminated.

Estimates of present and probable ultimate water requirement in the Santa Cruz-Monterey Area, as measured by application of water under mean conditions of water supply and climate, were presented in Tables 35 and 36, respectively, and a corresponding estimate of the present requirement for supplemental water was developed in the preceding section. Utilizing these estimates, the forecast of probable ultimate seasonal requirement for supplemental water in the several units of the Santa Cruz-Monterey Area, under mean conditions of water supply and climate, is presented in Table 38.

TABLE 38

PROBABLE ULTIMATE MEAN SEASONAL SUPPLEMENTAL WATER REQUIREMENT IN UNITS OF SANTA CRUZ-MONTEREY AREA

(In acre-feet)

Unit	Present water requirement	Probable ultimate water requirement	Probable increase in water requirement	Present supplemental water requirement	Probable ultimate supplemental water requirement
North Coastal	2,100	7,900	5,800	0	5,800
San Lorenzo	5,300	21,100	15,800	600	16,400
Soquel	2,400	9,600	7,200	0	7,200
Pajaro	26,500	48,100	21,600	3,700	25,300
TOTALS	36,300	86,700	50,400	4,300	54,700

CHAPTER IV

PLANS FOR WATER DEVELOPMENT

It has been shown heretofore that the present basic water problems in the Santa Cruz-Monterey Area are sea-water intrusion in confined aquifers underlying the Pajaro Unit, resulting from increasing ground water draft to support an expanding irrigated acreage, and insufficient summer stream flow in the North Coastal and San Lorenzo Units during dry years to meet peak water demands for urban purposes. Elimination of these problems, prevention of their recurrence in the future, and the provision of water for lands not presently served will require further conservation development of available water supplies. In the preceding chapter, estimates were presented as to the amount of supplemental water required for these purposes both at the present time and under probable ultimate conditions of development.

It has been shown that relatively large surplus flows of water are presently available to the Santa Cruz-Monterey Area from many local streams, and from the Pajaro River which rises outside of the area. This surface water is available during the winter and spring months of nearly every season, and in all but very dry seasons flows sufficient to meet present supplemental requirements of the area are available into the summer months. Studies which are described in this chapter indicate that the surplus flows, if properly controlled and regulated, would more than meet the probable ultimate water requirements of the Santa Cruz-Monterey Area.

As was stated in Chapter I, the Division of Water Resources is presently conducting surveys and studies for the State-wide Water Resources Investigation, under the direction of the State Water Resources Board. This investigation has as its objective the formulation of The California Water Plan, for full conservation, control, and utilization of the State's water resources, to meet present and future water needs for all beneficial purposes and uses in all parts of the State, insofar as practicable. Although this investigation is still in progress, it is sufficiently advanced to permit tentative description of certain proposed major features of The California Water Plan that could provide supplemental water to meet the probable ultimate water requirements of the Santa Cruz-Monterey Area. These projects would also provide supplemental water supplies for many other seriously water-deficient areas of California. In addition, benefits from the projects would include hydroelectric power, flood and salinity control, mining debris storage, and benefits in the interests of recreation and the preservation of fish and wildlife.

In general, the major proposed features of The California Water Plan which were mentioned in the preceding paragraph would be large multipurpose projects requiring relatively great capital expenditures. Their scope, with regard to both location of the works and benefits derived from their operation, would not be limited to any one local area, but would embrace considerable portions of California. Much additional study will be required to estimate costs and to determine possible means of financing these large projects. In the light of these facts, and in view of relatively large undeveloped local water supply, numerous surveys and studies were made in order to estimate costs of supplemental water supplies for the Santa Cruz-Monterey Area under more localized plans, that might be suitable for current financing, construction, and operation by appropriate local public agencies. These plans for initial development generally are such that the works could be integrated into future major projects. Their purposes are largely limited to conservation of new water supplies sufficient to meet the present requirements of the Santa Cruz-Monterey Area and to provide for limited future growth in water demands of the area.

Major features of The California Water Plan that might be pertinent to solution of the ultimate water problems of the Santa Cruz-Monterey Area are described in general terms in this chapter under the heading "The California Water Plan." These projects will be more specifically described in future reports of the State Water Resources Board. The several plans for possible local development of supplemental water supplies which were given consideration in connection with the Santa Cruz-Monterey Counties Investigation are described in this chapter under the heading "Plans for Initial Local Development," and locations of their principal features are shown on Plate 19, entitled "Existing Water Conservation Works and Works Considered for Future Development." Those of the plans that were found to be the most favorable for initial development are presented in some detail in this chapter, together with estimates of capital and annual costs and unit costs of the developed supplemental water supplies. The fact that these plans were designated "most favorable for initial construction" does not constitute a determination of their financial feasibility, and should not be construed as a recommendation for their immediate construction. Alternative plans considered, but found to be less favorable for initial construction, are described only briefly in this chapter and in more detail in Appendix L. All plans considered would be subject to vested rights.

THE CALIFORNIA WATER PLAN

The Feather River Project, a feature of The California Water Plan, could provide supplemental water to meet the probable ultimate requirement of the Pajaro Unit. The San Lucas Project, involving multipurpose water resources development on the Salinas River, is another project that could provide supplemental water to meet the probable ultimate requirement of the Pajaro Unit. Possible conservation works on the Pajaro River drainage system outside of the Santa Cruz-Monterey Area are also briefly described.

Feather River Project

The probable ultimate supplemental water requirement of the Pajaro Unit could be met under a plan which would provide regulatory storage on the Feather River near Oroville in the Sacramento Valley, and conveyance of a portion of the regulated supply across the Sacramento-San Joaquin Delta, over Altamont Pass, through Livermore and Santa Clara Valleys and to the Pajaro River, from which it could be diverted for use in the Pajaro Unit. Such storage and conveyance facilities would be made available by construction of works which are described in detail in a publication of the State Water Resources Board entitled "Report on Feasibility of Feather River Project and Sacramento-San Joaquin Delta Diversion Projects Proposed as Features of The California Water Plan," dated May, 1951. These projects were authorized and adopted by the 1951 Legislature, in an act which authorized their construction, operation, and maintenance by the Water Project Authority of the State of California.

San Lucas Project

The probable ultimate supplemental water requirement in the Pajaro Unit could be met under a plan which would provide regulatory storage on the Salinas River in Monterey County to the southeast of the Santa Cruz-Monterey Area. Such storage would be made available by construction of San Lucas Dam and Reservoir, with a capacity of about 375,000 acre-feet, on the Salinas River at a point about seven miles upstream from King City and three miles downstream from the town of San Lucas. The San Lucas Project is described in a publication of the State Water Resources Board, entitled "San Lucas Project in Salinas River Basin, Monterey County," dated November, 1950. This project was adopted by the 1951 Legislature, in an act which authorized a plan for construction of the San Lucas Dam and Reservoir by the Monterey County Flood Control and Water Conservation District, in cooperation with the State of California and the United States, for purposes of flood control and water conservation. The act also authorized the expenditure of state funds in the amount of $2,500,000 for the project to meet the costs of lands, easements, rights of way, and all necessary utilities, highway, and railway relocations. Such financial participation by the State is in accordance with the policy set forth in the State Water Resources Act of 1945, as amended.

A tentative plan, resulting from studies now in progress for the State-wide Water Resources Investigation, indicates that it would be feasible from the engineering standpoint to convey releases of water from San Lucas Reservoir to the Pajaro Unit, as well as to service areas in Salinas Valley. Briefly, the conveyance system under consideration would include a concrete-lined canal extending northwesterly along the westerly side of the Salinas Valley for a distance of about 25 miles from the dam, at which point the water would cross the valley in a siphon and continue northwesterly along the easterly side of the valley, thence through San Miguel Canyon to serve the Moss Landing-Watsonville area. A terminal reservoir site is preliminarily located about one mile southeast of Watsonville.

Further studies on features of the San Lucas Project are being made by the Corps of Engineers, United States Army, and by the Division of Water Resources.

Other Projects Under Consideration

Surveys and studies in connection with the Santa Clara Valley Investigation, which are reported in detail in Bulletin No. 7 of the State Water Resources Board, indicate that substantial yield of new water could be effected by construction of dams and reservoirs on Uvas and Llagas Creeks in South Santa Clara Valley. It is apparent that such yield could be made available to the Pajaro Unit by releases down these tributaries of the Pajaro River. However, plans presently under consideration contemplate that the new yield that may be developed on Uvas and Llagas Creeks will be utilized on lands in Santa Clara Valley requiring supplemental water.

Reconnaissance engineering and geologic investigation of possible dam and reservoir sites on the San Benito County tributaries of the Pajaro River has been made by the Division of Water Resources in connection with the State-wide Water Resources Investigation. Additional investigation and study of the possibilities of conserving waters of these streams will be made and reported in a subsequent bulletin of the State Water Resources Board.

PLANS FOR INITIAL LOCAL DEVELOPMENT

Surveys and studies in connection with the Santa Cruz-Monterey Counties Investigation indicate that it would be feasible from the engineering standpoint to so regulate and conserve the flow of streams of the Santa Cruz-Monterey Area as to yield firm new water supplies in excess of the probable ultimate supplemental requirements of the North Coastal, San Lorenzo, Soquel, and Pajaro Units. Although some 36 possible dam and reservoir sites in the area were given preliminary reconnaissance and study, only 20 of the most favorable were chosen for more detailed survey, design, and cost estimating. Locations of these 20 sites are shown on Plate 19.

Possible plans for initial local development of supplemental water supplies for the Santa Cruz-Monterey Area, together with cost estimates, are described in this section and in Appendix L. Design of features of the plans was necessarily of a preliminary nature and primarily for cost estimating purposes. More detailed investigation, which would be required in order to prepare plans and specifications, might result in designs differing in detail from those presented in this bulletin. However, it is believed that such changes would not be significant.

In general, the conservation works considered would be located in or closely adjacent to their probable water service areas, and extensive conduits to convey the water to the service areas would not be required. For this reason, the plans were compared on the basis of cost of dams and reservoirs in most instances, and designs and cost estimates of conveyance conduits were prepared only for those plans involving off-stream storage wherein the conduits would be necessary for operation of the conservation works.

Capital costs of dams, reservoirs, diversion works, conduits, pumping plants, and appurtenances, included in the considered plans, were estimated from preliminary designs based largely on data from surveys made during the current investigation. Approximate construction quantities were estimated from these preliminary designs. Unit prices of construction items were determined from recent bid data on projects similar to those in question, or from manufacturers' cost lists, and are considered representative of prices prevailing in the fall of 1952. The estimates of capital cost included costs of rights of way and construction, and interest during one-half of the estimated construction period at 3 percent per annum, plus 10 percent and 15 percent of construction costs for engineering and contingencies, respectively. Estimates of annual costs included interest on the capital investment at 3 percent, repayment over a 50-year period on a 3 percent sinking fund basis, replacement, operation, and maintenance costs, and costs of electrical energy for pumping.

Because of geographical considerations, and respective types of water service and water supplies in the several units of the Santa Cruz-Monterey Area, possible plans for initial water development are presented in this section separately for the North Coastal, San Lorenzo, Soquel, and Pajaro Units.

North Coastal Unit

It was shown in Chapter III that there is no present requirement for supplemental water in the North Coastal Unit, but that the probable ultimate supplemental water requirement will be about 5,800 acre-feet per season. In the design of projects for initial local development, it was considered desirable to provide a water supply in the amount of about one-half the estimated ultimate supplemental requirement. This initial water supply was estimated to be about 2,800 acre-feet per season, giving consideration to the probable expansion and intensification of urban, suburban and rural, recreational, and irrigated agricultural development, and to the available sources of water supply as determined by engineering and economic limitations on size of the proposed works.

Nine possible alternative plans of works, for initial construction to provide supplemental water to the North Coastal Unit were considered. These plans involved seven dam and reservoir sites as shown on Plate 19. For reasons hereinafter mentioned, one of these plans, designated the "Archibald Project," on Scott Creek, was chosen as the most favorable for initial construction, and is described in some detail later in this section. The remaining eight plans were given no further present consideration for initial construction, but may warrant future study. They are described briefly in this section and in more detail in Appendix L.

Alternative Plans Considered. The first of the nine alternative plans considered for initial construction, shown on Plate 19, consisted of conservation of runoff of Waddell Creek by construction of a dam and reservoir at the El Oso site, about three miles upstream from the mouth of the creek. Studies indicated that this plan would provide somewhat in excess of the probable ultimate supplemental water requirement of the North Coastal Unit, but that the unit cost of the conserved water would be substantially greater than for the Archibald Project, described later in this section. For these reasons the plan was given no further present consideration.

The second and third plans consisted of conservation of runoff of Laguna Creek by construction of dams and reservoirs at the Laguna and Bald Mountain School sites, about five miles and two miles, respectively, upstream from the mouth of the creek. Studies indicated that neither of these reservoirs would provide the desired initial yield of 2,800 acre-feet per season, and that in both instances the unit cost of the conserved water would be greater than that of the Archibald Project. For these reasons the plans were given no further present consideration.

The six remaining alternative plans considered for initial construction in the North Coastal Unit consisted of runoff of Scott Creek by construction of dams and reservoirs at four alternative sites, designated Archibald Numbers 1, 2, 3, and 4, and located about 1.5 miles, 1.9 miles, 2.0 miles, and 2.1 miles, respectively, upstream from the mouth of the creek. Alternative sizes of reservoirs were studied at two of the sites. Studies indicated that construction and operation of any one of five of these six plans would provide considerably more water than the desired initial yield of 2,800 acre-feet per season. It was further indicated that the greater capital costs of these five plans could not be justified since the full amount of the yield could not be put to beneficial use for many years in the future. For these reasons, five of the six plans for initial development of Scott Creek were given no further present consideration.

The plan chosen as the most favorable for initial construction in the North Coastal Unit was the Archibald Project, which would provide the desired initial yield of 2,800 acre-feet per season. Furthermore, the estimated capital cost of this project is less than the capital cost of any other plan considered for the North Coastal Unit. Water conserved by construction and operation of the Archibald Project would serve the probable future supplemental water requirement in the "Archibald Service Area" shown on Plate 20, entitled "Possible Water Conservation Works and Service Areas Under Initial Development." This service area includes some 3,300 acres of land along the coast not presently served with water, as well as certain land now receiving a water supply but requiring supplemental water in the future.

Archibald Project. The Archibald Project would consist of a dam and reservoir on Scott Creek, about 1.9 miles upstream from its mouth and about four miles northwest of the town of Davenport, at the Number 2 site, as shown on Plate 20. The proposed Archibald Dam, principal features of which are shown on Plate 21, entitled "Archibald Dam on Scott Creek," would be an earthfill structure with a chute spillway. It would be located in the southeast quarter of Section 18, Township 10 South, Range 3 West, M. D. B. & M. Stream bed elevation at this site is 30 feet. The conserved water would be released from the reservoir through a steel pipe beneath the dam and directly into a main distribution conduit. For reasons heretofore mentioned, the distribution system was not included in design and cost estimates for the Archibald Project.

As a first step in determination of the size of the project, estimates were made of yield of the proposed works for various reservoir storage capacities. It was estimated that mean seasonal runoff of Scott Creek, from the approximately 28 square miles of watershed above the dam site, is about 21,600 acre-feet. Based upon estimates of runoff during the critical dry period which occurred in the Santa Cruz-Monterey Area from 1923-24 through 1930-31, yield studies were made for four sizes of reservoir at the Archibald site. Since the probable use of most of the conserved water would be for urban, suburban and rural, and irrigation purposes, it was assumed that demands on the reservoirs would be met without deficiency. Monthly demands on the reservoir were assumed to be proportional to the estimated distribution of urban demands in the Santa Cruz-Monterey Area, as presented in Table 36. A summary of the results of the yield studies is presented in Table 39.

TABLE 39

ESTIMATED SAFE SEASONAL YIELD OF ARCHIBALD RESERVOIR, BASED ON CRITICAL DRY PERIOD FROM 1923-24 THROUGH 1930-31

(In acre-feet)

Reservoir storage capacity	Safe seasonal yield
3,150	2,800
10,000	6,600
20,000	10,000
40,000	14,500

After consideration of the results of the yield studies, geologic conditions, topography of the dam site, and cost analyses hereinafter discussed, a reservoir of 3,150 acre-foot capacity, including 230 acre-feet of dead storage, with estimated safe seasonal yield of 2,800 acre-feet, was chosen for cost estimating purposes. The yield study for this size of reservoir is included in Appendix J.

A topographic map of the Archibald dam and reservoir sites, at a scale of one inch to 200 feet, with contour interval of 20 feet, was made by the Division of Water Resources in 1951, using photogrammetric survey methods. Topography of the dam and reservoir sites was shown on the map up to an elevation of 320 feet. Storage capacities of Archibald Reservoir at various stages of water surface elevation are given in Table 40.

TABLE 40

AREAS AND CAPACITIES OF ARCHIBALD RESERVOIR

Depth of water at dam, in feet	Water surface elevation, USGS datum, in feet	Water surface area, in acres	Storage capacity, in acre-feet
0	30	0	0
10	40	5	51
30	60	50	600
50	80	106	2,160
58	88	134	3,150
70	100	180	5,020
90	120	260	9,420
92	122	268	10,000
110	140	342	15,400
122	152	394	20,000
130	160	428	23,200
150	180	537	32,800
164	194	601	40,000

Based upon preliminary geological reconnaissance, the Archibald dam site is considered suitable for an earthfill dam of any height up to at least 145 feet. The site lies in the Monterey formation of Miocene age. The strata consist of tan siliceous and diatomaceous shales, bedded in thin layers, which are badly distorted and finely jointed, especially where exposed to weathering. Shears are present in great numbers, but are of

Archibald Site

small scale and not easily differentiated from joints. The bedrock is probably not appreciably stronger at depth than in the weathered zone. A cutoff trench backfilled with earth would probably be advisable, as would grouting.

Stripping under the impervious section of the dam would be necessary on both abutments for removal of about three feet of overburden and humus, and eight feet of fragmental bedrock normal to the surface. Stripping from the channel section would include about eight feet of silt and gravel, and about eight feet of bedrock.

A large quantity of mixed soils, silts, and sands, probably suitable for use in the impervious section of an earthfill dam, can be obtained from flats either within the reservoir area or a short distance downstream from the site. Material for riprap is available from the massive sandstone cliffs high on the right abutment. It is doubtful that any use could be made of the Monterey shale which would be excavated during stripping of the site.

The dam for the 3,150 acre-foot Archibald Reservoir would be an earth- and rockfill structure, 58 feet in height from stream bed to spillway lip, 71 feet in height from stream bed to crest, and would have a crest elevation of 101 feet. It would have a crest length of about 440 feet, a crest width of 30 feet, and 3 : 1 upstream and 2 : 1 downstream slopes. The impervious core would have a top width of 15 feet, and 3 : 1 upstream and 1 : 1 downstream slopes. The pervious zone of the dam would consist of materials obtained from a nearby quarry. The upstream slope of the dam would be faced with a 3-foot layer of riprap. The dam would have an estimated volume of fill of 163,600 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the left abutment of the dam, and discharging through a chute into Scott Creek about 200 feet below the dam. It would have a capacity of 19,600 second-feet required for an estimated maximum discharge of about 700 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be nine feet, and an additional four feet of freeboard would be provided. Outlet works would consist of a 24-inch diameter steel pipe, placed in a trench excavated beneath the dam, and encased in concrete. Releases from the reservoir would be controlled at the upstream end by a hydraulically operated gate, located at a submerged inlet structure upstream from the dam on the left abutment, and operated by hydraulic controls from the crest of the dam.

The reservoir area is covered by brush and trees which would have to be removed. Portions of the bottom land are presently planted in truck crops and pasture. Improvements in the reservoir area consist of a school house and other buildings. Public utilities which would require relocation consist of about five miles of county road, power lines, and telephone lines. Possible silting of the reservoir might present a problem. However, the dead storage space would provide silt storage for a number of years in the future.

Pertinent data with respect to general features of the Archibald Project, as designed for cost estimating purposes, are presented in Table 41.

TABLE 41

GENERAL FEATURES OF ARCHIBALD PROJECT

Earthfill Dam
- Crest elevation—101 feet
- Crest length—440 feet
- Crest width—30 feet
- Height, spillway lip above stream bed=58 feet
- Side slopes—3:1 upstream
  2:1 downstream
- Freeboard, above spillway lip—13 feet
- Elevation of stream bed—30 feet
- Volume of fill—163,600 cubic yards

Reservoir
- Surface area at spillway lip—134 acres
- Capacity at spillway lip—3,150 acre-feet
- Drainage area—28 square miles
- Estimated mean seasonal runoff—21,600 acre-feet
- Estimated safe seasonal yield—2,800 acre-feet
- Type of spillway—Ogee weir, concrete-lined chute
- Spillway capacity—19,600 second-feet
- Type of outlet—24-inch diameter steel pipe beneath abutment

The capital cost of the Archibald Project, based on prices prevailing in the fall of 1952, was estimated to be about $679,000. Corresponding annual costs of the project were estimated to be about $29,400. The resultant estimated average unit cost of the 2,800 acre-feet of water per season conserved by the Archibald Reservoir is, therefore, about $10.50 per acre-foot at the dam. The foregoing costs do not include the cost of distributing the conserved water in areas of use. Detailed cost estimates of the Archibald Project are presented in Appendix K.

San Lorenzo Unit

It was shown in Chapter III that the estimated present requirement for supplemental water in the San Lorenzo Unit is about 600 acre-feet per season, and that the ultimate seasonal supplemental requirement probably will be about 16,400 acre-feet. Expansion and intensification of urban and suburban development has occurred at a rapid rate during the past few years, and it is indicated that such rapid growth will continue for some time into the future. In the design of projects for initial local development it was considered desirable to provide capacity in the amount of about 60 percent of the estimated ultimate supplemental requirement. This initial capacity was estimated to be about 10,000 acre-feet per season, giving consideration to the present supplemental requirement, to the cited growth factor, and to the available sources of water supply as determined by engineering and economic limitations on size of the proposed conservation works. Of the desired new yield of 10,000 acre-feet per season, about 3,900 acre-feet would be served to communities and recreational areas in the San Lorenzo River basin north of Santa 'ruz, and about 6,100 acre-feet would be served to he City of Santa Cruz and adjoining urban areas. 'hese service areas are shown on Plate 20 as the Zay-.nte and Doyle Gulch Service Areas, respectively.

Seven possible plans of works for initial construction o provide supplemental water to the San Lorenzo Unit vere considered. These plans involve six dam and eservoir sites as shown on Plate 19. For reasons herenafter mentioned, two of the plans were chosen as the nost favorable for initial construction and are decribed in some detail later in this section. One of hese, designated the "Zayante Project," could pro-ide supplemental water to the service area in the San ,orenzo River basin north of Santa Cruz, while the ther, designated the "Doyle Gulch Project," could rovide supplemental water to the service area in and djacent to the City of Santa Cruz. The remaining five lans were given no further present consideration, but nay warrant future study. They are described briefly n this section and in more detail in Appendix L.

Alternative Plans Considered. The first of the even alternative plans considered for initial construc-ion in the San Lorenzo Unit consisted of the onservation of runoff of the San Lorenzo River by onstruction of a dam and reservoir on the river at he Waterman Switch site, about six miles upstream rom the town of Boulder Creek. The second plan onsisted of conservation of runoff of Boulder Creek y construction of a dam and reservoir on the creek at he Jamison site, about two miles above the town of Boulder Creek. Similarly, the third plan consisted of onservation of runoff of Newell Creek by construction f a dam and reservoir on the creek at the Newell site, t a point 1.1 miles above its junction with the San ,orenzo River. Studies indicated that none of these lans would provide the desired initial yield for the ervice area in the San Lorenzo River basin north of Santa Cruz, and that unit cost of the conserved water n all cases would be greater than that of the Zayante Project. For these reasons the three plans were given o further present consideration.

The fourth of the plans considered for inital con-truction in the San Lorenzo Unit consisted of conser-ation of runoff of Bear Creek by construction of a lam and reservoir on the creek at the Bear site, about our miles upstream from its junction with San ,orenzo River. Studies indicated that this plan would rovide new water in an amount somewhat larger than he desired initial yield for the service area in the San Lorenzo River basin north of Santa Cruz, but hat unit cost of the conserved water would be sub-tantially greater than that of the Zayante Project. For this reason the plan was given no further present onsideration.

The fifth plan in the San Lorenzo Unit was the Zayante Project, and consisted of conservation of run-off of Zayante Creek by construction of a dam and eservoir on the creek at the Zayante site, about five miles northeast of Felton. Studies indicated that this plan would provide new water in the amount of the desired initial yield for the service area in the San Lorenzo River basin north of Santa Cruz. Furthermore, the project would conserve water at an estimated lower unit cost than would any of the other plans considered for this service area. It should be noted that the project could provide supplemental water to the City of Santa Cruz. However, the Zayante Project was chosen as the most favorable for initial construction to serve the area of the San Lorenzo River basin north of Santa Cruz, since, as is hereinafter shown, other new water is available to the City of Santa Cruz at comparable costs.

The sixth of the plans considered for initial construction in the San Lorenzo Unit consisted of diversion of water from the San Lorenzo River at Santa Cruz during the winter months, and its conveyance to a proposed reservoir of 14,500 acre-foot capacity in Doyle Gulch, about two miles northeast of Santa Cruz, for off-stream storage and later release for use during the summer months. Studies indicated that this plan would provide new water in an amount considerably greater than the desired initial amount for the service area in and adjacent to Santa Cruz. It was further indicated that the capital costs of the plan probably could not be justified at this time since the full amount of the yield could not be put to beneficial use for many years in the future. For these reasons the plan was given no further present consideration.

The seventh plan in the San Lorenzo Unit was the Doyle Gulch Project, and consisted of diversion of water from the San Lorenzo River at Santa Cruz during the winter months, and its conveyance to a proposed reservoir of 5,600 acre-foot capacity in Doyle Gulch, for off-stream storage and later release during the summer months. Studies indicated that this plan would provide new water in the amount of the desired initial supplemental supply for the service area in and adjacent to the City of Santa Cruz. The project would conserve water at an estimated unit cost approximately as low as that of any other plan considered for the San Lorenzo Unit. Furthermore, estimated capital costs of the project probably could be borne at this time. For these reasons the Doyle Gulch Project was chosen as the most favorable for initial construction to serve the area in the San Lorenzo Unit in and adjacent to the City of Santa Cruz.

Zayante Project. The Zayante Project would consist of a dam and reservoir on Zayante Creek, about five miles upstream from its confluence with the San Lorenzo River, as shown on Plates 19 and 20. The proposed Zayante Dam, principal features of which are shown on Plate 22, entitled "Zayante Creek Dam on Zayante Creek," would be an earthfill structure with a chute spillway. It would be located in the southeast quarter of Section 36, Township 9 South, Range 2 West, M. D. B. & M. Stream bed elevation at this site is about 476 feet. The conserved water would be released from the reservoir through a steel pipe under the dam and into the channel of Zayante Creek, where it would be available downstream for diversion and use. For reasons heretofore mentioned, a distribution system was not included in design and cost estimates for the Zayante Project.

As a first step in determination of the size of the project, estimates were made of yield of the proposed works for three reservoir storage capacities. It was estimated that mean seasonal runoff of Zayante Creek, from the approximately 9.5 square miles of watershed above the dam site, is about 9,000 acre-feet.

The estimated yields of Zayante Reservoir with three capacities were based upon estimates of runoff during the critical dry period that occurred in the Santa Cruz-Monterey Area from 1923-24 through 1930-31. Since most of the probable use of the conserved water would be for suburban, rural, and recreational purposes, it was assumed that demands on the reservoir would be met without deficiency. Monthly demands on the reservoir were assumed to be proportional to the estimated distribution of urban demands in the Santa Cruz-Monterey Area, as presented in Table 36. A summary of the results of the yield studies is presented in Table 42.

TABLE 42

ESTIMATED SAFE SEASONAL YIELD OF ZAYANTE RESERVOIR, BASED ON CRITICAL DRY PERIOD FROM 1923-24 THROUGH 1930-31

(In acre-feet)

Reservoir storage capacity	Safe seasonal yield
6,900	3,900
15,000	5,600
25,000	6,450

After consideration of the results of the yield studies, geologic reconnaissance, topography of the dam site, and cost analyses hereinafter discussed, a reservoir of 6,900 acre-foot capacity, including 100 acre-feet of dead storage, with estimated safe seasonal yield of 3,900 acre-feet, was chosen for cost estimating purposes. The yield study for this size of reservoir is included in Appendix J.

A plane table topographic survey of the Zayante Creek dam site was made by the Division of Water Resources in 1951, at a scale of one inch to 200 feet, with 10-foot contour interval. Reservoir topography was obtained in 1951 by using photogrammetric survey methods, at a scale of one inch to 500 feet, with 20-foot contour interval. Topographic maps of the dam and reservoir sites were prepared from these survey data. Storage capacities of Zayante Reservoir at various stages of water surface elevation are given in Table 43.

TABLE 43

AREAS AND CAPACITIES OF ZAYANTE RESERVOIR

Depth of water at dam, in feet	Water surface elevation, USGS datum, in feet	Water surface area, in acres	Storage capacity, in acre-feet
0	476	0	0
4	480	1	5
24	500	8	100
44	520	21	390
64	540	40	990
84	560	70	2,090
104	580	108	3,880
124	600	146	6,430
127	603	153	6,900
144	620	191	9,800
164	640	238	14,100
168	644	247	15,000
184	660	292	19,400
192	678	345	25,000
204	680	350	25,800
224	700	413	33,400

Based upon preliminary geological reconnaissance, the Zayante dam site is considered suitable for an earthfill dam of any height up to at least 224 feet. The site lies in the Vaqueros formation of Miocene age. The strata consist of fine-grained sandstones and siltstones with intercalated layers of tan shales having a thickness of as much as eight inches. Shale layers comprise about 20 percent of the formation. The sandstone is moderately to well compacted. Sandstone exposed on the channel edge is moist and shows a strong tendency to spall. A moderately well consolidated cobble and pebble conglomerate occurs high on the left abutment. This is apparently the basal member of the Vaqueros sandstone formation, borne out by the presence of occasional subangular blocks of partially decomposed granitic rock within the lower horizons of the conglomerate. There are many tight shears throughout the area. Joints are numerous near the surface, but probably tighter and more widely spaced with depth. Attitudes of the bedding are generally consistent, with the strike parallel to the stream course and the dip into the right abutment.

Stripping for the foundation of an earthfill type of dam at this site should not exceed six feet of overburden and four feet of fractured rock for the right abutment, and five feet of overburden and two feet of rock for the left abutment. The stated depths are estimated normal to the surface. Stripping in the channel section would consist of about four feet of mixed sand and gravel. It may be, however, that the possible presence of concealed landslide detritus would materially increase the stripping estimate. Moderate grouting of joints and bedding planes would probably be required.

Large supplies of material suitable for concrete aggregate are available about three miles southwest of the site. An estimated 1,500,000 cubic yards of earth suitable for use in an impervious embankment is located near Olympia, about two miles downstream from the site. Material suitable for riprap would have to be hauled from a distance of at least four miles.

The dam for the 6,900 acre-foot Zayante Reservoir would be an earth- and rockfill structure 127 feet in height from stream bed to spillway lip, 140 feet in height from stream bed to crest, and would have a crest elevation of 616 feet. It would have a crest length of about 470 feet, a crest width of 28 feet, and 2.5:1 upstream and downstream slopes. The central impervious core would have a top width of 10 feet and 0.8:1 slopes. The outer pervious zones of the dam would consist of materials salvaged from stripping and excavation, and materials from a nearby quarry. The upstream slope of the dam would be faced with a three-foot layer of riprap. The dam would have an estimated volume of fill of 433,800 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the right abutment of the dam, and discharging through a chute into Zayante Creek about 400 feet below the dam. It would have a capacity of 8,900 second-feet required for an estimated maximum discharge of about 950 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be eight feet, and an additional five feet of freeboard would be provided. The outlet works would consist of a 36-inch diameter steel pipe, placed in a trench excavated beneath the dam, and encased in concrete. Releases from the reservoir would be controlled by means of hydraulically operated gates in an inclined inlet structure on the slope of the left abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with four 18-inch gate valves, hydraulically operated from a control house on the top of the structure.

The reservoir area is generally rugged, and is covered by small brush with some second-growth redwood, and oak and madrone, which would have to be removed. The land has little agricultural value. Improvements in the reservoir area consist of five cottages with garages and water systems that are occupied throughout the year, and 14 summer residences and weekend cabins. Public utilities which would require relocation consist of about three miles of county roads, power lines, and telephone lines.

Pertinent data with respect to general features of the Zayante Project, as designed for cost estimating purposes, are presented in Table 44.

The capital cost of the Zayante Project, based on prices prevailing in the fall of 1952, was estimated to be about $1,299,000. The corresponding annual cost of the project was estimated to be about $53,900. The resultant estimated average unit cost of the 3,900 acre-feet of water per season conserved by Zayante Reservoir is, therefore, about $13.80 per acre-foot at the dam. The foregoing costs do not include the cost of distributing the conserved water in areas of use. Detailed cost estimates of the Zayante Project are presented in Appendix K.

TABLE 44

GENERAL FEATURES OF ZAYANTE PROJECT

Earthfill Dam
- Crest elevation—616 feet
- Crest length—470 feet
- Crest width—28 feet
- Height, spillway lip above stream bed—127 feet
- Side slopes—2.5:1
- Freeboard, above spillway lip—13 feet
- Elevation of stream bed—476 feet
- Volume of fill—433,800 cubic yards

Reservoir
- Surface area at spillway lip—153 acres
- Capacity at spillway lip—6,900 acre-feet
- Drainage area—9.5 square miles
- Estimated mean seasonal runoff—9,000 acre-feet
- Estimated safe seasonal yield—3,900 acre-feet
- Type of spillway—Ogee weir, concrete-lined chute
- Spillway capacity—8,900 second-feet
- Type of outlet—36-inch diameter steel pipe beneath dam

Doyle Gulch Project. The Doyle Gulch Project would include a dam and reservoir on Doyle Gulch, at a site about one mile north of State Highway No. 1 and two miles northeast of Santa Cruz. A pumping plant on the San Lorenzo River, at the site of the existing diversion works of the City of Santa Cruz Water Department, would divert surplus winter flow of the river through a pipe line some five miles in length to a point below the dam. At this point, a second pumping plant would lift the water into the reservoir for temporary storage and later release to the service area in and adjacent to the City of Santa Cruz. The locations of the dam, reservoir, and pipe line, are shown on Plates 19 and 20.

The proposed Doyle Gulch Dam, principal features of which are shown on Plate 23, entitled "Doyle Gulch Dam in Doyle Gulch," would be an earthfill structure with a chute spillway. It would be located in the southeast quarter of Section 4, Township 11 South, Range 1 West, M. D. B. & M. Stream bed elevation at this site is about 110 feet. The elevation of the water surface at the proposed point of diversion on the San Lorenzo River is about 20 feet, and the minimum water surface elevation in Doyle Gulch Reservoir would be about 140 feet.

For purposes of design it was assumed that water would be diverted from the San Lorenzo River and pumped to the reservoir during the period from November through May, and that the conduit would serve as a conveyance line to deliver water released from the reservoir to the service area during the summer months. The diverted water would require treatment as does most raw water used for municipal purposes. Since distribution of the water would largely be accomplished by the distribution system of the City of Santa Cruz Water Department, design and cost estimates for distribution were not included in the Doyle Gulch Project. Design and cost estimates for treatment also were not included.

Since the Doyle Gulch Project would involve an off-stream storage reservoir supplied by winter diversion of water from the San Lorenzo River, the yield of the project would be governed both by size of the reservoir and capacity of the diversion works and conduit. Therefore, the first step in determining the most feasible size of project involved estimates of yield for various sizes of reservoir and various capacities of diversion works and conduit. It was estimated that mean seasonal runoff of the San Lorenzo River from the approximately 118 square miles of watershed above the diversion point is about 109,700 acre-feet. The watershed above the Doyle Gulch Dam is only about 1.8 square miles, and in the yield studies no account was taken of minor runoff from this drainage area.

Yield studies were made for two sizes of reservoir at the Doyle Gulch site and for three capacities of diversion works and conduit, based upon estimates of runoff during the critical dry period that occurred in the Santa Cruz-Monterey Area from 1923-24 through 1930-31. It was assumed that water would be diverted from the San Lorenzo River only when the flow is greater than 10 second-feet. Since most of the probable use of the conserved water would be for urban purposes, it was assumed that demands on the reservoir would be met without deficiency. Monthly demands on the reservoir were assumed to be proportional to the estimated distribution of urban demands in the Santa Cruz-Monterey Area, as presented in Table 36. A summary of the results of the yield studies is presented in Table 45.

TABLE 45

ESTIMATED SAFE SEASONAL YIELD OF DOYLE GULCH PROJECT, BASED ON CRITICAL DRY PERIOD FROM 1923-24 THROUGH 1930-31

Diversion and conduit capacity, in second-feet	Reservoir storage capacity, in acre-feet	Safe seasonal yield, in acre-feet
20	5,600	6,500
50	14,500	13,200
100	14,500	14,200

After consideration of the results of the yield studies, geologic reconnaissance, topography of the dam site, and cost analyses hereinafter discussed, a diversion works and conduit of 20 second-foot capacity and a reservoir of 5,600 acre-foot capacity, with estimated safe seasonal yield of 6,500 acre-feet, were chosen for cost estimating purposes. The yield study for this size of project is included in Appendix J.

The diversion works on the San Lorenzo River would employ the diversion weir presently used by the City of Santa Cruz Water Department. This is a concrete gravity structure about 80 feet in length and about 2 feet in height above stream bed, with a crest elevation of about 20 feet, and surmounted by temporary flashboards about 18 inches in height. A 48-inch diameter steel inlet pipe would lead from the pool behind the weir to a reinforced-concrete silt trap located on the right bank above the flood plain. The silt trap would be about 40 feet long, 20 feet wide, and 20 feet deep, and would be compartmented by two baffle plates. The trap would be provided with three 2-foot square sluice gates. Water would be pumped from the silt trap by a battery of four electrically driven, horizontal, centrifugal pumping units, two of which would have a capacity of 5 second-feet each, and two of which would have a capacity of 10 second-feet each. This installed pumping capacity would include 10 second-feet of capacity for standby purposes. Each unit having a capacity of 5 second-feet would be driven by a 125-horsepower motor, and each unit of 10 second-foot capacity would be driven by a 250-horsepower motor. The pumps would operate at a uniform static head of about 120 feet, and the friction head would vary from 10 to 40 feet depending on the rate of pumping. The pumps would be located in a reinforced-concrete pump house, and would discharge through a manifold into the 30-inch diameter, dipped and wrapped, welded steel pipe conveyance conduit. A 12-inch diameter check valve would be installed in the discharge line of each pump.

The conveyance conduit would cross to the left bank beneath the San Lorenzo River at a point upstream from the pumping plant and diversion weir. The proposed route of the conduit, as shown on Plate 19, would be for the most part along city streets. It would lead generally in an easterly direction for a distance of about 4.5 miles to Doyle Gulch, and would then swing in a northerly direction for about 0.5 mile, to the pumping plant located on the right bank at the base of the Doyle Gulch Dam.

The design of the pumping plant at the dam was essentially the same as that for the plant at the river, except that it would operate against a variable head depending on the reservoir stage. The plant would include four electrically driven, horizontal, centrifugal pumping units, two of which would have a capacity of 5 second-feet each, and two of which would have a capacity of 10 second-feet each. This installed pumping capacity would include 10 second-feet of capacity for standby purposes. The pumps would operate against a static head varying from 20 to 120 feet. They would be located in a reinforced-concrete pump house, and would discharge through a manifold into a 48-inch diameter steel pipe beneath the dam, and into the reservoir through the outlet structure, hereinafter described. A 12-inch diameter check valve would be installed in the discharge line of each pump.

A topographic map of the Doyle Gulch dam and reservoir sites, at a scale of one inch to 500 feet, with a contour interval of 20 feet, was made by the Division of Water Resources in 1952, using photogrammetric survey methods. Topography was shown on the map up to an elevation of 320 feet. Storage capacities of

Doyle Gulch Reservoir at various stages of water surface elevation are given in Table 46.

TABLE 46

AREAS AND CAPACITIES OF DOYLE GULCH RESERVOIR

Depth of water at dam, in feet	Water surface elevation, USGS datum, in feet	Water surface area, in acres	Storage capacity, in acre-feet
0	110	0	0
10	120	2	20
30	140	7	100
50	160	14	317
70	180	27	720
90	200	42	1,410
110	220	61	2,440
130	240	86	3,900
147	257	112	5,600
150	260	116	5,900
170	280	149	8,600
190	300	189	12,000
204	314	220	14,500

Based on preliminary geological reconnaissance, the Doyle Gulch dam site is considered suitable for an earthfill dam of any height up to at least 204 feet. Foundation rock at the site is massive, medium-grained, moderately cemented, light buff sandstone, probably of the lower Miocene Vaqueros formation. Outcrops are limited, but in those inspected no joints were noted. Jointing was observed, however, in this formation in other areas. Regionally, this formation dips gently to the south, and strikes east-west. The tops of the ridges on either side of the dam site are very flat and are capped by thin Quaternary terrace gravels.

It is probable that stripping requirements under the impervious section of an earthfill dam at the Doyle Gulch site would be moderate. Stripping of about three feet of overburden and three feet of soft, partly weathered and jointed bedrock, would be necessary on the abutments. The channel section would require stripping of about 25 feet of alluvial fill and 3 feet of sandstone bedrock. Soil in the flats of the reservoir area appears to be adequate in quantity and satisfactory in quality for the impervious core. The firm sandstone in the canyon walls could be quarried in any desired amount for use in the pervious section, after stripping about three feet of covering soil.

The dam for the 5,600 acre-foot Doyle Gulch Reservoir would be a combination earth- and rockfill structure 147 feet in height from stream bed to spillway lip, 156 feet in height from stream bed to crest, and with a crest elevation of 266 feet. It would have a crest length of about 670 feet, a crest width of 30 feet, and 2.5 : 1 upstream and downstream slopes. The central impervious core would have a top width of 20 feet and 1 : 1 slopes. The outer pervious zones of the dam would consist of sandstone quarried from the canyon walls. The volume of fill of the dam would be an estimated 671,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, cut through a saddle upstream from the left abutment, and discharging into a tributary of Doyle Gulch. It would have a capacity of 2,700 second-feet required for the small drainage area of 1.8 square miles above the dam. The maximum depth of water above the spillway lip would be five feet, and an additional four feet of freeboard would be provided. The outlet works would consist of a 30-inch diameter steel pipe, placed in a trench excavated beneath the dam, and encased in concrete. Releases from the reservoir would be controlled at the upstream end of the outlet by means of hydraulically operated gates in an inclined inlet structure on the slope of the right abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with four 18-inch and one 24-inch gate valves hydraulically operated from a control house on top of the structure. The outlet works would also serve as inlet works during the winter period when San Lorenzo River water would be conveyed to the reservoir.

Most of the forest and brush has been removed from the Doyle Gulch reservoir area except in the stream channel. Improvements in the area consist of about a dozen farmhouses and associated buildings, and several orchards. Public utilities which would require relocation consist of about one mile of paved county road, power lines, and telephone lines.

Pertinent data with respect to general features of the Doyle Gulch Project, as designed for cost estimating purposes, are presented in Table 47.

The capital cost of the Doyle Gulch Project, based on prices prevailing in the fall of 1952, was estimated to be about $1,889,000. The corresponding annual cost of the project was estimated to be about $92,900. The estimated average unit cost of the 6,500 acre-feet of water per season conserved by the Doyle Gulch Project is, therefore, about $14.30 per acre-foot. The foregoing costs do not include cost of distributing the conserved water in areas of use nor its treatment. Detailed cost estimates of the Doyle Gulch Project are presented in Appendix K.

Soquel Unit

It was shown in Chapter III that there is no present requirement for supplemental water in the Soquel Unit, but that the probable ultimate supplemental water requirement will be about 7,200 acre-feet per season. In the design of projects for initial local development, it was considered desirable to provide capacity in the amount of about 60 percent of the estimated ultimate supplemental requirement. This initial capacity was estimated to be about 4,100 acre-feet per season in the Soquel Unit, giving consideration to the probable expansion and intensification of urban, suburban and rural, and recreational development, and to the available sources of water supply as deter-

TABLE 47

GENERAL FEATURES OF DOYLE GULCH PROJECT

Conveyance Conduit
- Type—Welded steel pipe, dipped and wrapped
- Length—5 miles
- Diameter—30-inch
- Capacity—20 second-feet

Earthfill Dam
- Crest elevation—266 feet
- Crest length—670 feet
- Crest width—30 feet
- Height, spillway lip above stream bed—147 feet
- Side slopes—2.5:1
- Freeboard, above spillway lip—9 feet
- Elevation of stream bed—110 feet
- Volume of fill—671,000 cubic yards

Reservoir
- Surface area at spillway lip—112 acres
- Capacity at spillway lip—5,600 acre-feet
- Drainage area, San Lorenzo River at point of diversion—118 square miles
- Drainage area above dam—1.8 square miles
- Estimated mean seasonal diversion from San Lorenzo River—6,700 acre-feet
- Estimated safe seasonal yield—6,500 acre-feet
- Type of spillway—Ogee weir, concrete-lined chute
- Spillway capacity—2,700 second-feet
- Type of outlet—30-inch diameter steel pipe beneath dam

Diversion Works
- San Lorenzo River—Existing concrete gravity weir; 48-inch diameter pipe leading from weir pool to concrete silt trap, 40x20x20 feet, with baffle plates and sluice gates, located on right bank

Pumping Plants (two similar plants, one at diversion point, and one at Doyle Gulch Dam)
- Pumps (each plant)—Horizontal, centrifugal type, 2 each of 5 second-foot capacity and 2 each of 10 second-foot capacity
- Estimated minimum water surface elevation in San Lorenzo River—20 feet
- Discharge elevation—140 feet, reservoir empty; 257 feet, reservoir full
- Estimated maximum pumping head—280 feet
- Installed pumping capacity—30 second-feet
- Maximum demand—20 second-feet
- Motors (each plant)—2 each, 125 horsepower; 2 each, 250 horsepower

mined by engineering and economic limitations on size of the proposed conservation works.

Four possible alternative plans of works for initial construction to provide supplemental water to the Soquel Unit, as shown on Plate 19, were considered. For reasons hereinafter mentioned, two of these plans, designated the "Glenwood Project" on the West Branch of Soquel Creek, and the "Upper Soquel Project" on Soquel Creek, were chosen as the most favorable for initial construction, and are described in some detail later in this section. The remaining two plans were given no further present consideration for initial construction, but may warrant future study. They are described briefly in this section and in more detail in Appendix L.

Alternative Plans Considered. The first of the alternative plans considered for initial construction in the Soquel Unit consisted of conservation of runoff of Soquel Creek by construction of a dam and reservoir on the creek at the Soquel site, with the dam located about 500 feet below the junction of the East and West Branches of Soquel Creek. Studies indicated that this plan would provide water in excess of the probable ultimate supplemental water requirement of the Soquel Unit, but that the unit cost of the conserved water would be substantially greater than for the Glenwood and Upper Soquel Projects. For these reasons the plan was given no further present consideration.

The second plan consisted of conservation of runoff of Aptos Creek by construction of a dam and reservoir on the creek at the Aptos site, with the dam located about one mile north of Aptos. Studies indicated that this plan would not provide the desired initial yield of 4,100 acre-feet per season, and that unit cost of the conserved water would be greater than that of the Glenwood and Upper Soquel Projects. For these reasons the plan was given no further present consideration.

The plans chosen as the most favorable for initial construction in the Soquel Unit, the Glenwood and Upper Soquel Projects, shown on Plate 20, would together provide the desired initial yield of 4,100 acre-feet per season. Furthermore, the combined estimated capital cost of these projects is less than the capital cost of any other plan considered for the Soquel Unit. Water conserved by construction and operation of these projects would serve the area of probable future supplemental water requirement shown as the Glenwood and Upper Soquel Service Areas on Plate 20. These service areas include some 3,700 acres of land not presently served with water, as well as about 1,200 acres of land now receiving a water supply but requiring supplemental water in the future.

Glenwood Project. The Glenwood Project would consist of a dam and reservoir on the West Branch of Soquel Creek, about six miles air-line north of the town of Soquel. The proposed Glenwood Dam, principal features of which are shown on Plate 24, entitled "Glenwood Dam on West Branch Soquel Creek," would be an earthfill structure with a chute spillway. It would be located in the northeast quarter of Section 10, Township 10 South, Range 1 West, M. D. B. & M. Stream bed elevation at this site is about 400 feet. Water would be released from the reservoir through a steel pipe under the dam and into the stream channel, where it would be available downstream for diversion and use. For reasons heretofore mentioned, a distribution system was not included in design and cost estimates for the Glenwood Project.

As a first step in determination of the size of the project, estimates were made of yield of the proposed works for three reservoir storage capacities. It was estimated that mean seasonal runoff of the West Branch of Soquel Creek, from the approximately 7.8 square miles of watershed above the dam site, is about 9,100 acre-feet.

The yields of Glenwood Reservoir with the three capacities were based upon estimates of runoff during the critical dry period that occurred in the Santa Cruz-Monterey Area from 1923-24 through 1930-31. Since most of the probable use of the conserved water would be for urban, suburban and rural, and recreational purposes, it was assumed that demands on the reservoir would be met without deficiency. Monthly demands were assumed to be proportional to the estimated distribution of urban demands in the Santa Cruz-Monterey Area, as presented in Table 36. A summary of the results of the yield studies is presented in Table 48.

TABLE 48

ESTIMATED SAFE SEASONAL YIELD OF GLENWOOD RESERVOIR, BASED ON CRITICAL DRY PERIOD FROM 1923-24 THROUGH 1930-31

(In acre-feet)

Reservoir storage capacity	Safe seasonal yield
1,500	1,500
2,480	2,000
4,000	3,000

After consideration of the results of the yield studies, geologic reconnaissance, topography of the dam site, and cost analyses hereinafter discussed, a reservoir of 2,480 acre-foot capacity, including 120 acre-feet of dead storage, with estimated safe seasonal yield of 2,000 acre-feet, was chosen for cost estimating purposes. The yield study for this size of reservoir is included in Appendix J.

A topographic map of the Glenwood dam site, at a scale of one inch to 200 feet, with 20-foot contour interval, was prepared from a plane table survey made by the Division of Water Resources in 1952. The Glenwood reservoir site was surveyed in 1952 utilizing photogrammetric survey methods, and a topographic map of the site was prepared at a scale of one inch to 500 feet, with 20-foot contour interval. Topography of the dam site was shown on the map up to an elevation of 540 feet, while topography of the reservoir site was shown up to an elevation of 600 feet. Storage capacities of Glenwood Reservoir at various stages of water surface elevation are given in Table 49.

TABLE 49

AREAS AND CAPACITIES OF GLENWOOD RESERVOIR

Depth of water at dam, in feet	Water surface elevation, USGS datum, in feet	Water surface area, in acres	Storage capacity, in acre-feet
0	400	0	0
20	420	4.4	48
40	440	15	244
60	460	30	692
80	480	45	1,440
81	481	46	1,500
100	500	59	2,480
120	520	75	3,830
122	522	77	4,000
140	540	92	5,500

Based upon preliminary geological reconnaissance, the Glenwood dam site is considered suitable for an earthfill dam of any height up to at least 140 feet. The site lies in the Vaqueros formation of Miocene age. The rock at the site is a massive, fine to coarse-grained, well cemented sandstone. Conglomerate beds are found short distances above and below the site. Bedding was observed downstream from the site, striking across the channel and dipping gently downstream. Jointing at the site is quite prominent. One set of joints appears to govern the direction of stream flow. It strikes parallel to the stream course (N. 5° W.) and dips into the left abutment (45° W.).

Stripping under the impervious section of the dam would be necessary on both abutments, for removal of about two feet of soil and loose rock, and about three feet of jointed bedrock normal to the surface. Stripping from the channel section would remove about three feet of jointed bedrock and small amounts of cobbles and boulders.

There is abundant soil in the reservoir area which appears suitable for an impervious fill. Haul of this material would be downhill and would be about one-half mile in distance. Hard sandstone could be quarried upstream from the dam site for use in the pervious section. This material is available in almost limitless quantities.

The dam for the 2,480 acre-foot Glenwood Reservoir would be an earth- and rockfill structure 100 feet in height from stream bed to spillway lip, 111 feet in height from stream bed to crest, and would have a crest elevation of 511 feet. It would have a crest length of about 400 feet, a crest width of 30 feet, and 3:1 upstream and 2.5:1 downstream slopes. The upstream impervious earthfill section would have a top width of 20 feet, and 3:1 upstream and 1:1 downstream slopes. The pervious downstream section would be wedge-shaped, with an upstream slope of 1:1 and a downstream slope of 2.5:1. The upstream slope of the impervious section would be faced with a 3-foot layer of riprap. The dam would have an estimated volume of fill of 152,800 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the left abutment of the dam, and discharging through a chute into the West Branch of Soquel Creek about 100 feet below the dam. It would have a capacity of 8,100 second-feet required for an estimated discharge of about 1,000 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be seven feet, and an additional four feet of freeboard would be provided. The outlet works would consist of a 30-inch diameter steel pipe, placed in a trench excavated beneath the dam, and encased in concrete. Releases from the reservoir would be controlled at the upstream end of the outlet by means of hydraulically operated gates in an inclined inlet structure on the slope of the left abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with three 18-inch gate valves, hydraulically operated from a control house on the top of the structure.

The reservoir area is densely covered by second-growth redwood. Improvements in the area consist of 14 homes and outbuildings. The land has little agricultural value, and there are no known public utilities that would require relocation.

Pertinent data with respect to general features of the Glenwood Project, as designed for cost estimating purposes, are presented in Table 50.

TABLE 50

GENERAL FEATURES OF GLENWOOD PROJECT

Earthfill Dam
- Crest elevation—511 feet
- Crest length—400 feet
- Crest width—30 feet
- Height, spillway lip above stream bed—100 feet
- Side slopes—3:1 upstream
  2.5:1 downstream
- Freeboard, above spillway lip—11 feet
- Elevation of stream bed—400 feet
- Volume of fill—152,800 cubic yards

Reservoir
- Surface area at spillway lip—59 acres
- Capacity at spillway lip—2,480 acre-feet
- Drainage area—7.8 square miles
- Estimated mean seasonal runoff—9,100 acre-feet
- Estimated safe seasonal yield—2,000 acre-feet
- Type of spillway—Ogee weir, concrete-lined chute
- Spillway capacity—8,100 second-feet
- Type of outlet—30-inch diameter steel pipe beneath dam

The capital cost of the Glenwood Project, based on prices prevailing in the fall of 1952, was estimated to be about $632,000. The corresponding annual cost of the project was estimated to be about $27,500. The estimated average unit cost of the 2,000 acre-feet of water per season conserved by the Glenwood Reservoir is, therefore, about $13.80 per acre-foot at the dam. The foregoing costs do not include the cost of distributing the conserved water in areas of use. Detailed cost estimates of the Glenwood Project are presented in Appendix K.

Upper Soquel Project. The Upper Soquel Project would consist of a dam and reservoir on Soquel Creek about seven miles east of the town of Soquel. The proposed Upper Soquel Dam, principal features of which are shown on Plate 25, entitled "Upper Soquel Dam on Soquel Creek," would be an earthfill structure with a chute spillway. It would be located in the southwest quarter of Section 12, Township 10 South, Range 1 West, M. D. B. & M. Stream bed elevation at this site is about 446 feet. Water would be released from the reservoir through a steel pipe under the dam and into the stream channel, where it would be available downstream for diversion and use. For reasons heretofore mentioned, a distribution system was not included in design and cost estimates for the Upper Soquel Project.

As a first step in determination of the size of the project, estimates were made of yield of the proposed works for three reservoir storage capacities. It was estimated that mean seasonal runoff of Soquel Creek, from the approximately 13.7 square miles of watershed above the dam site, is about 15,900 acre-feet.

The estimated yields of Upper Soquel Reservoir with three capacities were based on estimates of runoff during the critical dry period that occurred in the Santa Cruz-Monterey Area from 1923-24 through 1930-31. Since most of the probable use of the conserved water would be for urban, suburban and rural, and recreational purposes, it was assumed that demands on the reservoir would be met without deficiency. Monthly demands were assumed to be proportional to the estimated distribution of urban demands in the Santa Cruz-Monterey Area, as presented in Table 36. A summary of the results of the yield studies is presented in Table 51.

TABLE 51

ESTIMATED SAFE SEASONAL YIELD ON UPPER SOQUEL RESERVOIR, BASED ON CRITICAL DRY PERIOD FROM 1923-24 THROUGH 1930-31

(In acre-feet)

Reservoir storage capacity	Safe seasonal yield
1,000	1,400
1,700	2,100
4,600	3,900

After consideration of the results of the yield studies, geologic reconnaissance, topography of the dam site, and cost analyses hereinafter discussed, a reservoir of 1,700 acre-foot capacity, including 100 acre-feet of dead storage, with estimated safe seasonal yield of 2,100 acre-feet, was chosen for cost estimating purposes. The yield study for this size of reservoir is included in Appendix J.

The Upper Soquel dam and reservoir sites were surveyed in 1952, utilizing photogrammetric methods, and a topographic map of the sites was prepared to a scale of one inch to 500 feet, with 20-foot contour interval. Topography of the dam and reservoir sites was shown on the map up to elevations of 700 and 620 feet, respectively. Storage capacities of Upper Soquel Reservoir at various stages of water surface elevation are given in Table 52.

Based upon preliminary geologic reconnaissance, the Upper Soquel dam site is considered suitable for an earthfill dam of any height up to at least 154 feet. The rock exposed at the site is a soft, slightly cemented, massive, friable sandstone, which is probably of Pliocene age. There is no apparent bedding at the site. Some vertically dipping joints were observed striking approximately east-west. Leakage is to be expected under any structure built at this site. Grouting probably would not prove feasible, and a solid cutoff wall would be required.

TABLE 52

AREAS AND CAPACITIES OF UPPER SOQUEL RESERVOIR

Depth of water at dam, in feet	Water surface elevation, USGS datum, in feet	Water surface area, in acres	Storage capacity, in acre-feet
0	446	0	0
14	460	1.6	11
34	480	5.8	85
54	500	13	272
74	520	23	635
85	531	34	1,000
94	540	42	1,390
99	545	48	1,700
114	560	62	2,440
134	580	80	3,650
144	590	91	4,600
154	600	100	5,680

Stripping under the impervious section of the dam would require the removal of about four feet of soil and two feet of weathered sandstone on the right abutment. Stripping on the left abutment would require the removal of about three feet of soil and four feet of weathered bedrock. Stripping from the channel section would require the removal of about five feet of fine gravel and cobbles, and about two feet of weathered bedrock.

Limited amounts of soil, probably satisfactory for the impervious section of the dam, are found in a flat on Soquel Creek above the mouth of Amaya Creek. The haul distance of this soil to the dam site would average about one mile by road. About 1,000,000 cubic yards of soil material is available. Decomposed granite is available at a quarry situated on the east slope of Sugarloaf Mountain, about two miles downstream from the dam site. About 100,000 cubic yards of gravel could be recovered from the stream channel above the site. Riprap material could be imported from the quarry.

The dam for the 1,700 acre-foot Upper Soquel Reservoir would be an earth- and rockfill structure 99 feet in height from stream bed to spillway lip, 109 feet in height from stream bed to crest, and would have a crest elevation of 555 feet. It would have a crest length of 425 feet, a crest width of 30 feet, and 3 : 1 upstream and 2.5 : 1 downstream slopes. The impervious upstream section would have a top width of 10 feet, and 3 : 1 upstream and 1 : 1 downstream slopes. The pervious section would have a top width of 10 feet, an upstream slope of 1 : 1, and a downstream slope of 2.5 : 1. The upstream slope of the impervious section would be faced with a 3-foot layer of riprap. The dam would have an estimated volume of fill of 341,500 cubic yards.

The concrete-lined spillway would be of the side channel type, located at the left abutment of the dam, discharging through a chute into Soquel Creek about 200 feet below the dam. It would have a capacity of 11,500 second-feet required for an estimated maximum discharge of 850 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be six feet, and an additional four feet of freeboard would be provided. The outlet works would consist of a 24-inch diameter steel pipe, placed in a trench excavated beneath the dam, and encased in concrete. Releases from the reservoir would be controlled at the upstream end of the outlet pipe by means of hydraulically operated gates in an inclined inlet structure on the slope of the right abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with three 18-inch gate valves, hydraulically operated from a control house on the top of the structure.

The land in the reservoir area is covered by native vegetation, consisting of oak, brush, and second-growth redwood. The only improvement in the area which would be flooded is an access road maintained for fire protection by the United States Forest Service.

Pertinent data with respect to general features of the Upper Soquel Project, as designed for cost estimating purposes, are presented in Table 53.

TABLE 53

GENERAL FEATURES OF UPPER SOQUEL PROJECT

Earthfill Dam
- Crest elevation—555 feet
- Crest length—425 feet
- Crest width—30 feet
- Height, spillway lip above stream bed—99 feet
- Side slopes—3:1 upstream
  2.5:1 downstream
- Freeboard, above spillway lip—10 feet
- Elevation of stream bed—446 feet
- Volume of fill—341,500 cubic yards

Reservoir
- Surface area at spillway lip—48 acres
- Capacity at spillway lip—1,700 acre-feet
- Drainage area—13.7 square miles
- Estimated mean seasonal runoff—15,900 acre-feet
- Estimated safe seasonal yield—2,100 acre-feet
- Type of spillway—Ogee weir, concrete-lined chute
- Spillway capacity—11,500 second-feet
- Type of outlet—24-inch diameter steel pipe beneath dam

The capital cost of the Upper Soquel Project, based on prices prevailing in the fall of 1952, was estimated to be about $709,000. The corresponding annual cost of the project was estimated to be about $30,600. The estimated average unit cost of the 2,100 acre-feet of water per season conserved by the Upper Soquel Reservoir is, therefore, about $14.50 per acre-foot at the dam. The foregoing costs do not include the cost of distributing the conserved water in areas of use. Detailed cost estimates of the Upper Soquel Project are presented in Appendix K.

Pajaro Unit

It was shown in Chapter III that the estimated present requirement for supplemental water in the Pajaro Unit is about 3,700 acre-feet per season, and that the ultimate seasonal supplemental requirement probably will be about 25,300 acre-feet. Expansion and intensification of urban and agricultural development has occurred during the past few years, and it is indicated that such growth will continue for some time into the future. In the design of projects for initial local development it was considered desirable to provide a water supply in the amount of about 40 percent of the estimated ultimate supplemental requirement. This initial water supply was estimated to be about 9,700 acre-feet per season, giving consideration to the present supplemental requirement, to the cited growth factor, and to the available sources of water supply as determined by engineering and economic limitations on size of the proposed conservation works. Of the desired new yield of 9,700 acre-feet per season, about 3,700 acre-feet, the amount of the present supplemental requirement, would be served to an area of some 2,800 acres of irrigated valley floor lands between Watsonville and Monterey Bay, presently being served by ground water. The remainder of the new yield, in the amount of about 6,000 acre-feet per season, would permit water service to about 4,100 acres of irrigable but presently nonirrigated lands in the Pajaro Unit. A possible service area for the desired new yield is shown on Plate 20.

Four possible alternative plans of works for initial construction to provide supplemental water to the Pajaro Unit, three of which are shown on Plate 19, were considered. For reasons hereinafter mentioned, one of these plans, designated the "Watsonville Project," was chosen as the most favorable for initial construction and is described in some detail later in this section. The remaining three plans were given no further present consideration, but may warrant future study. They are described briefly in this section, and in more detail in Appendix L.

Alternative Plans Considered. The first of the alternative plans considered for initial construction consisted of shifting the center of heavy pumping draft on confined ground water in the Pajaro Unit from its present position near the Monterey Bay shore to a more inland site, with maintenance of the present rate of draft. This would probably induce increased subsurface inflow to the confined aquifers from the Forebay Zone, with corresponding increase in safe ground water yield. Safe seasonal ground water yield under the present pattern of wells and pumping draft is about 21,000 acre-feet. If the hydraulic gradient of the ground water that occurred in the 1948-49 season around the upper perimeter of the pressure zones could be increased sufficiently, safe seasonal ground water yield might be increased to a maximum of about 26,000 acre-feet, the difference between mean seasonal recharge in the Forebay Zone and subsurface outflow from the confined aquifers to Monterey Bay. Under such circumstances this plan would largely solve the problem of sea-water encroachment into the confined aquifers. However, the hydraulic effects of shifting the center of heavy pumping draft inland cannot be predicted accurately with the data available. The implementation of such a plan would necessitate a major modification in methods of water service prevailing in Pajaro Valley and would involve difficult legal and economic problems. Furthermore, the plan would not provide the desired amount of new yield for the Pajaro Unit. For these reasons the plan was given no further present consideration.

The second plan consisted of conservation of runoff of Corralitos Creek by its off-stream storage in an enlarged Pinto Lake. This would be accomplished by diversion of water from the creek at a point about 3.5 miles northwest of Watsonville, and its conveyance by gravity in a canal about 10,700 feet in length to Pinto Lake. Storage capacity of Pinto Lake would be increased from the present 1,600 acre-feet to 4,800 acre-feet by construction of an earthfill dam. Studies indicated that safe seasonal yield developed under this plan would be only about 1,100 acre-feet, which is substantially less than the present supplemental water requirement and only a small portion of the desired initial supplemental yield for the Pajaro Unit. Furthermore, the estimated unit cost of the conserved water would be considerably greater than that of the Watsonville Project. For these reasons the plan was given no further present consideration.

The third of the alternative plans considered for initial construction consisted of conservation of runoff of the Pajaro River by its off-stream storage in a reservoir to be constructed on Elkhorn Slough. This would be accomplished by construction of a weir on the Pajaro River approximately 3.5 miles upstream from Watsonville to permit diversion of winter flow of the stream. A canal some 9,200 feet in length would convey the diverted water to a pumping plant on the south side of the valley about two miles west of Aromas. From the plant the water would be lifted to Elkhorn Reservoir which would be created by a dam located about three miles southeast of Watsonville on the slough. Releases from the reservoir during the irrigation season would return through the canal to the original point of diversion on the Pajaro River, for downstream diversion and use. Studies indicated that yield from this plan would be more than sufficient to meet the probable ultimate supplemental water requirement of the Pajaro Unit. However, estimated capital cost of this plan and unit cost of the conserved water would be greater than comparable costs for the Watsonville Project. For this reason the plan was given no further present consideration.

The plan chosen as the most favorable for initial construction in the Pajaro Unit, the Watsonville Project, likewise consisted of conservation of runoff of the Pajaro River by off-stream storage. This would be accomplished by diversion of water from the river during the winter months, and its conveyance by canal and a pumping lift to a proposed reservoir in Corn Cob Canyon, for later release during the irrigation season. Studies indicated that this plan would provide new water in the amount of the desired initial supplemental supply for the Pajaro Unit. In addition, the project would conserve water at an estimated lower unit cost than any of the other alternative plans considered. For these reasons the Watsonville Project was chosen as the most favorable for initial construction in the Pajaro Unit.

Watsonville Project. The Watsonville Project, as shown on Plates 19 and 20, would include a reservoir in Corn Cob Canyon, with a dam at a site about two miles southeast of Watsonville and one mile east of State Highway No. 1. Six small auxiliary dams would be required around the northerly rim of the reservoir. Surplus winter flow of the Pajaro River would be diverted at a point on that stream about four miles east of Watsonville, and conveyed in an unlined canal about one mile in length to a pumping plant on the south side of the valley about 3.5 miles southeast of Watsonville. From this plant the water would be lifted into the upstream end of Watsonville Reservoir, for temporary storage and later release to the service area between Watsonville and Monterey Bay.

The proposed Watsonville Dam, principal features of which are shown on Plate 26, entitled "Watsonville Dam in Corn Cob Canyon," would be an earthfill structure with a chute spillway. It would be located in the southwest quarter of Section 14, Township 12 South, Range 2 East, M. D. B. & M. Stream bed elevation at this site is about 53 feet. The elevation of the water surface at the proposed point of diversion on the Pajaro River is about 40 feet, and the minimum water surface elevation in Watsonville Reservoir would be about 80 feet.

For purposes of design it was assumed that water would be diverted from the Pajaro River and pumped to the reservoir during the period from November through May, and that the stored water would be released from the reservoir and back to the Pajaro River through the conveyance canal during the irrigation season. The released water would be available in the Pajaro River for diversion and distribution. Design and cost estimates for required rediversion and distribution facilities were not included in the Watsonville Project.

Since the Watsonville Project would involve an off-stream storage reservoir supplied by winter diversion of water from the Pajaro River, the yield of the project would be governed both by size of the reservoir and capacity of the diversion works and canal. Therefore, the first step in determining the most feasible size of project involved estimates of yield for several combinations of sizes of reservoir and capacities of diversion works and canal. It was estimated that mean seasonal runoff of the Pajaro River from the approximately 1,200 square miles of watershed above the diversion point is about 150,000 acre-feet. The watershed above the Watsonville Dam is only about two square miles and in the yield studies no account was taken of minor runoff from this drainage area.

Yield studies were made for three sizes of reservoir at the Watsonville site and for three capacities of diversion works and canal, based upon records and estimates of runoff during the critical dry periods which occurred in the Santa Cruz-Monterey Area from 1923-24 through 1930-31, and from 1947-48 through 1949-50. The yield studies indicated that the latter period was the more critical of the two. It was assumed that water would be diverted from the Pajaro River only when the flow is greater than 10 second-feet, and that releases from the reservoir would be made in accordance with the monthly irrigation demand schedule presented in Table 36. Studies indicated that winter flows of the Pajaro River in the estimated mean seasonal amounts of 17,200 acre-feet, 27,000 acre-feet, and 35,000 acre-feet would be available for diversion to Watsonville Reservoir, with diversion and canal capacities of 100 second-feet, 200 second-feet, and 300 second-feet, respectively. These estimates were based on present impairment of Pajaro River stream flow. Any future development and use of either surface or subsurface water upstream from the proposed point of diversion will tend to decrease the estimated yield of the project. Geologic investigation indicates that the Watsonville Reservoir area is quite permeable and that the reservoir probably would be subject to appreciable leakage. For purposes of the yield studies it was assumed that such losses would amount to about 1,000 acre-feet per season. It is probable that a substantial portion of the assumed reservoir leakage would percolate to and augment the supply of the confined aquifers in the Pajaro Unit. However, no credit was taken for this probable augmentation of the ground water supply. In the yield studies it was assumed that demands on the reservoir would be made without deficiency.

A summary of the results of the yield studies, based on the critical dry period from 1947-48 through 1949-50, is presented in Table 54.

TABLE 54

ESTIMATED SAFE SEASONAL YIELD OF WATSONVILLE PROJECT, BASED ON CRITICAL DRY PERIOD FROM 1947-48 THROUGH 1949-50

Diversion and conduit capacity, in second-feet	Reservoir storage capacity, in acre-feet	Safe seasonal yield, in acre-feet
100	12,000	6,000
200	12,000	7,000
100	15,000	6,700
200	15,000	8,300
100	21,000	8,200
200	21,000	9,700
300	21,000	10,500

Watsonville Site

After consideration of the results of the yield studies, geologic reconnaissance, topography of the dam site, and cost analyses hereinafter discussed, a diversion works and canal of 200 second-foot capacity and a reservoir of 21,000 acre-foot capacity, with estimated safe seasonal yield of 9,700 acre-feet, were chosen for cost estimating purposes. The yield study for this size of project is included in Appendix J.

The diversion works on the Pajaro River would include a concrete gravity weir structure located in the southwest quarter of Section 7, Township 12 South, Range 3 East, M. D. B. & M. The structure would include a fixed ogee overflow weir section with length of 60 feet, and two weir sections controlled by bascule gates, each with a length of 40 feet. The top of the weir structure would be at an elevation of 55 feet. Elevation of the crest of the fixed section of the weir would be 41 feet, and elevation of the crest of the gated sections with the gates lowered would be 35 feet. With the gates lowered the weir would safely pass a flood with peak flow of about 19,000 second-feet. This is the capacity utilized by the Corps of Engineers of the United States Army in design of levees recently constructed along the Pajaro River in this vicinity.

Waters of the Pajaro River would be diverted at the left abutment of the weir structure through two 5-foot square slide headgates in a reinforced-concrete headwall into a reinforced-concrete sand trap. The sand trap would be 20 feet by 20 feet in horizontal dimensions, and would be compartmented by two vertical baffle walls. The bottom elevation of the trap would be 32 feet, and the headwall elevation 55 feet. Three 2-foot square slide sluice gates would be provided, one for each compartment of the sand trap.

From the sand trap the diverted water would enter an unlined canal with capacity of 200 second-feet. The canal, which would be capable both of conveying water to and returning water from the Watsonville Reservoir, would have a flat grade. It would be of trapezoidal section, with bottom width of 10 feet, depth of water of 6 feet, and with side slopes of 1.5 : 1. The canal would be constructed all in cut, would be approximately one mile long, would run in a southwesterly direction from the sand trap to the bottom of the bluff bounding Pajaro Valley on the south, and would terminate in the northeast quarter of Section 13, Township 12 South, Range 2 East, M. D. B. & M.

At the terminus of the canal a pumping plant would lift the water through a 72-inch diameter steel pipe line, about 1,500 feet in length, to Watsonville Reservoir. The pipe line would pass beneath the most easterly of the auxiliary dams on the north rim of the reservoir, and would be entrenched in the dam foundation and encased in concrete. At its reservoir end the pipe line would divide into two 54-inch diameter pipe outlets, each of which would contain a 48-inch diameter butterfly valve, hydraulically controlled from the top of the auxiliary dam.

In order to permit flexibility of operation, the pumping plant would consist of a battery of six pumps, two with capacities of approximately 18 second-feet, three with capacities of approximately 31 second-feet, and one of about 100 second-foot capacity. A check valve would be provided on the discharge line of each pump. The pumps would be housed in a reinforced-concrete pump house. The maximum flow line in Watsonville Reservoir would be at an elevation of about 205 feet, and elevation of the water surface at the intake of the pumping plant would be about 40 feet. The maximum static head against which the water would be pumped would be approximately 165 feet, and it was estimated that friction losses in the pipe line would not exceed one foot. The minimum static head would be about 40 feet, and the plant was designed for an average pumping head of approximately 150 feet.

Cross-sections of the diversion dam site on the Pajaro River and of the conveyance canal were determined from a stadia survey made by the Division of Water Resources in 1952. A field check was also made of the approximate location of the maximum water line which would occur above the diversion dam. At the same time, topography of the Watsonville Reservoir and dam sites was determined from plane table surveys. The reservoir area was mapped to a scale of one inch to 400 feet, with 20-foot contour interval, and the main dam site was mapped to a scale of one inch to 200 feet, with 10-foot contour interval. Storage capacities of Watsonville Reservoir at various stages of water surface elevation are given in Table 55.

TABLE 55

AREAS AND CAPACITIES OF WATSONVILLE RESERVOIR

Depth of water at dam, in feet	Water surface elevation, USGS datum, in feet	Water surface area, in acres	Storage capacity, in acre-feet
0	53	0	0
7	60	17	85
27	80	37	630
47	100	69	1,700
67	120	107	3,450
87	140	152	6,050
107	160	197	9,550
118	171	224	12,000
127	180	246	14,000
131	184	256	15,000
147	200	297	19,500
152	205	310	21,000
167	220	350	26,000

Based upon preliminary geological reconnaissance, the Watsonville dam site is considered suitable for an earthfill dam of any height up to at least 155 feet. Foundation rock at the site consists of the Aromas formation which is made up almost entirely of a red-brown, nearly pure quartz sand. It is medium-grained, readily friable and clean, and often shows signs of cross-bedding. The soft sandstone generally grades upward into a residual tan soil. Roots penetrate as easily into the unconsolidated sediments as they do into the soil. In places, concretions have been noted beginning to set up within the sands, and a few one-inch thick limonite-centered beds have been observed. The site is easily eroded where exposed without protective cover of vegetation. The dam site is some distance from the San Andreas and Vergeles faults, which are the dominant faults in the area. Small-scale jointing and shearing are not visible in the soft rocks of the Aromas formation.

The Aromas formation is highly permeable and probably serves in part as an intake to the confined aquifers underlying Pajaro Valley. The bedding of the formation is essentially horizontal. Leakage at the dam site and from the reservoir area might be appreciable, although such would not be a threat to the safety of the dam. Consideration should be given to the possibility of lining the reservoir with some suitable material which would reduce water losses through leakage. Works may be required along the bottom of the bluff north of the proposed reservoir to prevent a possible drainage problem.

Stripping for the foundation of an earthfill dam at this site should not exceed three feet of residual soil and three feet of underlying sandstone for both the right and left abutments, and six feet of soil and three feet of underlying sandstone for the channel section. These estimates apply only under the impervious section of an earthfill dam. Only the overburden would have to be stripped from under the pervious sections of such a dam.

Large quantities of earth could be obtained from Elkhorn Slough which would be suitable for use in an impervious section. A portion of the material required for the impervious section would be obtained from excavation for the conveyance canal. Ample material, both residual and alluvial, suitable for the pervious sections of the dam, is available in the vicinity of the site, but its sandy texture might preclude its use for construction of the impervious section. It is possible that a blend of this material with the soil lying on the floor of Pajaro Valley might prove suitable for impervious fill. Sand for aggregate could probably be recovered from the Aromas formation in virtually unlimited quantities. The Logan quarry located near Pajaro Gap could supply large quantities of granitic rock for use as rockfill, riprap, or gravel.

The dam for the 21,000 acre-foot Watsonville Reservoir would be an earthfill structure 152 feet in height from stream bed to spillway lip, 158 feet in height from stream bed to crest, and with a crest elevation of 211 feet. The dam would have a crest length of about 1,300 feet, crest width of 30 feet, and 3 : 1 upstream and 2.5 : 1 downstream slopes. The central impervious section would have a top width of 10 feet, and 1 : 1 slopes. The outer pervious sections of the dam would consist of material excavated from the abutments and from borrow pits near the dam. The upstream slope of the dam would be faced with a 3-foot layer of riprap. The volume of fill for the dam would be an estimated 1,880,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the left abutment of the dam, and discharging through a chute into Corn Cob Canyon about 400 feet below the dam. It would have a capacity of 750 second-feet required for an estimated discharge of about 500 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be two feet, and an additional four feet of freeboard would be provided. The outlet works would consist of the inlet facilities heretofore described, supplemented by a trash rack at the reservoir end of the pipe line, and by a short 72-inch diameter steel pipe to bypass the pumping plant and convey the released

TABLE 56

GENERAL FEATURES OF WATSONVILLE PROJECT

Diversion Works
- Pajaro River—Concrete gravity weir, with ogee overpour section 60 feet in length, and two 40-foot bascule gated sections; diversion box with two 5-foot square slide headgates in concrete headwall; and 20x20-foot concrete sand trap with two baffle walls and three 2-foot square slide sluice gates

Conveyance Conduit
- Type—Trapezoidal unlined canal; bottom width, 10 feet; depth of water, 6.0 feet; side slopes, 1.5:1
- Length—1 mile
- Capacity—200 second-feet

Pumping Plant
- Pumps—Two 8,000 gpm units, three 14,000 gpm units, and one 45,000 gpm unit; double suction, single stage, horizontally split casing, centrifugal pumps
- Motors—All-weather type; two 350 horsepower, three 700 horsepower, and one 2,600 horsepower
- Estimated minimum water surface in canal at inlet—40 feet
- Discharge elevation—80 feet, reservoir empty; 205 feet, reservoir full
- Estimated maximum pumping head—165 feet
- Design pumping head—150 feet
- Installed pumping capacity—229 second-feet
- Maximum demand—200 second-feet

Earthfill Dam
- Crest elevation—211 feet
- Crest length—1,300 feet
- Crest width—30 feet
- Height, spillway lip above stream bed—152 feet
- Side slopes—3:1 upstream; 2.5:1 downstream
- Freeboard, above spillway lip—6 feet
- Elevation of stream bed—53 feet
- Volume of fill—1,880,000 cubic yards

Auxiliary Dams (six)
- Crest elevation—211 feet
- Total crest length (six dams)—1,600 feet
- Crest width—20 feet
- Side slopes—2.5:1
- Total volume of fill (six dams)—407,000 cubic yards

Reservoir
- Surface area at spillway lip—310 acres
- Capacity at spillway lip—21,000 acre-feet
- Drainage area, Pajaro River at point of diversion—1,200 square miles
- Drainage area, above dam—1.6 square miles
- Estimated mean seasonal runoff available for diversion from Pajaro River—27,000 acre-feet
- Estimated safe seasonal yield—9,700 acre-feet
- Type of spillway—Ogee weir, concrete-lined chute
- Spillway capacity—750 second-feet
- Type of outlet—72-inch diameter steel pipe beneath auxiliary dam

water to the canal. The bypass line would contain a 60-inch Howell-Bunger valve. The released water would be returned to the Pajaro River through the canal and would be available for downstream diversion and use.

As has been stated, six small auxiliary dams would be required along the edge of the bluff overlooking Pajaro Valley around the northerly rim of the reservoir. The auxiliary dams would consist of rolled earth sections, with 20-foot crest widths and 2.5 : 1 side slopes. Total crest length of the six dams would be about 1,600 feet and the maximum height of fill would be about 70 feet. The slopes of the auxiliary dams facing the reservoir would be protected with three feet of rock riprap, while their outside slopes would be protected with two feet of the same material. It was estimated that about three feet of residual soil and three feet of underlying sandstone would have to be stripped under the auxiliary dams. The total volume of fill of the six dams would be an estimated 407,000 cubic yards.

Improvements within the reservoir area include about 40 residences. The lands in the reservoir area are generally uncultivated and used only for grazing purposes. A light growth of brush and trees occurs throughout, and would have to be removed prior to use of the reservoir. Only minor relocation of roads and utilities would be required.

Pertinent data with respect to the general features of the Watsonville Project, as designed for cost estimating purposes, are presented in Table 56.

The capital cost of the Watsonville Project, based on prices prevailing in the fall of 1952, was estimated to be about $3,970,000. The corresponding annual cost of the project was estimated to be about $192,900. The estimated average unit cost of the 9,700 acre-feet of water per season conserved by the Watsonville Project is, therefore, about $19.90 per acre-foot. Detailed cost estimates of the Watsonville Project are presented in Appendix K.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

As a result of field investigation, and study and analyses of available data on the water resources and water problems of the Santa Cruz-Monterey Area, the following conclusions and recommendations are made.

CONCLUSIONS

It is concluded that:

1. Due to geographic and water service considerations, the Santa Cruz-Monterey Area is naturally divided into four principal units. These have been designated the "North Coastal Unit," "San Lorenzo Unit," "Soquel Unit," and "Pajaro Unit," and are shown on Plate 2.

2. There are two present basic water problems in the Santa Cruz-Monterey Area. One of these consists of sea-water intrusion into the confined aquifers underlying the Pajaro Unit, which results from a rate of ground water draft for irrigation during summer months in excess of safe yield of the aquifers. The other problem consists of insufficient summer stream flow during dry years to meet peak demands for surface water used in the San Lorenzo Unit for urban and recreational purposes.

3. Precipitation in the Santa Cruz-Monterey Area ranges from moderate in valley areas and near the coast to heavy in the mountains. In the Pajaro Unit, the only unit for which it was evaluated quantitatively, the mean seasonal depth of precipitation is about 29 inches, and precipitation contributes water to the unit in a mean seasonal amount of about 170,000 acre-feet.

4. The highly productive watersheds of the Santa Cruz Mountains constitute sources of water supply available to all units of the Santa Cruz-Monterey Area. In addition, the Pajaro Unit receives flow in the Pajaro River that rises in watersheds outside the Santa Cruz-Monterey Area. Mean seasonal runoff from local streams in the North Coastal, San Lorenzo, and Soquel Units is about 85,700 acre-feet, 125,100 acre-feet, and 64,300 acre-feet, respectively. Mean seasonal surface inflow to the valley floor of the Pajaro Unit, including that in the Pajaro River, is about 163,400 acre-feet. Mean seasonal outflow from the valley floor of the Pajaro Unit is about 197,000 acre-feet.

5. The principal ground water basin in the Santa Cruz-Monterey Area, and the only one of major extent and yield, is that which underlies the Pajaro Unit. The Pajaro ground water basin includes a forebay zone, or area of ground water recharge, which is limited principally to the mountains and bench lands west of the San Andreas fault, and two pressure zones, or areas with confined aquifers, that comprise nearly the entire valley floor of the Pajaro Unit. The confined aquifers are capped by impervious blue clay strata, and are supplied with water from the Forebay Zone. A free ground water body exists above the blue clay under a large part of the valley floor.

a. Pumpage from the confined aquifers in the pressure zones supplies nearly all water for lands irrigated in the Pajaro Unit. The free ground water above the confining blue clay strata is of little or no importance as a source of supply to wells, but is of some importance in maturing crops where the water table is sufficiently close to the ground surface to supply water in the root zone of the crops.

b. Mean seasonal recharge to ground water in the Forebay Zone is about 28,000 acre-feet. During the investigational seasons of 1946-47 through 1948-49, the average seasonal decrement in ground water storage in the Forebay Zone was about 9,000 acre-feet. However, the investigational seasons were relatively dry, and under mean conditions of water supply and climate, with 1949 conditions of ground water development and use which are considered representative of present conditions, ground water storage in the Forebay Zone would probably have increased at a rate of about 2,000 acre-feet per season.

c. Gross extraction of ground water from the pressure zones during 1948-49 was about 25,000 acre-feet, or some 3,000 acre-feet less than mean seasonal recharge to the Forebay Zone. However, during the irrigation season the rate of ground water extraction from the confined aquifers was such that the elevation of the hydraulic gradient in these aquifers was depressed below sea level near Monterey Bay. This resulted in a trough with a landward gradient on the bay side and caused sea-water intrusion into the aquifers.

d. Safe yield of the confined aquifers, or the maximum rate of yield without sea-water intrusion, is a rate of about 60 second-feet. The maximum rate of pumping draft from these aquifers in 1946-47 and 1948-49 was substantially greater than the safe yield, and during the 1949 irrigation season was about 98 second-feet. Of this maximum 1948-49 pumping draft, about 8 second-feet was supplied on the bay side of the trough from Monterey Bay, 60 second-feet was the safe ground water yield supply from the Forebay Zone, and 30 second-feet was the increased flow from the Forebay Zone. This increased flow was induced on the landward side of the trough by the steepened hydraulic gradient beyond that which would have prevailed under safe yield conditions.

e. In terms of seasonal quantity, under the present monthly pattern of draft on the confined aquifers, safe seasonal ground water yield is about 21,000 acre-feet. Ground water draft in 1948-49 exceeded this safe yield by about 4,000 acre-feet. Of this excess draft, about 1,000 acre-feet constituted sea-water intrusion, and 3,000 acre-feet constituted increased flow in the confined aquifers from the forebay. This increased flow was induced by the steepened hydraulic gradient beyond that which would have prevailed under safe yield conditions.

6. Minor ground water basins in the North Coastal, San Lorenzo, and Soquel Units support wells of small draft for local domestic and irrigation use, but the aggregate yield of the basins is small and will be of little importance in meeting the ultimate water requirements within these units. The most significant of the minor ground water basins in the Santa Cruz-Monterey Area is that which underlies Soquel Valley in the Soquel Unit.

7. The Soquel ground water basin consists of a forebay zone, a pressure zone, and a body of free ground water above the confined aquifer in the pressure zone. The pressure zone, which comprises the floor of Soquel Valley, has an areal extent of approximately five square miles, and the ground water is confined by a thin stratum of well-cemented "hard shell" fossiliferous sandstone. The forebay zone probably includes most of the watershed tributary to the pressure zone. There is no overdraft on the Soquel ground water basin at the present time, and draft on the basin probably could be increased somewhat over the present rate of about 600 acre-feet per season without exceeding possible replenishment to the basin.

8. The surface and ground water supplies of the Santa Cruz-Monterey Area generally range from excellent to good in mineral quality. The following are the principal exceptions:

a. Ground water in confined aquifers underlying lower portions of the valley floor of the Pajaro Unit adjacent to Monterey Bay contains excessive concentrations of chlorides, and a few wells tapping this confined ground water have been abandoned for this reason. The high concentrations of chlorides in these aquifers probably result from intrusion of sea water.

b. Free ground water overlying the confined aquifers adjacent to Monterey Bay in the Pajaro Unit also contains excessive concentrations of chlorides.

c. Confined ground waters in Soquel Valley contain substantial amounts of iron and manganese which render the water undesirable for general domestic and some industrial uses.

d. Waters of many surface streams of the area range from moderate to excessive in total hardness, and their usefulness for domestic, municipal, and certain industrial purposes is thereby impaired.

9. At the present time there are approximately 21,400 acres of irrigated land in the Santa Cruz-Monterey Area, distributed among the several units as follows: North Coastal Unit, 2,000 acres; San Lorenzo Unit, 500 acres; Soquel Unit, 900 acres; and Pajaro Unit, 18,000 acres. The probable ultimate land use in the area will include about 31,800 acres of irrigated land, distributed as follows: North Coastal Unit, 3,900 acres; San Lorenzo Unit, 100 acres; Soquel Unit, 900 acres; and Pajaro Unit, 26,900 acres.

10. At the present time there are approximately 16,900 acres of land in the Santa Cruz-Monterey Area devoted to urban and recreational types of land use, distributed among the several units as follows: North Coastal Unit, 100 acres; San Lorenzo Unit, 13,100 acres; Soquel Unit, 1,800 acres; and Pajaro Unit, 1,900 acres. The probable ultimate pattern of land use in the area will include about 56,900 acres of urban, suburban, rural, and recreational lands, distributed as follows: North Coastal Unit, 12,000 acres; San Lorenzo Unit, 26,700 acres; Soquel Unit, 15,200 acres; and Pajaro Unit, 3,000 acres.

11. Of the total amount of water, excluding rainfall, presently utilized in the Santa Cruz-Monterey area, approximately 73 percent is used in the production of irrigated crops, while urban and recreational areas use the remaining 27 percent. At the present time the mean seasonal utilization of water, measured as applied water and excluding rainfall, is about 36,400 acre-feet, distributed among the several units as follows: North Coastal Unit, 2,100 acre-feet; San Lorenzo Unit, 5,400 acre-feet; Soquel Unit, 2,400 acre-feet; and Pajaro Unit, 26,500 acre-feet.

12. Under probable conditions of ultimate development in the Santa Cruz-Monterey Area the mean seasonal utilization of water, measured as applied water and excluding rainfall, will increase to about 86,700 acre-feet, distributed among the several units as follows: North Coastal Unit, 7,900 acre-feet; San Lorenzo Unit, 21,100 acre-feet; Soquel Unit, 9,600 acre-feet; and Pajaro Unit, 48,100 acre-feet.

13. The present requirement for supplemental water in the Santa Cruz-Monterey Area is about 4,300 acre-

feet per season, and is limited to the San Lorenzo and Pajaro Units. About 600 acre-feet of supplemental water per season is presently required by the Water Department of the City of Santa Cruz for its service area in the San Lorenzo Unit to prevent a deficiency in supply in late summer months of dry years. An additional supplemental water supply of about 3,700 acre-feet per season is presently required in the Pajaro Unit to prevent sea-water intrusion into confined aquifers near the Monterey bay shore and resultant degradation in mineral quality of the ground water.

14. Under probable conditions of ultimate development in the Santa Cruz-Monterey Area the requirement for supplemental water, including the present supplemental requirement, will increase to about 54,700 acre-feet per season, distributed among the several units as follows: North Coastal Unit, 5,800 acre-feet; San Lorenzo Unit, 16,400 acre-feet; Soquel Unit, 7,200 acre-feet; and Pajaro Unit, 25,300 acre-feet.

15. Major features of The California Water Plan, which is presently being formulated under the direction of the State Water Resources Board, could provide supplemental water to meet all or a portion of the probable ultimate requirements of the Santa Cruz-Monterey Area. The Feather River Project and the Santa Clara-Alameda Diversion of the Sacramento-San Joaquin Delta Diversion Projects, adopted features of The California Water Plan, or the San Lucas Project on the Salinas River could provide water to meet the probable ultimate supplemental requirement of the Pajaro Unit. However, it is feasible from an engineering standpoint locally to regulate and conserve the relatively large flows of Waddell Creek, Scott Creek, San Lorenzo River, Soquel Creek, and Pajaro River, so as to yield firm water supplies in excess of the probable ultimate supplemental water requirements of the North Coastal, San Lorenzo, Soquel, and Pajaro Units.

16. New water sufficient to provide for growth in the water requirement of the North Coastal Unit for a number of years in the future could be furnished by construction of a dam and reservoir on Scott Creek, designated the Archibald Project. Cost estimates indicate that the average unit cost of the water developed would be about $10.50 per acre-foot at the dam.

17. New water sufficient to meet the present supplemental requirement of the San Lorenzo Unit, together with additional water for growth in water demand for a number of years in the future, could be furnished by construction of a dam and reservoir on Zayante Creek, designated the Zayante Project, and by construction of facilities for pumping water from the San Lorenzo River during winter months to a reservoir that would be created by construction of a dam on Doyle Gulch, designated the Doyle Gulch Project. Cost estimates indicate that the average unit cost of water developed by the Zayante Project would be about $13.80 per acre-foot at the dam, and that the average unit cost of water developed by the Doyle Gulch Project would be about $14.30 per acre-foot.

18. New water sufficient to provide for growth in the water requirement of the Soquel Unit for a number of years in the future could be furnished by construction of a dam and reservoir on the West Branch of Soquel Creek, designated the Glenwood Project, and a dam and reservoir on Soquel Creek, designated the Upper Soquel Project. The estimated average unit cost of the water developed would be about $14.00 and $14.50 per acre-foot at the respective dams.

19. New water sufficient to meet the present supplemental water requirement of the Pajaro Unit, together with additional water for growth in water demand for a number of years in the future, could be furnished by construction of facilities for diverting and pumping water during winter months from the Pajaro River to a reservoir that would be created by construction of a dam on Corn Cob Canyon, and for conveyance of the stored water during the irrigation season from the reservoir back to the point of diversion on the Pajaro River. This plan was designated the Watsonville Project. Cost estimates indicate that the average unit cost of water developed by the Watsonville Project would be about $20.00 per acre-foot when redelivered to the Pajaro River.

20. The unit costs of water as given for the foregoing local projects are based on current prices of construction and operation, with interest on the capital investment at 3 percent, and are illustrative of the cost of new water for the several units of the Santa Cruz-Monterey Area developed locally by works exclusively for water conservation purposes. The costs exceed those for both surface and ground waters presently served in the area.

21. The foregoing local projects, which are probably the most favorable for initial construction in the Santa Cruz-Monterey Area, are in accordance with the objectives of The California Water Plan.

RECOMMENDATIONS

It is recommended that:

1. Public districts endowed with appropriate powers be created as required for the purposes of proceeding with further study of the local water problems of the Santa Cruz-Monterey Area, and with financing, construction, and operation of projects if found financially feasible.

2. Local development of water resources be accomplished by an orderly progression of phases of devel-

opment and in accordance with The California Water Plan. Successive steps in proposed plans should first develop those projects with indicated lowest capital cost and unit cost of water, and then proceed in order of expense to phases of greater unit cost as needs become manifest.

3. Additional engineering investigation and study be made as required for design, financing, and construction of the more favorable of the local projects for initial development, when the financial feasibility of these projects has been determined.

4. Stream gaging stations be constructed and continuous records of stream flow be obtained at strategic points on those streams for which future construction of water conservation works is probable, in order to permit more reliable determination of yield of the projects and their most economic design and construction.

5. Regular periodic observations of ground water levels and sampling of ground water for quality determinations in Pajaro Valley be made, and records maintained, in order to permit more reliable determination of safe ground water yield and future ground water conditions.

6. Periodic surveys be made of land use and water application as they relate to water utilization, in order to permit evaluation of future water demands and orderly development of water conservation works.

7. A program be initiated for the acquisition of lands, easements, and rights of way necessary for construction of required local water conservation works.

APPENDIX A

AGREEMENTS BETWEEN THE STATE WATER RESOURCES BOARD, THE COUNTIES OF MONTEREY AND SANTA CRUZ, AND THE DEPARTMENT OF PUBLIC WORKS

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AGREEMENTS BETWEEN THE STATE WATER RESOURCES BOARD, THE COUNTIES OF MONTEREY AND SANTA CRUZ, AND THE DEPARTMENT OF PUBLIC WORKS

AGREEMENT BETWEEN THE STATE WATER RESOURCES BOARD, THE COUNTIES OF MONTEREY AND SANTA CRUZ, AND THE DEPARTMENT OF PUBLIC WORKS

THIS AGREEMENT, executed in quintuplicate, entered into by the State Water Resources Board, hereinafter referred to as the "Board"; the Counties of Monterey and Santa Cruz, hereinafter referred to as the "Counties"; and the Department of Public Works, acting through the agency of the State Engineer, hereinafter referred to as the "State Engineer."

WITNESSETH:

WHEREAS, by Chapter 1514, Statutes of 1945, the Board is authorized to make investigations, studies, surveys, hold hearings, prepare plans and estimates, and make recommendations to the Legislature in regard to water development projects, including flood control plans and projects, when requested in writing to do so by a county, city, State agency or public district; and

WHEREAS, by Chapter 1514, Statutes of 1945, the State Engineer is authorized to cooperate with any county, city, State agency or public district on flood control and other water problems and when requested by any thereof may enter into a cooperative agreement to expend money in behalf of any thereof to accomplish the purposes of said act; and

WHEREAS, each of the Counties by written application has requested the Board to make an investigation and report on the underground water supply of Pajaro Valley, in the Counties of Monterey and Santa Cruz, including quality, replenishment and utilization thereof; and

WHEREAS, the Board hereby requests the State Engineer to cooperate in making an investigation and report on the underground water supply of said Pajaro Valley, including quality, replenishment and utilization thereof;

NOW THEREFORE, in consideration of the premises and of the several promises to be faithfully performed by each as hereinafter set forth, the Board, the Counties, and the State Engineer do hereby mutually agree as follows:

ARTICLE I—WORK TO BE PERFORMED:

The work to be performed under this agreement shall consist of investigation and report on the underground water supply of Pajaro Valley in the Counties of Monterey and Santa Cruz, including quality, replenishment and utilization thereof.

The Board by this agreement authorizes and directs the State Engineer to cooperate by making said investigation and report and by otherwise advising and assisting in making an evaluation of present and ultimate underground water problems in said Pajaro Valley.

During the progress of said investigation and report all maps, plans, information, data and records pertaining thereto which are in the possession of any party hereto shall be made fully available to any other party for the due and proper accomplishment of the purposes and objects hereof.

The work under this agreement shall be diligently prosecuted with the objective of completion of the investigation and report on or before December 31, 1948, or as nearly thereafter as possible.

ARTICLE II—FUNDS:

Each of the Counties, upon execution by it of this agreement, shall transmit to the State Engineer the sum of Two Thousand Dollars ($2,000) for deposit, subject to the approval of the Director of Finance, into the Water Resources Fund (also known as the Water Resources Revolving Fund) in the State Treasury, for the expenditure by the State Engineer in performance of the work provided for in this agreement. Also, upon execution of this agreement by the Board, the Director of Finance is requested to approve the transfer of the sum of Four Thousand Dollars ($4,000) from funds appropriated by Chapter 1487, Statutes of 1945, to said Water Resources Fund for expenditure by the State Engineer in performance of the work provided for in this agreement and the State Controller is requested to make such transfer.

If the Director of Finance, within thirty (30) days after receipt by the State Engineer of said sums from the Counties, shall not have approved the deposit thereof into said Water Resources Fund, together with the transfer of said sum of Four Thousand Dollars ($4,000) from funds appropriated by Chapter 1487, Statutes of 1945, into said Water Resources Fund for expenditure by the State Engineer in performance of the work provided for in this agreement, said sums contributed by said Counties shall be returned thereto by the State Engineer.

The Board and the State Engineer shall under no circumstances be obligated to expend for or on account of the work provided for under this agreement any amount in excess of the sum of Eight Thousand Dollars ($8,000) as made available hereunder and if funds are exhausted before completion of the work provided for in this agreement, the Board and the State Engineer may discontinue said work and shall not be liable or responsible for the completion thereof.

Upon completion of and final payment for the work provided for in this agreement, the State Engineer shall furnish the Board and each of the Counties a statement of all expenditures made under this agreement. One-half of the total amount of all said expenditures shall be deducted from the sum advanced from funds appropriated by Chapter 1487, Statutes of 1945, and one-fourth of the total amount of all said expenditures shall be deducted respectively, from the sum advanced by each of the Counties and any balances which may remain shall be returned to the funds appropriated by Chapter 1487, Statutes of 1945, and to the Counties, respectively.

In Witness Whereof, the parties hereunto have affixed their signatures, the County of Monterey on the 1st day of February, 1947, the County of Santa Cruz on the 23rd day of January, 1947, the Board on the 13th day of February, 1947, and the State Engineer on the 13th day of February, 1947.

Approved:
/s/ C. H. Purcell
Director of Public Works

Approval Recommended:
/s/ Henry Holsinger
Associate Attorney
Division of Water Resources

Approved as to Form:
/s/ Anthony Brazil
District Attorney
County of Monterey

/s/ Stephen Wyckoff
District Attorney
County of Santa Cruz

Approved:
/s/ James S. Dean
Director of Finance

Approved as to Legality:
/s/ C. C. Carleton
Chief Attorney
Department of Public Works

COUNTY OF MONTEREY

By /s/ A. B. Jacobsen
Chairman, Board of Supervisors
/s/ Emmet G. McMenamin
Clerk, Board of Supervisors

COUNTY OF SANTA CRUZ

By /s/ F. L. Clement
Chairman, Board of Supervisors
/s/ H. E. Miller
Clerk, Board of Supervisors

STATE WATER RESOURCES BOARD

By /s/ Royal Miller
Chairman

DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

By /s/ A. D. Edmonston
Asst. State Engineer

AGREEMENT BETWEEN THE STATE WATER RESOURCES BOARD, THE COUNTIES OF SANTA CRUZ AND MONTEREY AND THE DEPARTMENT OF PUBLIC WORKS

THIS AGREEMENT, executed in quintuplicate, entered into by the State Water Resources Board, hereinafter referred to as the "Board"; the Counties of Santa Cruz and Monterey, hereinafter referred to as the "Counties" and the Department of Public Works, acting through the agency of the State Engineer, hereinafter referred to as the "State Engineer":

WITNESSETH:

WHEREAS, by the State Water Resources Act of 1945 as amended, the Board is authorized to make investigations, studies, surveys, hold hearings, prepare plans and estimates and make recommendations to the legislature in regard to water development projects including flood control plans and projects; and

WHEREAS, by said act the State Engineer is authorized to cooperate with any county, city, state agency or public district on flood control and other water problems and when requested by any thereof may enter into a cooperative agreement to expend money in behalf of any thereof to accomplish the purposes of said act: and

WHEREAS, the counties desire and hereby request the Board to enter into a cooperative agreement for the making of an investigation and report on all water supplies, surface and underground, as more particularly set forth hereinafter in Article I; and

WHEREAS, the Board hereby requests the State Engineer to cooperate in making said investigation and report;

NOW THEREFORE, in consideration of the premises and the several promises to be faithfully performed by each as hereinafter set forth, the Board, the Counties and the State Engineer do hereby mutually agree as follows:

ARTICLE I—WORK TO BE PERFORMED:

The work to be performed under this agreement shall consist of an investigation and report on the water supplies, surface and underground, of Pajaro Valley in the Counties of Monterey and Santa Cruz, and of the San Lorenzo River Basin, of Soquel Creek Basin, of Aptos Creek Basin, and of Corralitos Creek Basin, and of other streams within Santa Cruz County, including an inventory of the water resources, both surface and underground, of the areas involved; a survey of the location, extent and type of use of water under present development in said areas; an estimate of the future water requirements for all said areas; plans for securing additional water supplies to meet immediate demands and for ultimate development, utilizing both surface and underground storage; estimates of cost of the various plans evolved; and recommendations as to allotments of supply to the respective areas.

The Board by this agreement authorizes and directs the State Engineer to cooperate by making said investigation and report and by otherwise advising and assisting in making an evaluation of the present and ultimate water problems, surface and underground, in said area, and in formulating a solution or solutions of said water problems. During the progress of said investigation and report all maps, plans, information, data and records pertaining thereto which are in the possession of any party hereto shall be made fully available to any other party for the due and proper accomplishment of the purposes and objectives hereof.

The work under this agreement shall be diligently prosecuted with the objective of completion of the investigation and report on July 1, 1950, or at an earlier date if possible.

ARTICLE II—FUNDS:

The County of Santa Cruz shall transmit the sum of Seven Thousand Dollars ($7,000), and the County of Monterey the sum of Two Thousand Dollars ($2,000) to the State Engineer, upon execution by said respective counties of this agreement, which sums shall be deposited, subject to the approval of the Director of Finance, into the Water Resources Revolving Fund in the State Treasury for expenditure by the State Engineer in performance of the work provided for in this agreement. It is the understanding that the Seven Thousand Dollars ($7,000) to be transmitted by the County of Santa Cruz will be in part contributed to said county by the City of Santa Cruz in amount of Two Thousand Six Hundred Dollars ($2,600) and by the City of Watsonville in amount of One Thousand Four Hundred Dollars ($1,400). Also, upon execution of this agreement by the Board, the Director of Finance will be requested to approve the transfer of the sum of Nine Thousand Dollars ($9,000) from funds appropriated to the Board by Item 335 of the Budget Act of 1948 for expenditure by the State Engineer in the performance of the work provided for in this agreement, and the State Controller will be requested to make such transfer.

If the Director of Finance within thirty days after receipt by the State Engineer of said sums from the counties shall not have approved the deposit thereof into said Water Resources Revolving Fund, together with the transfer of the sum of Nine Thousand Dollars ($9,000) from funds appropriated to the Board by Item 335 of the Budget Act of 1948 for expenditure by the State Engineer in performance of the work provided for in this agreement, said respective sums contributed by said counties shall be returned thereto, respectively, by the State Engineer.

The Board and the State Engineer shall under no circumstances be obligated to expend for or on account of the work provided for in this agreement any amount in excess of the sum of Eighteen Thousand Dollars ($18,000) as made available hereunder and if funds are exhausted before completion of the work provided for in this agreement the Board and the State Engineer may discontinue said work and shall not be liable or responsible for the completion thereof.

Upon completion of and final payment for the work provided for in this agreement, the State Engineer shall furnish to the Board and to each of the counties a statement of all expenditures made under this agreement. One-half of the total amount of all said expenditures shall be deducted from the sum advanced from funds appropriated to the Board and seven-eighteenths and two-eighteenths, respectively, of said total amount of all said expenditures shall be deducted from the sums advanced by the County of Santa Cruz and by the County of Monterey, respectively, and any balance which may remain shall be returned to the Board, to the County of Santa Cruz, and to the County of Monterey, on the basis of one-half to the Board, seven-eighteenths to the County of Santa Cruz, and two-eighteenths to the County of Monterey.

ARTICLE III—EFFECTIVE DATE:

This agreement shall become effective immediately upon its execution by all of the parties hereto.

IN WITNESS WHEREOF the parties hereunto have affixed their signatures, the County of Santa Cruz on the 7th day of September 1948, the County of Monterey on the 27th day of September 1948, the Board on the 8th day of October 1948, and the State Engineer on the 7th day of October 1948.

SEAL

Approved as to form:
/s/ JUNE D. BORINA
District Attorney
County of Santa Cruz

/s/ ANTHONY BRAZIL
District Attorney
County of Monterey

Approval Recommended:
/s/ SPENCER BURROUGHS
Principal Attorney
Division of Water Resources

Approved as to Legality:
/s/ C. C. CARLETON
Chief Attorney,
Department of Public Works

Approved:
Director of Finance

R. S. Form	J. W. M. Budget	Value	Descript.

DEPARTMENT OF FINANCE
APPROVED
Oct 20 1948
JAMES S. DEAN, Director
Original signed
By A. EARL WASHBURN
Deputy

COUNTY OF SANTA CRUZ

By /s/ F. L. CLEMENT
Chairman, Board of Supervisors

/s/ H. E. MILLER
Clerk, Board of Supervisors

COUNTY OF MONTEREY

By /s/ A. B. JACOBSEN
Chairman, Board of Supervisors

/s/ EMMET G. MCMENAMIN
Clerk, Board of Supervisors

STATE WATER RESOURCES BOARD

By /s/ C. A. GRIFFITH
Vice Chairman

DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

By /s/ C. H. PURCELL
Director of Public Works

/s/ EDWARD HYATT
State Engineer

APPENDIX B

GEOLOGY OF SANTA CRUZ-MONTEREY AREA

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GEOLOGY OF SANTA CRUZ-MONTEREY AREA

INTRODUCTION

The area encompassed by the Santa Cruz-Monterey Counties Investigation has been divided into four units, the North Coastal, San Lorenzo, Soquel, and Pajaro Units. The North Coastal Unit includes all coastal land draining to the ocean and lying northwest of Santa Cruz and west of the San Lorenzo River Basin, extending approximately from the mouth of Meder Creek to the northern boundary of Santa Cruz County. The San Lorenzo Unit includes all of the San Lorenzo River drainage plus minor coastal drainage between the mouth of Meder Creek and the drainage divide between Arana and Doyle Gulches. The Soquel Unit lies southeast of this drainage divide and of the San Lorenzo drainage basin, and extends to the western boundary of the Pajaro River drainage basin. The Pajaro Unit includes portions of Santa Cruz, Monterey, and San Benito Counties, and comprises all of the lands tributary to Pajaro River except the tributary watershed east of Pajaro Gap. Boundaries of the Pajaro Unit are the drainage divide between Pajaro River and Aptos Creek on the west; the crest of the Santa Cruz Mountains and Pajaro Gap on the north and east; the drainage divide between Pajaro River and Elkhorn Slough on the south; and Monterey Bay on the southwest.

Previous Work and Acknowledgments

Northwest Santa Cruz County has been geologically mapped and described by Branner, Newsom, and Arnold in the United States Geological Survey Santa Cruz folio of 1909. The San Juan Bautista quadrangle, which includes a portion of the Pajaro Unit, has been mapped by J. E. Allen and published by the California State Division of Mines in 1946. A compilation of unpublished work by various geologists was used to complete the mapping of the Pajaro Unit. The resultant map was then field-checked and some modifications were made. Approximately 180 well logs were collected from local drillers, whose assistance is hereby gratefully acknowledged. These logs were utilized in construction of the peg model shown on the illustration entitled "Well Log Peg Model, Pajaro Valley." The peg model greatly facilitated study of the subsurface strata of Pajaro Valley.

Scope of Investigation

The geologic investigation for the present report has included some study of geologic formations throughout the Santa Cruz-Monterey Area and more detailed investigation of the water-bearing sediments of Pajaro and Soquel Valleys and the nonwater-bearing rocks immediately surrounding them. The contact of the water-bearing formations of Pajaro Valley with the rocks of the surrounding highlands was mapped. Observations of the lithology and permeability of the water-bearing sediments were made, in order to describe and interpret the occurrence and direction of movement of ground water.

PHYSIOGRAPHY

The Santa Cruz-Monterey Area lies in the southern Coast Ranges geomorphic province, which is characterized by folded and faulted sedimentary rocks on a pre-Cretaceous basement. The regional trend is generally to the northwest, parallel to the San Andreas fault, although Pajaro River cuts across this trend through Pajaro Valley.

North Coastal Unit

The North Coastal Unit consists of a rugged mountainous region in the erosional stage of late youth. The mountains extend to the west to the seacoast, although a sloping marine terrace averaging one-half mile in width is located between the mountains and the sea south of Scott Creek. The latest land subsidence in the area is illustrated by the occurrence of sea cliffs over 50 feet in height. A number of streams, at least two of which are perennial, drain the unit directly into the ocean. These streams include Waddell, Scott, San Vicente, Laguna, and Majors Creeks. Dendritic drainage patterns exist on mixed igneous, metamorphic, and sedimentary rock types. Occasional prominent cliffs occur at the valley edges, especially in the areas of pre-Monterey sediments. This unit has been upthrown along the Ben Lomond fault on the east. Ben Lomond Mountain, which has a sharp escarpment produced by the fault on the east and a relatively gentle slope to the west, was formed as a result of this movement.

San Lorenzo Unit

The San Lorenzo Unit is also generally mountainous and possesses a rugged topography. Primary drainage here is by the San Lorenzo River, which flows south and slightly east to enter Monterey Bay at the City of Santa Cruz. Santa Cruz harbor is a minor indentation in the much larger Monterey Bay at the mouth of the San Lorenzo River. The San Lorenzo River has nearly reached grade in the vicinity of Felton, owing to erosion in an area of relatively soft sediments. Rincon Gorge, just downstream from the flats in the vicinity of Felton, has been cut into a much more resistant granitic rock. Uplift along the Ben Lomond and associated faults, with subsequent erosion, has resulted in the exposure of the granitic basement in this area. The lines of the Ben Lomond and other major faults are marked by more or less continuous valleys. Butano and Castle

Rock ridges have been formed by the anticlinal folding of sedimentary rocks.

Soquel Unit

The Soquel Unit is drained by two primary streams—Soquel and Aptos Creeks. Rugged mountains occur in the northern half of the unit, but rolling hills are found to the south adjacent to the marine terrace at the edge of the ocean. This terrace is generally well developed, sloping, and abruptly terminated at the beach line by high sea cliffs. The drainage pattern is dendritic throughout the unit, which is underlain chiefly by relatively soft sedimentary rocks. The Soquel Creek headwaters flow in a subsequent valley along the San Andreas fault for a distance of several miles.

Pajaro Unit

The Pajaro Unit is composed of the Pajaro Valley and surrounding highlands within the Pajaro River watershed. The Pajaro Valley, from a point northeast of Watsonville to Monterey Bay, is essentially an even-floored valley sloping very gently to the southwest and drained by Watsonville Slough and the Pajaro River. The area north and west of Watsonville is occupied by a number of relatively flat, slightly elevated terraces, dissected by actively cutting streams and capped by terrace gravels for the most part. Near the coast, south of La Selva Beach, sand dunes are found over an extensive area, and these continue in diminishing abundance to the southeast along the edge of the bay. The south side of Pajaro Valley is bounded by low rolling hills which present a gently undulating surface interrupted only by the broad valley of Elkhorn Slough. The latter valley was a Pleistocene channel of the San Benito River. The valley floor east and northeast of Watsonville gradually slopes into a series of coalescing alluvial fans at the base of the Santa Cruz Mountains. These mountains form a topographically rough, northwest-trending range which is transected by the San Andreas fault along its western slopes. The break in slope produced by the fault may be seen and traced laterally from several points near the base of the mountain range. A number of shallow lakes northeast of Watsonville have been formed by additional faulting which dammed several small streams draining these mountains.

The Pajaro River flows westward from the wide Santa Clara Valley, through the relatively narrow Pajaro Gap between the Santa Cruz Mountains and the Gabilan Range, into Monterey Bay. The river formerly meandered freely across the wide Pajaro Valley but is presently contained in a definite channel by artificial levees. The Pajaro River and a number of small streams which flow down the steep western slopes of the Santa Cruz Range are offset laterally to the northwest as they cross the San Andreas fault. According to Allen, the average recent displacement of streams in this area along the fault is on the order of 3,800 feet.

Extensive Pliocene and Quaternary movements in the mountainous and faulted areas, with resultant periods of deposition and erosion, have obliterated many of the older physiographic features. However, evidences of at least two cycles of erosion still remain, with an erosion surface older than that presently developing being recognizable in many places.

The earlier erosional cycle was developed during the lower and middle Pleistocene and resulted in the deposition of the lagoonal and sand dune sediments of the Aromas formation. The uplift which marked the end of this period of deposition introduced the second recognizable and present cycle of erosion. This uplift resulted in the rejuvenation of the streams in the area, followed by an intensified period of erosion which has proceeded until the region is now in a stage of late youth. The Pajaro River captured the San Benito River in the vicinity of Chittenden as a direct result of vertical movement on the San Andreas fault during this uplift. Important lateral movement along the fault may have occurred also at this time.

During the period of intermittent uplift, the higher terraces were dissected, and several low terraces were formed at different levels. The series of lakes northeast of Watsonville were dammed by a low escarpment resulting from uplift on the west side of a distributive branch of the San Andreas fault. This branch is probably a continuation of the Vergeles fault of Allen. Other indications of the presence of such a fault are considered later in this report. The fault apparently has considerable significance with regard to the local supply and movement of ground water.

The last land movement of note in the general region has been one of settling on the magnitude of 100 feet or slightly more, with subsequent alluviation of the Pajaro River and its principal tributaries. Incision of the main streams into their flood plains is now taking place.

Vegetation throughout the area of the investigation varies from dense redwood forests north and east of Pajaro Valley to barren grasslands on the lower mountain slopes and in the valleys near sea level. The redwood forest growth is particularly characteristic of regions of high rainfall regardless of elevation. Most of the land of the principal valley floors is presently under cultivation.

GEOLOGIC FORMATIONS

The age of the geologic formations of the area ranges from pre-Cretaceous to Recent. Sedimentary, igneous, and metamorphic rock types, in decreasing order of importance, are all present. The great bulk of the rocks consists of marine sediments, but some continental and tidal sediments are found on, and immediately adjacent to, the major valley floors. Deep-seated igneous rock outcrops only on the west sides of the San Andreas and Ben Lomond faults. Relationship and occurrence of the formations within the various units is shown on the Correlation Chart, Plate B-1. A listing, in stratigraphic sequence, of all formations outcropping within the area of this report follows.

Age	*Formation*
Recent	Landslides
	Sand dunes
Recent-Upper Pleistocene	Late Quaternary fill
Pleistocene	Terrace gravels
	Aromas red sands
Pliocene	Purisima group
Upper Miocene	Santa Margarita
Middle Miocene	Monterey group
Lower Miocene	Vaqueros
Oligocene	San Lorenzo group
Upper Eocene	Butano
pre-Cretaceous	Santa Lucia granite
	pre-Franciscan metamorphics

The geologic formations may be divided into two groups for purposes of ground water study. These are (1) the pervious formations which constitute the ground water reservoirs and (2) the less pervious formations which bound the ground water reservoirs. They are herein classed, respectively, as water-bearing and nonwater-bearing formations. The classification is arbitrary in that all formations near the surface of the earth carry some water and the water-holding and water-yielding characteristics of none are uniform throughout their mass. In general the nonwater-bearing formations are those which transmit and yield water very slowly and in small amount.

Nonwater-bearing Group

In the area covered by this investigation the nonwater-bearing group comprises Santa Lucia granite, pre-Franciscan metamorphics, Butano formation, the San Lorenzo group, Vaqueros formation, and the Monterey group.

The Santa Lucia granite and pre-Franciscan metamorphics contain minor quantities of ground water. Springs occasionally emerge from joint cracks in the rocks, but the flow from any one of these is small, although the total supply from all may be appreciable. Isolated instances of shallow domestic wells with low yields are known in areas where these formations comprise the only known source of water. Such wells are probably tapping water moving principally along rock fractures.

Sedimentary rocks of the Butano, San Lorenzo, Vaqueros, and Monterey formations similarly carry water chiefly along rock fractures. Even the well sorted sandstones and conglomerates of these formations are well cemented and have low permeability. Domestic wells tap the strata in many places but only small yields are obtained. The San Lorenzo and Monterey groups have added hydrologic significance, however, in that their present positions of outcrop indicate that they probably have been primary sources of sediments in the building up of the major alluvial fills of the area.

Santa Lucia Quartz Diorite. This rock is exposed along the west side of the San Andreas fault in the Gabilan Range and west of the Ben Lomond fault on Ben Lomond Mountain. Smaller outcrops also occur adjacent to lesser faults in the Soquel Unit. All that is known of the age of the intrusives is that they are pre-Franciscan, the Franciscan group itself being Jurassic in age.

The intrusive rock varies in composition between a quartz diorite and a gabbro, with the former type predominant. The various outcrops are lithologically similar and undoubtedly all are a part of the same great batholithic mass which underlies this portion of the Coast Range. The rock is generally strongly weathered and therefore is not given to producing topographic features of sharp relief. Both the fresh and decomposed quartz diorite are quarried in several places for use in local construction. The largest such operation is the Granite Rock Company's aggregate plant at Logan Siding in Pajaro Gap.

Pre-Franciscan Metamorphics. These metamorphics consist essentially of micaceous schists and interbedded crystalline white to gray limestones. The rocks lie in scattered patches atop the granitic mass which forms the core of Ben Lomond Mountain. The exact age of the metamorphics is undetermined although the underlying pre-Franciscan igneous rock is obviously younger than either the schist or the limestone. The metamorphics are much disturbed, this being partly due to the granitic intrusion from beneath. It seems probable that at least some of the metamorphism was of a contact type, produced at the time of intrusion.

Schist outcrops are commonly severely weathered, and fresh hand specimens are not easily obtained. The rock is fine-grained and compact with cleavage evident along planes of schistosity, especially where weathered. The limestone varies from small impure layers to masses of white and gray crystalline marble.

Butano Formation. This formation is composed essentially of a marine sandstone with a few associated beds of pebble conglomerate and some intercalated shale. It outcrops on, and southeast of, Butano Ridge, which lies north of Big Basin State Park. The rocks are nonfossiliferous, so the exact age of the formation is not known. However, since it lies conformably just beneath the San Lorenzo formation of the Oligocene, its age is thought to be either upper Eocene or lower Oligocene. The primary member of the formation is a medium- to coarse-grained tan sandstone occurring in massive beds. Maximum thickness of the formation is in excess of 2,000 feet.

San Lorenzo Group. This group consists of variable sedimentary types including sandstones and fine-grained arenaceous shales. The rocks outcrop in several northwest-trending belts north of Santa Cruz and also in a similar belt near the head of Corralitos Creek. In the latter locality, the group now outcrops as a result of erosion of overlying sediments subsequent to raising of the block on which the exposure occurs. This uplift has been brought about by vertical movement on the San Andreas fault and a branch thereof. The group has also been highly disturbed by much internal faulting of lesser intensity.

Near the headwaters of Newell Creek and on the San Lorenzo River, Kings Creek, and Bear Creek, the shale predominates over the sandstone. This represents the more typical development of the series. Elsewhere, fine-grained, soft sandstones with minor amounts of intercalated shales occur. Bedding is not readily apparent in the sandstones, and weathering in the relatively soft series is deep. Therefore, few good exposures are to be found, and detailed mapping of rock structures is rarely possible. The age of the group has been determined as Oligocene by study of fossil content and by correlation of stratigraphic relationships with adjacent formations.

Vaqueros Formation. Rocks of the Vaqueros formation outcrop in the area north of Santa Cruz in a northwest-southeast-trending zonal pattern. Their distribution is quite extensive in this area. A single smaller area of outcrop occurs near the head of Elkhorn Slough, southeast of Aromas. A maximum thickness of 2,700 feet has been measured in the vicinity of Castle Rock Ridge. By fossil study and by comparison with beds of known age the Vaqueros has been determined to be of lower Miocene age.

Principal rocks of the formation are sandstones which vary from fine-grained to conglomeratic but are chiefly medium-grained. Hardness of the rocks varies considerably although the beds are generally quite massive. Even where relatively nonindurated these beds are more resistant to erosion than are the underlying formations. Erosion consequently produces a rugged topography with deep and narrow ravines prevailing along stream courses. The contact with the overlying Monterey formation is indefinite, possibly conformable, and may even be gradational in places.

Monterey Group. The Monterey group of marine sediments is one of the most widespread geologic formations in the Coast Ranges of California. In the Santa Cruz-Monterey Area the group generally consists of a thick series of arkosic sandstones associated with much shale and grading upward into typical diatomaceous and siliceous shale. The rocks outcrop extensively along the coast line between Santa Cruz and the northern boundary of Santa Cruz County. Other locations of lesser importance exist north and east of the town of Boulder Creek where several northwest-trending zones of Monterey shale occur. Much of the Santa Cruz Range northeast of Pajaro Valley is also underlain by this formation, and here the sediments occur chiefly on the east side of the San Andreas fault, as shown on Plate B-2 entitled "Geologic Cross Sections of Pajaro Unit."

In general, the shales of the formation are by far the most prominent rock type. The varieties of diatomaceous shale range from almost pure diatomite to shales containing only a very few diatom skeletons. Many of the fine- to medium-grained sandstones are impure and occasionally are moderately bituminous. Some occurrences of petroleum have been reported in sediments of the Monterey group. All of the rocks of the group are highly fractured and often severely crushed. Multiple small faults occur and fine-scale jointing is common. The latter occurs especially where the shale has been exposed to weathering over a long period of time and produces a weak rock made up of small angular fragments in situ.

Water-bearing Group

The formations here included in the water-bearing group are the Santa Margarita formation, Purisima group, Aromas red sands, terrace gravels, sand dunes, landslides, and late Quaternary fill.

Santa Margarita Formation. This formation is composed almost entirely of coarse-grained, white, unconsolidated, clean sands, and outcrops principally in the region between Santa Cruz and Ben Lomond. It does not appear outside the San Lorenzo Unit. The most significant occurrences are along lower Zayante Creek, and it is here that two large aggregate plants are operating, quarrying the materials for use in construction work locally and throughout much of the San Francisco Bay Area. The presence of small outcrops of Santa Margarita sand near the northeast end of Ben Lomond Mountain and again just east of the town of Boulder Creek indicates that the formation once covered a much larger area than that described above. The softness of the rocks northwest of Felton has allowed rapid erosion, and streams have removed all of the sediments, including those of the Santa Margarita formation, from their position overlying the plutonic igneous mass of the Ben Lomond fault block. These sediments have then been redeposited on the present sea floor.

The base of the Santa Margarita includes some beds of conglomerate, and the top 100 feet of the formation is often very shaly. Maximum measured thickness in the region is 300 feet. The sands which comprise the major part of the formation are generally very quartzose and often slightly conglomeratic. Rock fractures are extremely difficult to locate and to trace through the soft sediments of the Santa Margarita formation.

Permeability of the Santa Margarita formation is moderately high. The sands are clean, uncemented, and comparatively well sorted. Many domestic wells are to be found within the areas underlain by the white sands, especially along Zayante and Bean Creeks. Some irrigation of small fields is possible from these wells.

Water is chiefly contained interstitially in the Santa Margarita sediments, rather than along rock fractures.

Purisima Group. This formation includes a thick series of highly variable sediments ranging from marine fossiliferous rocks near the base of the formation to continental deposits in its upper portions. The sediments are chiefly poorly indurated gravels, sands, silts, and silty clays. They rest uncomformably on the older rocks of the area, and are in turn overlain locally by alluvium and to the south of Pajaro Valley by the Pleistocene Aromas red sands. Hydrologically, the most important occurrences are north and east of Pajaro Valley within the Pajaro River drainage basin. Much of the upper reaches of Corralitos and Green Valley Creeks, of Harkins Slough, and of Larkin Valley is underlain by Purisima sediments. The lower slopes of the Santa Cruz Mountains west of the San Andreas fault and nearly all of the drainage basins of Soquel, Aptos, and Branciforte Creeks, as well as the northern half of the alluvial fill of Pajaro Valley, are also underlain by rocks of the Purisima.

The total thickness of Purisima sediments represented locally is probably on the order of 10,000 feet. Lithology of the formation is so varied as to virtually prohibit a generalized description. In places it appears to be so shaly that it has been confused with the older Monterey shale. Basal gravels or lightly cemented conglomerates, often hundreds of feet in thickness, generally lie at the bottom of the stratigraphic section, and these are significantly composed of pebbles, cobbles, and boulders of the immediately underlying strata. This indicates a relatively short distance of transportation for the material prior to deposition. However, sandstones and sandy conglomerates, for the most part slightly indurated and friable, comprise the great bulk of the sediments of the Purisima formation. Attitude of the beds varies widely from horizontal to vertical due to the intense folding and tilting which has occurred in the area since deposition. Strata outcropping on the west side of the Santa Cruz Mountains apparently have a moderate regional dip to the southwest. Similar generalized attitudes appear in the vicinity of Soquel and Aptos Creeks.

The Purisima formation is almost uniformly fossiliferous throughout. A few fresh-water fossils have been found in its upper portions, thus indicating a probable continental origin for at least those upper horizons. Other indications of this continental nature include the presence of gypsum veinlets and of considerable well-developed cross-bedding. Fossils found in the rocks of the Purisima during the course of this investigation include echinoids, pectens, and oysters. These are all relatively shallow marine dwellers. Several strata in the vicinity of Pajaro Gap yielded especially good specimens of echinoids, genus Dendraster. Correlation of similar fossils collected in this area by others has established the age of the Purisima as including both the middle and upper Pliocene. Hard fossiliferous ''shell beds'' up to two feet thick have been noted in Pajaro Gap, Soquel Valley, and elsewhere.

A few wells of heavy draft are known to be pumping from the Purisima formation in the Green Valley Creek area, and there are many domestic and stock wells, which show small but steady yields, drilled in the formation throughout the area of investigation. More than half the Forebay Area of Pajaro Valley is directly underlain by Purisima sediments, and it is largely through these rocks that water percolates and eventually migrates into the valley fill. Some of the deeper wells on the north side of Pajaro Valley may be pumping partially from rocks of the Purisima which directly underlie the northern part of the Quaternary fill.

Soquel Valley, the other principal ground water basin of the region, is almost completely bounded by gravels and sands of the Purisima formation, except in the upper headwaters area of Soquel Creek. These sediments are sufficiently permeable, in general, to allow for appreciable deep penetration of precipitation. Surface runoff is not great, although this is one of the highest rainfall zones in the area. The pressure aquifer of Soquel Valley consists of a stratum of black sand of the Purisima which is persistent beneath the entire valley floor. Much of the runoff water eventually finds its way into this aquifer, which lies confined beneath thin layers of ''hard shell rock.'' Production of 250 to 500 gallons per minute has been obtained from several irrigation wells locally.

Aromas Red Sands. The Aromas red sands consist of friable, quartzose, brown to red sands, except for a thin basal breccia member which is present in some places. The hills on the south side of Pajaro Valley are underlain by Aromas sands, and this zone of outcrop extends from the sea almost to the San Andreas fault on the east. The southern part of the late Quaternary fill of Pajaro Valley is also probably directly underlain by the Aromas. The formation unconformably overlies all older formations with which it is in contact. Maximum thickness of the sands is about 1,000 feet.

No fossils have been found in the Aromas, but cross-bedding is quite common. The sediments were apparently deposited in a lagoonal or shore-line environment on a relatively flat pre-existing surface. Their deposition was probably the result of action by both wind and waves during the Pleistocene epoch. The sands are generally medium-grained in texture and owe their red color to the presence of iron oxide as a weak cementing agent. In some outcrops the sand is composed almost entirely of pure quartz grains. Due to the extremely friable nature of the sands they tend to erode easily upon denudation of overburden. This locally produces badlands topography on steep embankments.

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Bedding planes are not well developed, and consequently it is difficult to determine attitudes of the sand layers. Dips are generally on the order of five degrees or less where determined, however, and direction of the dip is to the west. This is significantly in accord with the direction of dip of the blue clay stratum in the alluvium between Watsonville and Aromas.

Permeability of the sands of the Aromas formation is generally greater than that of the Purisima sediments. The Aromas sands are well sorted and not tightly cemented. Domestic and irrigation wells drilled almost entirely within the Aromas formation and having comparatively heavy yields exist north and northeast of Springfield School. Smaller yields are obtained from a number of domestic wells penetrating the red sands elsewhere. Studies of ground water maps indicate that much of the water contained within the Aromas sediments eventually moves north into the Pajaro Valley pressure aquifer, chiefly adjacent to the barrier of the Vergeles fault east of Watsonville Junction, and in the area west and north of Springfield School.

Terrace Gravels. The upper Pleistocene was marked by the deposition of the sands and gravels which are now the terrace deposits north and northeast of Pajaro Valley and east of the mouth of Pajaro River. These deposits are typically poorly sorted and are composed of granitic and pre-Franciscan metamorphic material for the most part, although locally they are derived from older adjacent or underlying sedimentary rocks. In many places, especially at the base of the Santa Cruz Mountains, the terraces grade into alluvial fans of a slightly later age. The gravels have been dissected by Recent streams and are usually mantled by several feet of residuum which has a composition directly reflecting the nature of the underlying material.

During the same period, marine terraces were being cut and sediments deposited thereon along the seacoast from the northern boundary of Santa Cruz County to the northwest corner of Pajaro Valley. Sands are the most abundant of these deposits, although some clays and gravels are also represented locally. Maximum thickness of the marine terrace deposits does not exceed 50 feet, and generally only a few feet are to be found. The remnants of the various terrace deposits are indicative of alternating elevation and depression of the land surface with respect to sea level during Quaternary time. In Pajaro Valley, the upper Pleistocene deposits underlie Recent alluvium beneath the valley floor, and will be considered grouped with the alluvium under the section on late Quaternary fill.

Wells of high yield occur in many places where terrace gravels comprise the surface formation. Some of these wells pierce through the gravels and may obtain their water supply partially from underlying formations. The terrace deposits serve as aquifers principally in the areas east of College and Kelly Lakes, north of Pinto Lake, and in Aromas Valley. Yields of more than 500 gallons per minute have been reported in these areas. The gravels underlie much of the Forebay Zone and apparently absorb an appreciable share of the total quantity of water which eventually enters the Pajaro Valley pressure aquifer. This is especially true in the area along the base of the Santa Cruz Mountains where deep percolation of runoff from many small streams occurs. The marine terrace deposits are too thin to be of hydrologic importance.

Sand Dunes. Winds blowing along the seacoast northwest of Pajaro Valley have produced a series of dunes extending from the edge of Pajaro Valley north to the upper end of Larkin Valley. Only low scrub brush grows on the dunes, which are composed of well-sorted, medium-grained, quartzose sand. Depth of the aeolian sand is not known but should not be great. However, a well drilled south of La Selva Beach is reported to have penetrated nearly 400 feet of sand without appreciable change in lithology. Yield of this well is not known, but if such a depth of sand actually does exist, it seems likely that the formation could contain considerable quantities of water interstitially.

Landslides. Movement along the San Andreas and associated faults has been the cause of many of the major landslides on the west slope of the Santa Cruz Mountains. Both Miocene and Pliocene rocks have been affected. The slides cover areas as much as one-half mile in length from apex scarp to pressure ridge. The hydrologic significance of these landslides is negligible.

Late Quaternary Fill. The post-Aromas sediments composing the principal fill of Pajaro Valley were laid down late in the Quaternary period, presumably in upper Pleistocene and Recent time. This fill consists of both continental streamlaid and marine deposits. Sediments represented include gravels, sands, silts, and clays. The marine strata are commonly continuous over large areas, whereas the stream deposits usually occur as lenticular and interfingering layers. The uppermost sediments and their residuum comprise the soil of the valley floors, which is generally classed as a silty loam.

The blue clay layers of the late Quaternary fill act as confining strata overlying the primary aquifers of the two pressure zones in the Pajaro Unit. The blue clays are generally fine-grained in texture and vary from blue to gray in color, grading into yellow where weathered and oxidized. It is likely that the main valley floor has been under the sea during much of Quaternary time. This is indicated by the marine terraces previously described.

Deposits laid down upon a comparatively irregular surface on the floor of the ocean initially fill in the low hollows in the existing terrain and eventually cover the entire area in a great sheet. Smoothing and grading of the upper surface of such a shallow marine sediment, especially one which is relatively fine-grained, is a continuing process produced by wave and tidal action on the sea floor. Therefore, although the bottom of the stratum would be very irregular, the top would present a comparatively flat surface. Well log cross section C-C′ of Pajaro Valley, location of which is shown on Plate 12 and depicted on Plate B-3, illustrates this contrast between the top and bottom of the blue clay stratum very clearly. Subsequent uplift and erosion of the sediments permit the formation of some newer topographic expressions, such as the broad valley incised in the top of the blue clay in the vicinity of the Pajaro River.

A study of the peg model revealed that between Watsonville and Monterey Bay the blue clay lies nearly horizontal in one or possibly two horizons. However, tilting of parts of the Quaternary fill since deposition has apparently occurred in at least two directions. The blue clay dips nearly a degree to the south between Corralitos and Watsonville and about one-half degree to the west between Aromas and Watsonville. These generalized attitudes have been further complicated by some faulting and subsequent disturbance of large blocks of the fill. A thickness of more than 600 feet of fill has been reported from a well in lower Pajaro Valley, although the average thickness is much less than this. Deposits underlying the Pajaro Valley floor are generally well sorted and stratified. The clay, sand, and gravel deposits of the alluvial fans on the northeast side of the valley are seldom pure, however, and are usually torrentially bedded. The Quaternary fill of Soquel Valley is relatively thin and consists essentially of alluvial silts, sands, and gravels.

The Quaternary fill is not a primary aquifer in Soquel Valley as it is in Pajaro Valley. In the latter area the movement of water into and through the coarser sediments occurs in great quantities. This is evidenced by the high annual yield of the valley floor wells, most of which obtain their supply entirely from late Quaternary sediments.

GROUND WATER GEOLOGY

Two of the four units in the Santa Cruz-Monterey Area contain ground water basins of significant size: the Pajaro Unit and the Soquel Unit. The North Coastal Unit and the San Lorenzo Unit are generally mountainous, and contain no ground water basins large enough to merit detailed geologic study. Pajaro Valley contains two independent pressure zones and one large forebay zone. Almost the whole of Soquel Valley consists of a pressure zone in which the pressure aquifer is a member of the Purisima group of marine sediments.

Pajaro Valley

The Upper Pressure Zone in Pajaro Valley lies in the slightly elevated area south of Corralitos and west of College Lake. The Valley Floor Pressure Zone includes all of the main valley floor plus some of the hilly area north of Watsonville Slough. Although the sediments of the two pressure zones are probably the same, an area of free ground water representing a break in the continuity of the confining stratum of blue clay occurs between the zones, as shown on Plate 11. This narrow belt has therefore been included in the Forebay Zone. The latter lies chiefly outside the area of heavy pumping and includes practically none of the main valley floor. The most extensive part of the Forebay Zone lies to the north of the valley in a region underlain chiefly by sediments of the moderately permeable Purisima group. The Aromas sands underlying a part of the Forebay Zone on the south edge of the valley also contribute appreciably to the ground water supply. Direct percolation into the confined aquifers from streams in the pressure zones does not occur, although a direct contribution is made to the shallow water aquifers. Especially rapid rates of percolation have been noted in Corralitos Valley where shallow wells respond directly and almost immediately to fluctuations in volume of stream flow.

Forebay Zone. A large part of the Pajaro drainage basin acts as a forebay for the pressure aquifers of the two pressure zones. Certain portions of the drainage area which are excluded from the forebay are noted below. The greatest recharge apparently stems from the northern part of the unit, which is surficially drained by Corralitos, Green Valley, and Casserly Creeks. Much of this area is heavily forested. It is generally underlain by Pliocene Purisima gravels and sands. These sediments are permeable and permit heavy and deep penetration of rainfall. Attitudes of the Purisima here are varying, but the strata generally dip moderately to the southwest. A similar direction of dip in the alluvium between Corralitos and Watsonville indicates that some of the south component of the bedrock dip has been attained quite recently. Many faults and some minor folding have further complicated the structural pattern. No set pattern of paths of flow exists, apparently, other than the general slow movement of free ground water downward and laterally into the pressure zones to the south and southwest. Wells deriving water from the Purisima and other formations of the Forebay Zone have free ground water characteristics.

The section of the Santa Cruz Mountains east of Pajaro Valley but west of the San Andreas fault zone, as well as much of the area of coalescing alluvial fans at the base of the range, comprises a secondary part of the Forebay Zone. Precipitation in this area is not great, and stream runoff is slight. The nearly vertical zone of the great San Andreas fault provides an effective ground water barrier which limits subsurface movement from the higher mountain slopes directly to the valley. Location of the fault zone is shown on the Geologic Map of Pajaro Unit, Plate B-4. Rising water behind the fault is evidenced by seasonal springs and sag ponds. The hill slopes west of the fault are largely underlain by sediments of the Purisima group, which have a consistent moderate dip to the southwest in this area. Water percolating into the Forebay Zone east, as well as west, of the San Andreas fault and its distributaries may contribute to the pressure aquifer. However, ground water east of the fault zone must rise to the surface to cross the fault before percolating into the ground again or running off to the west.

The Pajaro River flows across granitic basement rock at Pajaro Gap. This rock has been thrust up along the west side of the San Andreas fault. Only a few feet of very recent stream gravels overlie the rock in the channel section. No water from the Pajaro River watershed east of Pajaro Gap can enter the valley, therefore, except as surface or near-surface flow in the river channel.

Contribution to the pressure aquifer of the valley floor is also made from the Aromas red sands which bound the valley on the south. Areas of recharge are west of Aromas and northwest of Springfield School. Water moving slowly through the sands from east to west along gentle gradients is apparently forced north into the sediments of the valley floor west of Aromas. It is possible that this movement of water northward is caused by the barrier effect of the Vergeles fault, which cuts the Aromas formation on the south side of Pajaro Valley. Approximate position of the fault is shown on the geologic map, Plate B-2. A ground water ridge which persists in the valley fill east of Watsonville indicates this direction of movement of water. The nose of this ridge points west of north. The fault apparently cuts all formations underlying the valley floor excepting the Quaternary fill. It therefore does not act as a barrier to movement of ground water through the sediments of the valley floor. In addition to the ground water ridge east of Watsonville, there are other evidences by which this extension of the Vergeles fault, concealed surficially except for topographic expression, has been mapped. Another ground water ridge has been noted to the west of College Lake; the Pajaro River is offset to the northwest some four miles west and slightly north of Aromas; a hill of Aromas sediments projects into the valley two miles east of Watsonville Junction; and several lakes northeast of Watsonville have been dammed by a fault scarp. These are all indications of the same fault.

During periods of heavy draft, when trough conditions exist between Watsonville and Monterey Bay, there are indications that a minor amount of water moves outward from the end of the long topographic ridge at the southwest corner of Pajaro Valley. Here, water contributed from the Aromas red sands spreads toward the mouth of Pajaro River, Monterey Bay, and Elkhorn Slough.

Pressure Zones. A pressure zone is a zone of confined ground water which occurs beneath strata impervious to the extent that free hydraulic connection with overlying ground water does not exist. This confined water, moving under pressure head due to the difference in elevation between the forebay and discharge areas, will rise in wells penetrating the overlying confining strata. The water may rise to a point above the ground surface, in which case the well flows. Shallow ground water, as used herein, refers to that water which overlies a confining stratum or strata and which can receive recharge directly by percolation from the surface. All the sediments of the Pajaro Valley fill are capable of containing ground water in varying amounts, but only the coarser materials yield this stored water readily to wells.

The confining stratum or strata of blue clay found in both pressure zones of the Pajaro Unit is a very fine-grained and tight material. This clay contains an appreciable amount of water firmly bound between the grains, but it will prohibit rapid transmittal of water between confined and free aquifers. The clay was probably deposited in a shallow embayment of the ocean. The blue color is probably due to reduction of the iron content in a submerged environment, whereas the iron in an alluvial deposit tends to oxidize to red or yellow colors. The continuity of the blue clay strata is interrupted along an irregular line between the two pressure zones. Either the material has been removed along this line, as might have occurred in the case of a marine terrace, or it was never deposited there at all, thus indicating two distinctly different periods of deposition. Thickness of the blue clay varies widely from 0 to about 130 feet.

A peg model of the unit was constructed to show well log relationships. The base map was on a scale of 1 inch equals 1,320 feet, and the pegs, representing the individual wells, were on a vertical scale of 1 inch equals 60 feet. The top and bottom of the well and the location and thickness of the blue clay strata were depicted on each peg. The peg model provided a basis for differentiating between pressure and forebay zones, as indicated by the continuity of the blue clay strata.

Further delineation of the boundaries of the pressure zones was made by determination of hydrologic characteristics of the ground water in individual wells. One of the chief means by which these characteristics were determined was by a correlation between depths of well perforations, positions of blue clay strata, and elevation of standing water surface. It was assumed in all cases that there were no breaks in the well casing above the perforations. In all probability, this is actually true in only about 90 per cent of the cases. The series of measurements of water levels of fall 1947, representing one of the lower positions of the pressure surface, was used in making this analysis. A well in which the perforations are below the base of a relatively impervious stratum of clay, and in which the water stands above the bottom of the clay bed, must be a pressure well. The water would not rise above the base of the clay unless a pressure head existed. The standing water surface therefore represents a piezometric or pressure surface. Approximately 80 per cent of the wells on which both a log and a record of the depth of perforations were available were determined by this means to be pressure wells. Distribution of these pressure wells is relatively uniform over both pressure zones and is shown on Plate 12.

The piezometric surface approaches more nearly to the ground surface between Watsonville and Monterey Bay than elsewhere in the region. Older residents report that many of the wells in this vicinity used to flow perennially. Such flows no longer occur.

Upper Pressure Zone. Both confined and free ground water occurs within this zone. Individual wells show characteristics of one or the other type of aquifer, and not a few show mixed characteristics. The free ground water is restricted to relatively shallow wells, although the yield from these is often nearly as great as from those wells pumping only from the pressure aquifer. The shallow water table stands about 50 feet higher than the pressure surface of the underlying confined aquifer.

The zone of shallow water ranges up to 80 feet in depth. The sediments therein consist largely of sands and gravels recently deposited by streams crossing the zone. Many of the wells in the Upper Pressure Zone are drawing water only from this upper horizon. The water table elevation fluctuates in close correspondence with the volume of flow in percolating streams of the zone. These streams directly recharge the shallow aquifer. Due to their dependence on stream flow, the shallow water wells do not produce as dependable yields as those of the pressure wells.

Thickness of the entire Quaternary fill, including the shallow water aquifer, the pressure aquifer, and the intervening blue clay strata, does not exceed 300 feet in this pressure zone. Sediments of the pressure aquifer are chiefly sands and gravels of lagoonal and fluvial origin. Underlying these sediments are sands and gravels of the Purisima group. The blue clay overlying the pressure aquifer is slightly thicker than that capping the pressure aquifer of the Valley Floor Pressure Zone. Intake for the pressure aquifer occurs in areas of terrace gravels and Purisima sediments which fringe the pressure zone. Moderate yields with sharp drawdown and quick recovery are obtained from wells tapping the pressure zone only.

The wells of highest yield in the Upper Pressure Zone are those which are perforated or have broken casings in both free and confined horizons. These are the wells which show mixed and erratic ground water characteristics. Mixing of the waters of the two aquifers occurs through these wells, but since the normal shallow water table stands above the normal pressure surface there is no loss in head resultant within the pressure aquifer. On the contrary, water must actually move from the shallow water aquifer down through the wells, thereby tending to increase the head in the pressure aquifer.

Valley Floor Pressure Zone. Both confined and free ground water aquifers occur here also. The free ground water occurs in a shallow aquifer which has an average thickness of less than 50 feet. The quantity of water contained in the sediments of this aquifer is not great, although a large number of domestic wells do obtain their supply from it. The water table of the shallow aquifer stands less than 10 feet beneath the ground surface over much of the area.

In 1942 the United States Soil Conservation Service drilled 20 auger holes, scattered over the floor of Pajaro Valley as shown on Plate 12. Average depth of the holes was from seven to nine feet. Measurement of standing water level in these holes was made in 1943 and 1944 at semimonthly intervals over a period of more than a year. An additional set of measurements was made in a few of the holes in July, 1946. Only rarely were any of them found to be completely dry. The water level generally did not fluctuate more than three feet during the entire period of record. Well owners report very little variation seasonally in water level or available supply from the shallow water aquifer.

The shallow water is supplied not only by lateral underground movement but also by direct percolation from above. The blue clay strata underlying the aquifer are relatively impermeable and will not readily transmit water. Thus the shallow water aquifer is practically sealed off from the underlying pressure aquifer. Evidence of this can be had by comparing water table elevations in auger holes with the standing water levels in nearby deep wells. For example, in July, 1946, water in S. C. S. hole No. 5 stood 2.8 feet beneath the ground surface. Water in neighboring well 12S/2E-18L1 stood at 20.4 feet beneath the surface in July, 1949. Measurements in the auger holes were not made after 1946, but since it is known that only minor fluctuations occur in the shallow water table from year to year, the above comparison may be reasonably drawn. Total fluctuation of water level in the test hole during the one-year period of record in 1946 was 3.5 feet. During 1949 the water level in the irrigation well fluctuated 22.0 feet.

A number of auger holes drilled by the Division of Water Resources in 1951 also established the presence of a high water table standing appreciably above the piezometric surface of the pressure aquifer. Location of these holes is as shown on Plate 12. The numbers of both sets of auger holes have been arbitrarily assigned and do not conform to the numbering system of the United States Geological Survey as do the numbers assigned to wells of the area.

The sediments of the pressure aquifer within the Valley Floor Pressure Zone are chiefly sands and gravels of mixed marine and fluvial origin. They are overlain by a continuous layer of blue clay which serves as a confining stratum for the aquifer, from which heavy yields are obtained. Recharge occurs laterally from the Forebay Zone.

Both the Purisima group and the Aromas formation directly underlie the late Quaternary fill in Pajaro Valley. These formations are known to be water-bearing in some degree beneath the valley floor. The maximum depth of the late Quaternary fill may be as great as 800 feet but its average depth probably is no greater than 400 feet. The movement of water of the pressure zone through the sediments southwest of Watsonville toward the bay is comparatively uniform. This is in contradistinction to a confused pattern of movement of water east and north of that city.

Soquel Valley

The principal aquifer of Soquel Valley consists of a stratum of black sand of the Purisima formation. This bed underlies the entire valley floor at a shallow depth beneath the late Quaternary fill. The latter consists of a relatively thin succession of alluvial silts, sands, and gravels which may be interbedded with some tidal or lagoonal sediments. Both the Quaternary fill and the Purisima sediments under the valley floor are relatively permeable, with the exception of occasional thin layers of well-cemented Purisima "hard shell rock." The "shell rock" is a highly fossiliferous sandstone which occurs in persistent strata one to two feet thick throughout the Purisima in this region.

The entire Soquel Valley consists of a pressure zone. Wells which still flow occasionally have been reported in recent years in the vicinity of Capitola, but these were probably perennially flowing wells when first drilled. The pressure aquifer is the stratum of Purisima sand mentioned above, and a layer or layers of the "hard shell rock" form the confining bed.

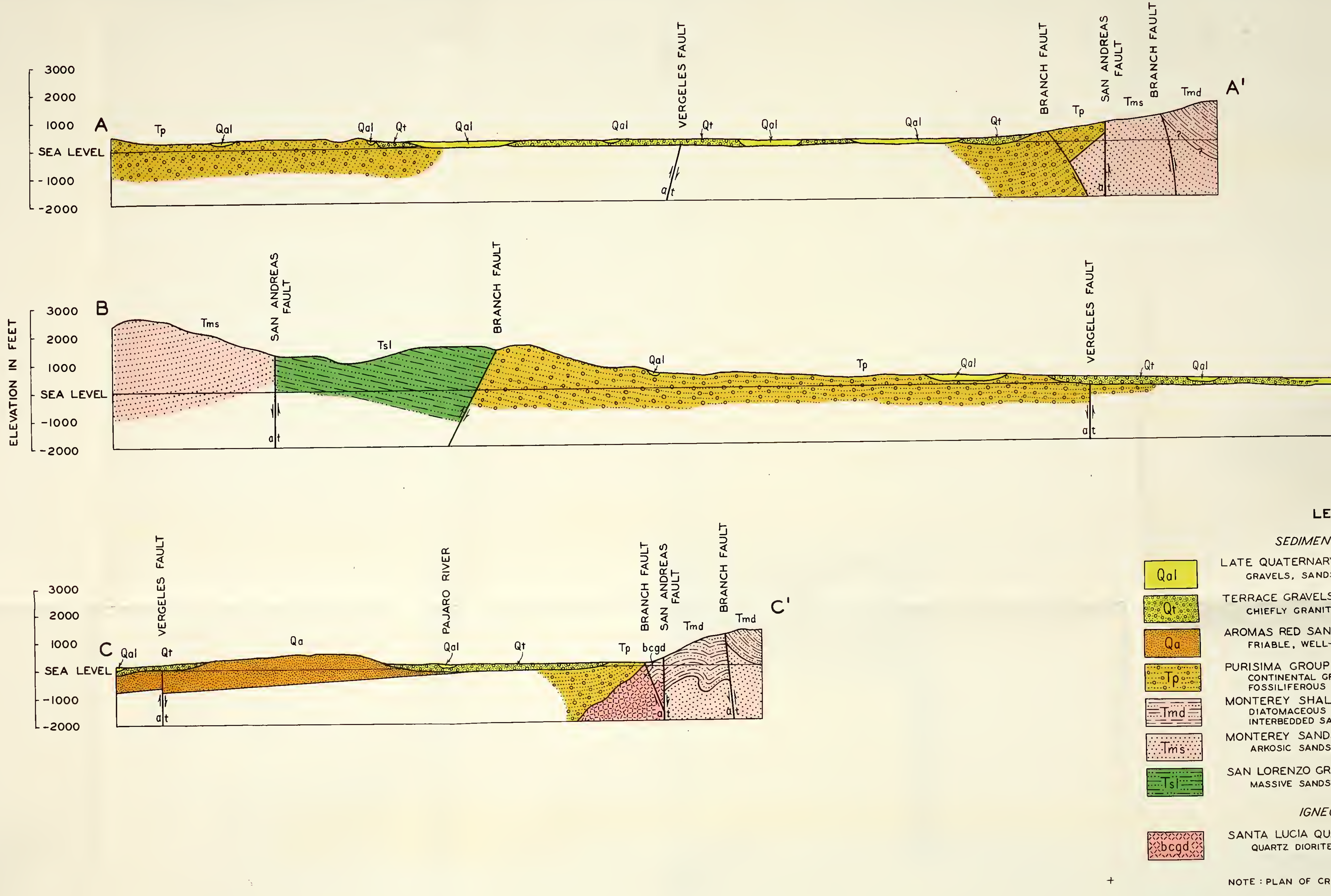
The persistent Purisima sand stratum is variously described by well drillers as "black sand" or "blue sand." It actually consists of a black to gray medium-grained, weakly cemented sandstone, notably high in dark constituents and, when broken down, strikingly similar to the black beach sands found near Aptos. The latter have been mined in the past for their chromium content, that metallic element being found combined with the abundant minerals ilmenite and magnetite. Presence of these minerals is undoubtedly responsible for the high iron content, both dissolved and in suspension, of much of the Soquel Valley water. Indications are that this aquifer is not over 60 feet in thickness, although other water-bearing strata could occur within the Purisima at greater depths, beyond the limits of present drilling efforts. Although the aquifer appears to be limited in extent, many irrigation and municipal water supply wells of comparatively heavy draft pump regularly from it. A large forebay zone exists in Soquel Valley. Most of the drainage basin other than the valley floor comprises this forebay, and is underlain by relatively permeable sediments of the Purisima group.

The shallow water aquifer which lies above the confining "hard shell" layers receives recharge directly from precipitation and from stream percolation. There is no hydraulic connection on the valley floor between the shallow water zone and the underlying confined water body. Only small yields suitable for domestic use are obtained from the shallow water zone of Soquel Valley.

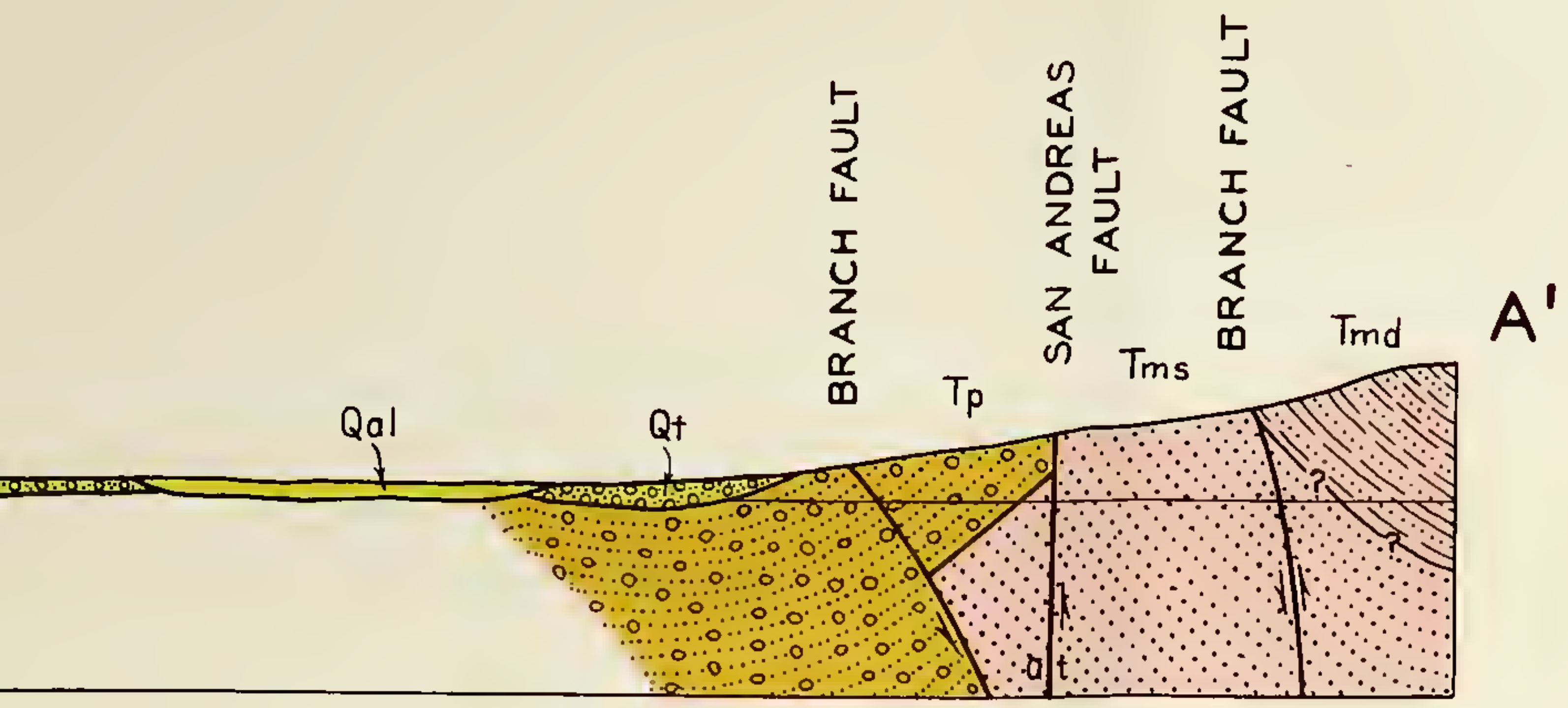
PLATE B-1

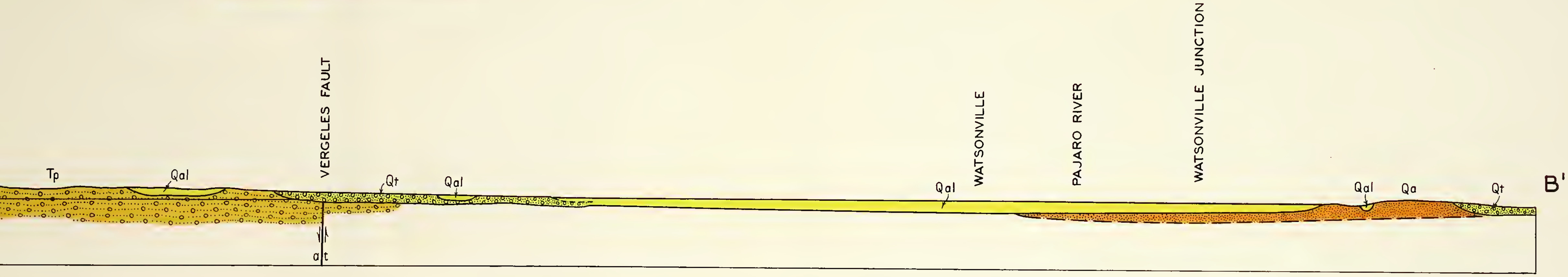
AGE	PAJARO UNIT	NORTH COASTAL UNIT	SAN LORENZO UNIT	SOQUEL UNIT
RECENT	LANDSLIDES SAND DUNES LATE QUATERNARY FILL	LATE QUATERNARY FILL	LATE QUATERNARY FILL	LATE QUATERNARY FILL
PLEISTOCENE	TERRACE GRAVELS AROMAS RED SANDS	TERRACE GRAVELS	TERRACE GRAVELS	TERRACE GRAVELS
PLIOCENE	PURISIMA GROUP		PURISIMA GROUP	PURISIMA GROUP
UPPER MIOCENE			SANTA MARGARITA FORMATION	
MIDDLE MIOCENE	MONTEREY SHALE MONTEREY SANDSTONE	MONTEREY GROUP	MONTEREY GROUP	
LOWER MIOCENE		VAQUEROS FORMATION	VAQUEROS FORMATION	
OLIGOCENE (?)	SAN LORENZO GROUP	SAN LORENZO GROUP	SAN LORENZO GROUP	SAN LORENZO GROUP
EOCENE		BUTANO FORMATION	BUTANO FORMATION	
PRE-CRETACEOUS	SANTA LUCIA GRANITE	SANTA LUCIA QUARTZ DIORITE PRE-FRANCISCAN METAMORPHICS	SANTA LUCIA GRANITE PRE-FRANCISCAN METAMORPHICS	SANTA LUCIA GRANITE

CORRELATION CHART



ELEVATION IN FEET
3000
2000
1000
SEA LEVEL
-1000
-2000
A
A'
Tp
Qal
Qt
VERGELES FAULT
BRANCH FAULT
SAN ANDREAS FAULT
Tms
Tmd
B
Tsl
C
C'
Qa
PAJARO RIVER
bcgd
LE
SEDIMEN
LATE QUATERNAR
GRAVELS, SAND
TERRACE GRAVELS
CHIEFLY GRANIT
AROMAS RED SAN
FRIABLE, WELL-
PURISIMA GROUP
CONTINENTAL G
FOSSILIFEROUS
MONTEREY SHAL
DIATOMACEOUS
INTERBEDDED SA
MONTEREY SAND
ARKOSIC SANDS
SAN LORENZO GR
MASSIVE SANDS
IGNE
SANTA LUCIA QU
QUARTZ DIORITE
NOTE : PLAN OF CR





LEGEND

SEDIMENTARY ROCKS

- Qal — LATE QUATERNARY FILL
  GRAVELS, SANDS, SILTS AND CLAYS
- Qt — TERRACE GRAVELS
  CHIEFLY GRANITIC GRAVELS
- Qa — AROMAS RED SANDS
  FRIABLE, WELL-SORTED SANDS
- Tp — PURISIMA GROUP
  CONTINENTAL GRAVELS AND SANDS, MARINE FOSSILIFEROUS GRAVELS, SANDS AND SILTS
- Tmd — MONTEREY SHALE
  DIATOMACEOUS AND SILICEOUS SHALES WITH SOME INTERBEDDED SANDSTONES AND LIMESTONE LENSES
- Tms — MONTEREY SANDSTONE
  ARKOSIC SANDSTONES AND SANDS
- Tsl — SAN LORENZO GROUP
  MASSIVE SANDSTONES AND SANDY SHALES. FOSSILIFEROUS

IGNEOUS ROCKS

- bcgd — SANTA LUCIA QUARTZ DIORITE
  QUARTZ DIORITE TO GABBRO; DIKES

NOTE: PLAN OF CROSS SECTIONS ON PLATE B-4

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SANTA CRUZ-MONTEREY COUNTIES INVESTIGATION

GEOLOGIC CROSS SECTIONS OF PAJARO UNIT

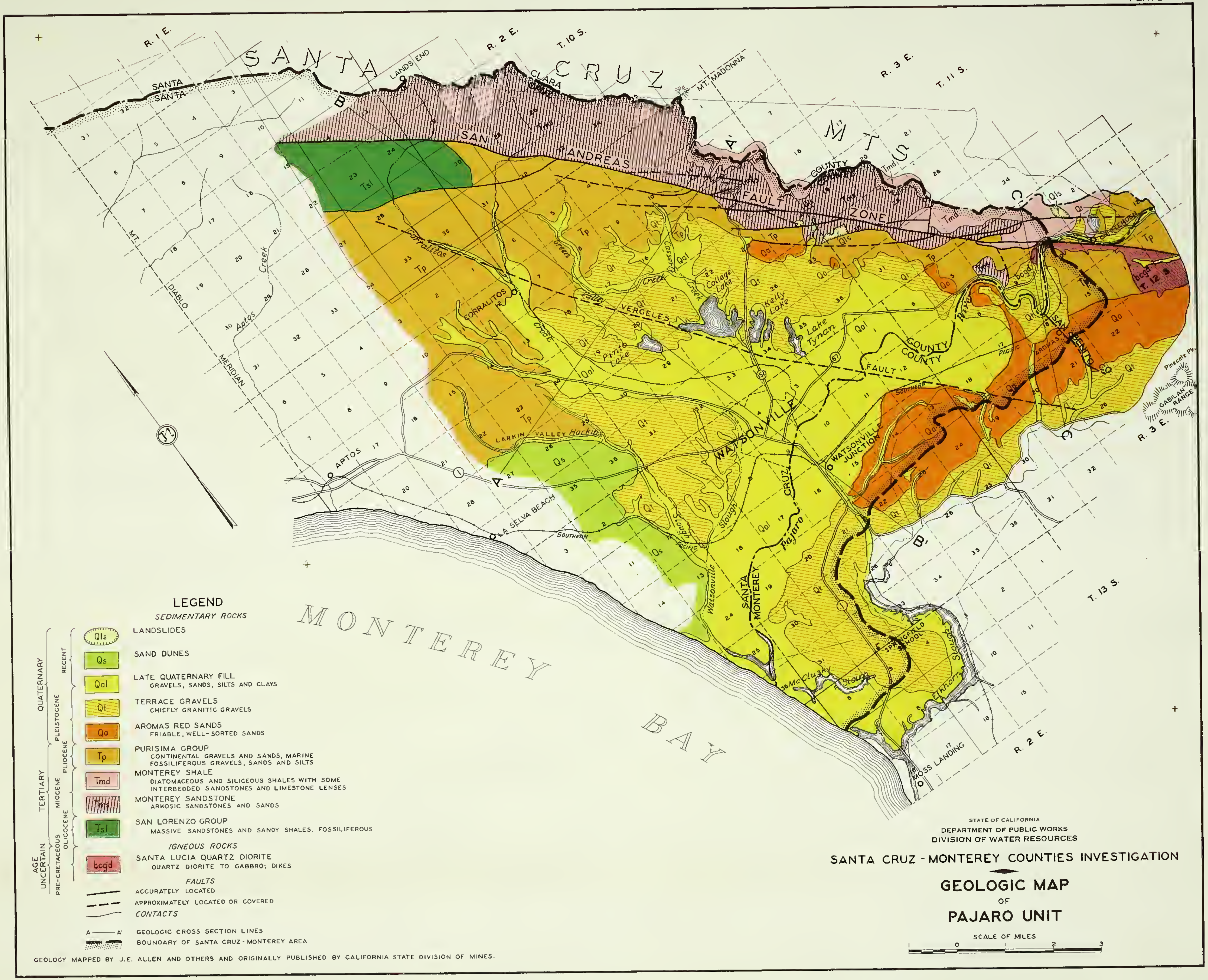
HORIZONTAL SCALE OF MILES
1 0 1 2


N 5° E
A
A'
SEA LEVEL
GROUND SURFACE
WATER LEVEL FALL 1947
TOP OF RELATIVELY IMPERVIOUS STRATA
BASE OF RELATIVELY IMPERVIOUS STRATA
WATSONVILLE
NO RECORD
CORRALITOS CREEK
GREEN VALLEY CREEK
12S 2E, 8-K2
12S 2E, 9-C1
12S 2E, 5-C1
11S 2E, 33-K2
11S 2E, 33-F2
11S 2E, 28-P1
11S 2E, 28-M1
11S 2E, 28-E1
11S 2E, 21-Q2
11S 2E, 20-A1
11S 2E, 18-P1
11S 2E, 15-M2
11S 2E, 17-A1
N 30° E
B
BEACH
McCLUSKY SLOUGH
WATER IMPERVIOUS LEVEL STRATA AND IRREGULAR
13S 2E, 8-E2
13S 2E, 6-C1
12S 2E, 31-K1
12S 2E, 30-R1
12S 2E, 29-E1
12S 2E, 29-B1
12S 2E, 20-N1
12S 2E, 20-K2
12S 2E, 20-K1
RED SAND TO 865 FEET
BLUE SHALE 865 TO 1180 FEET
N 37° E
C
C'
BEACH
WATSONVILLE SLOUGH
PAJARO RIVER
WATSONVILLE
VERGELES FAULT
12S 1E, 25-B1
12S 1E, 25-A2
12S 1E, 24-L1
12S 1E, 24-F2
12S 1E, 19-M1
12S 2E, 18-D1
12S 2E, 18-J1
12S 2E, 17-D2
12S 2E, 8-P1
12S 2E, 8-K2
12S 2E, 9-C1
11S 2E, 34-L1
11S 2E, 34-K1
11S 2E, 35-D1
N 78° W
D
12S 2E, 10-A1
PAJARO RIVER
LEGEND
YELLOW CLAY
BLUE CLAY
CLAY - UNDIFFERENTIATED
SOIL AND SEDIMENT
GRAVEL
SAND
RED SAND
LOGS SHOWN HALF-WIDTH ARE ONE-HALF TO ONE MILE FROM STRUCTURE SECTION LINE.
NOTE: PLAN OF CROSS SECTIONS APPEARS ON PLATE 12

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SANTA CRUZ-MONTEREY COUNTIES INVESTIGATION

WELL LOG CROSS SECTIONS
OF
PAJARO UNIT


SANTA CRUZ MTS
SAN ANDREAS FAULT ZONE
MONTEREY BAY
WATSONVILLE
APTOS
CORRALITOS
LA SELVA BEACH
MOSS LANDING
WATSONVILLE JUNCTION
SPRINGFIELD SCHOOL
AROMAS
MT. MADONNA
LANDS END
GABILAN RANGE
Pinecate Pk.
VERGELES FAULT
SANTA CRUZ COUNTY
SAN BENITO COUNTY
MONTEREY COUNTY
SANTA CLARA COUNTY
MT. DIABLO MERIDIAN
College Lake
Kelly Lake
Lake Tynan
Pinto Lake
Pajaro River
Corralitos Creek
Aptos Creek
Green Valley Creek
Watsonville Slough
Elkhorn Slough
McClusky Slough
Larkin Valley
R. 1 E.
R. 2 E.
R. 3 E.
T. 10 S.
T. 11 S.
T. 12 S.
T. 13 S.
LEGEND
SEDIMENTARY ROCKS
QUATERNARY
RECENT
PLEISTOCENE
TERTIARY
PLIOCENE
MIOCENE
OLIGOCENE
AGE UNCERTAIN
PRE-CRETACEOUS
Qls LANDSLIDES
Qs SAND DUNES
Qal LATE QUATERNARY FILL
GRAVELS, SANDS, SILTS AND CLAYS
Qt TERRACE GRAVELS
CHIEFLY GRANITIC GRAVELS
Qa AROMAS RED SANDS
FRIABLE, WELL-SORTED SANDS
Tp PURISIMA GROUP
CONTINENTAL GRAVELS AND SANDS, MARINE FOSSILIFEROUS GRAVELS, SANDS AND SILTS
Tmd MONTEREY SHALE
DIATOMACEOUS AND SILICEOUS SHALES WITH SOME INTERBEDDED SANDSTONES AND LIMESTONE LENSES
Tms MONTEREY SANDSTONE
ARKOSIC SANDSTONES AND SANDS
Tsl SAN LORENZO GROUP
MASSIVE SANDSTONES AND SANDY SHALES, FOSSILIFEROUS
IGNEOUS ROCKS
bcgd SANTA LUCIA QUARTZ DIORITE
QUARTZ DIORITE TO GABBRO; DIKES
FAULTS
ACCURATELY LOCATED
APPROXIMATELY LOCATED OR COVERED
CONTACTS
A — A' GEOLOGIC CROSS SECTION LINES
BOUNDARY OF SANTA CRUZ-MONTEREY AREA
GEOLOGY MAPPED BY J.E. ALLEN AND OTHERS AND ORIGINALLY PUBLISHED BY CALIFORNIA STATE DIVISION OF MINES.
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION
GEOLOGIC MAP
OF
PAJARO UNIT
SCALE OF MILES
1 0 1 2 3

APPENDIX C

RECORDS OF MONTHLY PRECIPITATION IN SANTA CRUZ-MONTEREY AREA NOT PREVIOUSLY PUBLISHED

TABLE OF CONTENTS

RECORDS OF MONTHLY PRECIPITATION IN SANTA CRUZ-MONTEREY AREA NOT PREVIOUSLY PUBLISHED

RECORD OF MONTHLY PRECIPITATION AT DAVENPORT

County: Santa Cruz
Date established: 1910
Elevation: 60 feet, U.S.G.S. datum

Station number on Plate 3: SCM-1
Location: SE ¼, Sec. 33, T. 10 S., R. 3 W., M.D.B.&M.
Record obtained from: Santa Cruz Portland Cement Company

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1909-10	----	----	----	----	----		3.36	2.14	5.61	0.28	0.00	0.00	----
1910-11	0.00	0.00	0.00	1.01	0.66	1.42	18.62	5.81	4.44	0.86	0.53	0.00	33.35
1911-12	0.00	0.00	0.00	0.91	0.67	5.16	4.43	0.81	3.42	3.63	1.80	0.71	21.54
1912-13	0.00	0.00	1.08	0.45	2.49	1.71	5.33	0.32	1.95	1.18	0.88	0.19	15.58
1913-14	0.32	0.00	0.00	0.00	8.60	7.80	13.03	4.86	1.37	2.09	0.38	0.61	39.06
1914-15	0.00	0.00	0.00	0.99	0.61	9.23	7.62	10.31	2.02	1.84	6.22	0.00	38.84
1915-16	0.00	0.00	0.00	0.00	0.55	5.71	14.09	5.87	2.94	0.00	0.12	0.00	29.28
1916-17	0.22	0.00	0.63	1.06	1.51	8.87	3.20	4.49	1.17	0.39	0.27	0.00	21.59
1917-18	0.00	0.00	0.00	0.00	1.54	1.68	1.22	3.58	2.94	0.52	0.05	0.00	11.53
1918-19	0.00	0.00	5.81	0.27	4.46	2.06	1.90	9.88	3.30	0.00	0.00	0.00	27.68
1919-20	0.00	0.00	0.55	0.13	0.03	7.81	1.06	2.08	4.61	2.29	0.00	0.70	19.26
1920-21	0.00	0.00	0.00	2.07	5.53	7.94	5.63	2.08	1.29	0.21	1.64	0.00	26.39
1921-22	0.00	0.00	0.68	0.21	2.18	9.16	3.85	6.05	4.50	0.82	1.01	0.00	28.46
1922-23	0.00	0.00	0.00	0.73	3.64	6.23	3.32	1.23	0.34	4.81	0.18	0.64	21.12
1923-24	0.00	0.00	0.50	0.40	0.39	2.27	2.82	0.69	2.60	0.10	0.00	0.00	9.77
1924-25	0.00	0.00	0.00	2.61	2.45	4.03	3.16	5.67	2.88	1.92	4.93	0.00	27.65
1925-26	0.00	0.00	0.19	0.47	1.82	1.16	4.81	5.58	0.53	3.50	0.00	0.00	18.06
1926-27	0.00	0.10	0.00	0.80	5.71	1.67	3.71	6.72	1.80	2.83	0.47	0.18	23.99
1927-28	0.00	0.00	0.03	1.42	2.53	4.52	1.40	2.00	5.33	1.43	0.20	0.00	18.86
1928-29	0.00	0.00	0.08	0.04	4.35	3.77	1.02	2.53	1.85	2.25	0.00	1.35	17.24
1929-30	0.00	0.00	0.09	0.21	0.00	3.32	5.98	5.27	3.55	0.76	0.17	0.00	19.35
1930-31	0.00	0.00	0.14	0.22	1.49	0.33	7.12	1.37	1.05	0.35	0.85	0.26	13.18
1931-32	0.00	0.00	0.00	0.60	2.83	9.44	4.83	5.80	1.72	1.34	1.35	1.05	28.96
1932-33	0.12	0.00	0.00	0.15	0.93	3.82	10.22	1.64	3.85	0.46	2.27	0.05	23.51
1933-34	0.08	0.00	0.00	2.00	0.00	7.40	1.91	7.86	0.00	0.75	0.49	1.53	22.02
1934-35	0.00	0.00	0.00	1.30	5.75	5.49	7.99	4.03	3.97	6.40	0.15	0.00	35.08
1935-36	0.00	0.34	0.05	2.83	0.74	5.09	6.65	12.36	1.15	2.29	0.69	0.63	32.82
1936-37	0.85	0.00	0.04	0.63	0.01	5.95	5.32	7.71	11.82	1.15	0.11	0.43	34.02
1937-38	0.00	0.00	0.00	1.74	2.51	10.46	5.55	11.71	8.60	1.79	0.20	0.00	42.56
1938-39	0.00	0.00	0.00	2.90	1.03	2.75	4.75	3.74	3.53	0.15	1.20	0.00	20.05
1939-40	0.00	0.00	0.70	1.31	0.50	1.16	18.88	11.15	7.93	1.15	1.09	0.00	43.87
1940-41	0.06	trace	0.73	1.73	1.05	12.34	14.34	11.35	10.10	7.76	2.45	0.17	62.08
1941-42	0.00	0.02	0.18	1.45	2.57	12.34	8.35	3.68	4.67	5.05	1.65	trace	39.96
1942-43	trace	0.00	0.10	2.00	3.45	4.57	11.09	3.41	7.87	3.10	0.65	0.02	36.26
1943-44	0.00	0.00	0.00	1.20	0.86	3.11	7.05	9.47	1.37	2.88	1.73	0.17	27.84
1944-45	0.01	0.00	trace	3.96	5.30	3.75	5.90	4.80	6.59	0.35	1.17	0.17	32.00
1945-46	0.00	0.00	trace	2.54	4.06	12.89	2.70	4.38	4.85	0.00	2.91	0.00	34.33
1946-47	0.00	0.00	0.10	0.53	4.72	2.34	1.03	2.62	4.22	0.40	0.61	0.49	17.06
1947-48	0.00	0.00	0.00	4.43	1.62	3.61	1.07	3.65	4.95	6.07	2.09	0.26	27.75
1948-49	0.02	0.00	0.00	1.21	0.96	11.23	4.64	4.92	7.05	0.19	0.43	0.00	30.65
1949-50	0.09	0.24	0.11	0.35	2.40	4.35	14.47	6.35	3.23	1.80	0.46	0.12	33.97
1950-51	0.00	0.00	0.40	3.14	8.20	8.70	5.47	4.22	3.89	1.50	1.88	0.00	37.40
1951-52	0.00	0.15	0.00	2.00	3.64	18.16	15.24	3.01	8.47	2.21	0.62	0.27	53.77

RECORD OF MONTHLY PRECIPITATION AT DAY (4 MILES NORTHEAST OF APTOS)

County: Santa Cruz
Date established: 1935
Elevation: 475 feet, U.S.G.S. datum

Station number on Plate 3: SCM-2
Location: NE ¼, Sec. 9, T. 11 S., R. 1 E., M.D.B.&M.
Record obtained from: United States Soil Conservation Service

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1935-36	0.00	0.00	0.00	2.36	0.62	3.41	6.97	13.65	1.69	1.51	1.64	0.66	32.51
1936-37	0.26	0.00	0.00	0.83	0.03	7.07	6.38	8.67	9.34	0.81	0.12	0.30	33.81
1937-38	0.00	0.00	0.00	0.43	2.57	9.37	6.00	11.33	8.65	0.00	0.20	0.00	38.55
1938-39	0.00	0.00	0.11	1.81	2.28	1.31	4.22	3.57	4.60	0.46	1.45	0.00	19.81
1939-40	0.00	0.00	1.00	0.65	0.44	1.28	16.21	10.77	6.63	0.44	1.04	0.00	38.46
1940-41	0.16	0.16	0.25	1.93	1.08	11.00	11.80	12.86	7.37	6.26	1.53	0.28	54.68
1941-42	0.05	0.00	0.00	0.89	1.98	12.26	5.68	4.67	3.78	6.71	1.91	0.00	37.93
1942-43	0.00	0.00	0.00	1.03	5.19	4.29	9.64	2.61	8.01	1.88	0.00	0.00	32.65
1943-44	0.07	0.00	0.00	1.18	0.82	2.99	6.21	10.97	1.00	2.71	1.14	0.20	27.29
1944-45	0.00	0.00	0.00	3.20	6.69	2.86	0.94	7.89	5.95	0.52	2.01	0.18	30.24
1945-46	0.09	0.30	0.00	2.43	2.74	10.83	1.30	2.72	3.20	0.34	1.23	0.10	24.28
1946-47	----	----	----	----	----	----	----	----	4.90		----	----	----
1947-48	----		----	----	----	----	----	----	----	6.16	----	----	----
1948-49	0.00	0.00	0.00	0.67	0.88	7.12	2.74	3.79	8.32	0.00	0.62	0.00	24.14
1949-40	0.20	0.00	0.62	0.00	2.24	4.01	9.04	4.59	2.19	1.46	0.80	0.00	25.15
1950-51	0.00	0.00	0.71	2.67	14.64	8.26	4.21	2.80	3.32	1.56	0.57	0.00	38.74
1951-52	0.00	0.00	trace	1.91	4.39	12.76	12.48	4.02	5.57	1.23	0.40	0.65	43.41

RECORD OF MONTHLY PRECIPITATION AT VALENCIA

County: Santa Cruz
Date established: 1931
Elevation: 375 feet, U.S.G.S. datum

Station number on Plate 3: SCM-3
Location: NW ¼, Sec. 9, T. 11 S., R. 1 E., M.D.B.&M.
Record obtained from: United States Soil Conservation Service

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1931-32	0.00	0.00	0.00	0.71	3.87	15.00	4.48	7.10	1.35	0.95	0.71	0.00	34.17
1932-33	0.03	0.00	0.00	0.00	0.52	4.55	10.47	1.70	3.90	0.25	1.93	0.10	23.45
1933-34	0.03	0.00	0.05	2.27	1.20	7.95	1.08	5.94	0.00	0.31	0.30	1.65	20.78
1934-35	0.00	0.02	0.14	0.60	5.10	4.20	8.25	0.45	6.15	4.62	0.00	0.00	29.53
1935-36	0.00	0.60	0.00	1.87	0.69	3.49	7.00	13.55	1.69	1.30	1.41	0.69	32.29
1936-37	0.28	0.00	0.00	0.79	0.03	7.01	6.85	8.16	9.40	0.82	0.17	0.33	33.84
1937-38	0.00	0.00	0.00	0.75	2.46	8.86	6.71	11.34	8.46	1.96	0.00	0.00	40.54
1938-39	0.05	0.00	0.09	2.39	1.55	1.55	4.31	3.04	4.67	0.55	1.36	0.00	19.56
1939-40	0.00	0.00	0.93	0.65	0.35	0.80	16.37	10.07	6.62	0.55	0.98	0.00	37.32
1940-41	0.04	0.20	0.50	2.13	0.98	11.25	13.66	11.84	7.84	6.84	1.69	0.28	57.25
1941-42	0.12	0.00	0.12	0.86	1.91	12.33	5.69	3.17	3.65	6.44	2.75	0.00	37.04
1942-43	0.00	0.00	0.00	1.50	4.85	4.92	9.06	3.48	7.29	2.00	0.00	0.10	33.20
1943-44	0.15	0.00	0.00	1.35	1.00	4.22	4.39	10.62	1.28	2.41	0.97	0.49	26.88
1944-45	0.23	0.00	0.00	1.45	6.57	3.09	1.07	7.95	5.02	0.50	1.42	0.15	27.45
1945-46	0.00	0.25	0.00	2.28	2.37	10.50	1.28	3.50	4.20	0.37	2.39	0.10	27.24
1946-47	trace	0.00	0.10	0.10	8.03	2.85	0.97	3.32	5.10	0.25	1.15	0.46	22.23
1947-48	0.00	0.00	0.00	5.99	1.61	1.85	1.24	3.13	5.68	6.83	2.62	0.25	29.20
1948-49	0.10	0.00	0.00	1.17	0.86	7.50	3.27	4.33	8.82	0.00	0.68	0.68	26.73
1949-50	0.27	0.00	0.20	0.00	2.35	4.78	11.30	4.99	2.76	2.10	1.44	0.00	30.19
1950-51	0.00	0.00	0.60	2.22	14.30	9.01	5.35	4.08	6.29	1.70	---	0.00	----
1951-52	0.00	0.00	0.00	2.53	4.81	12.35	13.41	3.24	4.83	1.28	0.05	1.50	44.40

RECORD OF MONTHLY PRECIPITATION AT APTOS-BETH MAR NURSERY

County: Santa Cruz
Date established: 1928
Elevation: 50 feet, U.S.G.S. datum

Station number on Plate 3: SCM-4
Location: SE ¼, Sec. 18, T. 11 S., R. 1 E., M.D.B.&M.
Record obtained from: Beth Mar Nursery

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1928-29	0.00	0.00	0.00	0.00	3.81	4.87	1.75	2.28	1.76	1.72	0.00	1.99	18.18
1929-30	0.05	0.00	0.03	0.03	0.00	5.39	5.40	5.71	3.98	1.44	0.33	0.00	22.36
1930-31	0.00	0.00	0.11	0.05	2.81	0.72	5.44	1.38	2.48	0.63	1.11	0.45	15.18
1931-32	0.00	0.00	0.00	0.62	3.72	14.65	4.32	5.61	1.22	0.84	0.94	0.15	32.07
1932-33	0.05	0.00	0.00	0.13	0.49	3.43	9.32	1.21	3.65	0.30	1.97	0.10	20.65
1933-34	0.00	0.16	0.07	2.44	0.08	6.93	1.09	6.09	0.00	0.53	0.54	2.04	19.97
1934-35	0.00	0.15	1.25	1.20	5.41	4.37	6.47	0.52	5.77	4.72	0.00	0.00	29.86
1935-36	0.00	0.00	0.07	1.87	0.65	3.38	5.43	13.91	1.64	1.65	1.65	0.54	30.79
1936-37	0.42	0.00	0.07	0.75	0.00	6.43	6.96	7.35	8.53	0.82	0.20	0.00	31.53
1937-38	0.00	0.00	0.00	0.61	2.74	6.24	6.76	10.92	7.27	1.83	0.00	0.00	36.37
1938-39	0.00	0.00	0.08	2.86	1.52	0.98	3.77	3.10	4.01	0.41	0.53	0.00	17.26
1939-40	0.00	0.00	0.67	0.88	0.35	0.99	15.16	9.65	6.13	0.53	0.93	0.00	35.29
1940-41	0.00	0.00	0.16	1.65	1.02	11.42	11.61	12.45	6.97	6.28	1.63	0.46	53.65
1941-42	0.00	0.00	0.00	1.09	1.53	9.82	6.41	5.96	2.89	6.34	1.73	0.00	35.77
1942-43	0.00	0.00	0.00	1.22	4.69	5.01	8.54	3.04	7.44	1.97	0.00	0.02	31.93
1943-44	0.02	0.00	0.00	1.50	0.78	2.55	6.63	10.48	1.28	2.19	1.38	0.10	26.91
1944-45	0.00	0.00	0.00	2.76	6.47	2.91	1.14	7.01	5.37	0.53	1.26	0.18	27.63
1945-46	0.00	0.00	0.00	2.46	3.39	10.00	1.38	3.16	3.37	0.00	1.38	0.10	25.24
1946-47	0.00	0.00	0.07	0.22	6.09	2.40	0.87	2.73	4.26	0.22	0.39	0.37	17.62
1947-48	0.00	0.00	0.00	4.87	1.04	2.20	0.98	1.79	5.20	5.76	1.65	0.08	23.57
1948-49	0.00	0.00	0.00	1.02	0.76	8.43	2.71	4.04	7.81	0.00	0.38	0.00	25.15
1949-50	0.00	0.00	0.00	0.00	1.85	4.54	9.50	5.43				-	--
1950-51	0.00	0.00	0.00	0.00	10.68	7.53	3.68	2.85	3.13	1.52	0.77	0.00	30.16
1951-52	0.00	0.00	0.46	1.14	3.78	13.05	11.44	4.25	5.27	1.23	0.36	0.73	41.71

RECORD OF MONTHLY PRECIPITATION AT BEAN HILL

County: Santa Cruz
Date established: 1926
Elevation: 1,175 feet, U.S.G.S. datum

Station number on Plate 3: SCM-5
Location: SE ¼, Sec. 27, T. 10 S., R. 1 E., M.D.B.&M.
Record obtained from: United States Soil Conservation Service

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1926-27	0.00	0.00	0.00	2.15	8.87	1.38	5.97	12.10	2.25	5.64	0.56	0.38	39.30
1927-28	0.00	0.00	0.00	1.95	6.27	4.98	1.56	4.43	13.86	1.94	0.21	0.00	35.20
1928-29	0.00	0.00	0.00	0.00	4.47	5.44	1.56	4.19	2.60	2.12	0.00	1.97	22.35
1929-30	0.00	0.00	0.00	0.00	0.00	10.17	7.80	6.19	4.75	1.66	0.30	0.00	30.87
1930-31	0.00	0.00	1.69	0.12	4.13	0.65	6.54	1.04	2.79	1.27	1.74	0.91	20.88
1931-32	0.00	0.00	0.00	1.67	4.81	23.00	5.79	7.08	1.97	1.07	1.16	0.06	46.61
1932-33	0.00	0.00	0.00	0.00	0.74	4.63	11.33	1.21	5.10	0.19	2.00	0.00	25.20
1933-34	0.00	0.00	0.00	3.81	0.00	10.36	1.39	7.17	0.00	0.65	1.26	2.28	26.92
1934-35	0.00	0.04	0.42	2.07	6.63	5.39	9.72	0.78	6.92	6.84	0.00	0.00	38.81
1935-36	0.00	0.00	0.00	2.25	0.85	4.44	11.41	16.15	1.75	2.22	1.69	1.05	41.81
1936-37	0.34	0.00	0.00	0.90	0.00	7.84	6.06	12.33	10.13	0.88	0.00	0.52	39.00
1937-38	0.00	0.00	0.00	0.45	4.67	13.59	6.29	12.55	11.39	2.02	0.14	0.00	51.10
1938-39	0.00	0.00	0.00	3.20	1.76	1.22	4.75	3.71	4.93	0.62	2.05	0.00	22.24
1939-40	0.00	0.00	1.07	0.83	0.35	1.99	20.60	14.37	8.70	0.67	1.45	0.00	50.03
1940-41	0.15	0.12	0.30	2.39	1.36	12.99	13.08	13.73	9.20	7.46	1.53	0.42	62.73
1941-42	0.00	0.00	0.00	0.78	2.64	14.70	---	----	-- -	---	---	----	----

RECORD OF MONTHLY PRECIPITATION AT EUREKA CANYON No. 1

County: Santa Cruz
Date established: 1929
Elevation: 1,000 feet, U.S.G.S. datum

Station number on Plate 3: SCM-6
Location: SW ¼, Sec. 25, T. 10 S., R. 1 E., M.D.B.&M.
Record obtained from: United States Soil Conservation Service

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1920-30	0.00	0.00	0.00	0.00	0.00	10.59	9.54	0.00	4.54	2.25	0.00	0.00	26.92
1930-31	0.00	0.00	1.03	0.00	4.41	0.00	11.16	1.15	2.95	1.69	0.00	0.64	23.03
1931-32	0.00	0.00	0.00	2.00	4.87	11.87	5.61	7.60	2.15	0.51	0.98	0.00	35.59
1932-33	0.00	0.00	0.00	0.00	0.63	2.48	11.62	1.00	4.94	1.73	1.57	0.00	23.97
1933-34	0.00	0.00	0.00	4.32	0.00	9.58	6.56	----	---	-	0.74	2.00	---
1934-35	0.00	0.00	0.60	1.95	8.71	3.72	8.87	0.63	5.54	7.37	0.00	0.00	37.39
1935-36	0.00	0.65	0.00	3.05	0.84	4.32	13.76	18.70	1.13	2.46	0.78	1.08	46.77
1936-37	0.25	0.00	0.00	1.13	0.00	8.61	8.56	12.49	11.20	1.45	0.10	0.74	44.53
1937-38	0.00	0.00	0.00	0.79	4.00	16.79	6.57	16.06	13.07	2.94	0.00	0.00	60.22
1938-39	0.00	0.00	0.29	3.25	1.90	1.46	6.09	4.13	5.44	0.63	2.79	0.00	25.98
1939-40	0.00	0.00	0.94	1.06	0.37	2.09	24.37	15.77	9.40	0.64	1.23	0.00	55.87
1940-41	0.70	0.10	0.17	3.61	1.43	13.11	12.92	15.01	10.36	9.10	1.67	0.52	68.70
1941-42	0.00	0.00	0.00	1.22	2.53	18.19	9.03	6.26	5.14	8.52	3.30	0.00	54.19
1942-43	0.00	0.00	0.00	1.02	----	----	----	----	----	----	----	----	---

RECORD OF MONTHLY PRECIPITATION AT EUREKA CANYON No. 2

County: Santa Cruz
Date established: 1926
Elevation: 590 feet, U.S.G.S. datum

Station number on Plate 3: SCM-7
Location: SW ¼, Sec. 1, T. 11 S., R. 1 E., M.D.B.&M.
Record obtained from: United States Soil Conservation Service

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1926-27	0.00.	0.00	0.00	2.02	7.40	1.68	5.71	10.57	3.62	2.52	0.00	0.61	34.13
1927-28	0.00	0.00	0.00	1.16	3.49	4.39	1.81	3.38	11.05	1.63	0.31	0.00	27.22
1928-29	0.00	0.00	0.00	0.00	3.43	5.72	1.52	2.94	2.48	1.86	0.00	2.05	20.00
1929-30	0.00	0.00	0.00	0.00	0.00	7.54	7.49	5.16	4.01	4.42	0.13	0.00	28.75
1930-31	0.00	0.00	0.52	0.53	3.39	0.00	5.91	1.22	1.67	1.29	1.30	0.40	16.23
1931-32	0.00	0.00	0.00	0.00	4.94	20.15	5.10	5.97	1.19	0.75	1.03	0.00	39.13
1932-33	0.00	0.00	0.00	0.00	0.44	5.05	9.59	1.28	3.69	0.16	2.43	0.00	22.64
1933-34	0.00	0.00	0.00	3.43	0.00	7.40	1.25	6.13	0.00	0.83	0.65	1.97	21.66
1934-35	0.00	0.00	0.84	1.67	6.35	4.36	6.93	0.92	6.82	5.95	0.00	0.00	33.84
1935-36	0.00	0.64	0.31	2.00	0.90	3.35	8.88	16.54	1.97	1.98	1.21	0.70	38.48
1936-37	0.42	0.00	0.00	0.85	0.00	7.81	6.54	7.11	10.14	1.13	0.00	0.71	34.71
1937-38	0.00	0.00	0.00	0.50	3.26	10.70	6.08	12.13	9.94	2.13	0.00	0.00	44.74
1938-39	0.00	0.00	0.28	2.79	1.51	1.40	4.80	3.40	4.79	0.41	1.99	0.00	21.37
1939-40	0.00	0.00	1.03	0.74	0.41	1.31	17.55	12.76	6.34	0.64	0.49	0.00	41.27
1940-41	0.00	0.00	0.57	2.84	0.95	11.02	12.88	13.13	6.12	6.74	1.36	0.46	56.07
1941-42	0.00	0.00	0.00	1.11	1.92	14.53	-- -	-	----	----	----	----	----

RECORD OF MONTHLY PRECIPITATION AT MT. MADONNA-ARANO

County: Santa Clara
Date established: 1935
Elevation: 1,610 feet, U.S.G.S. datum

Station number on Plate 3: SCM-8
Location: SW ¼, Sec. 1, T. 11 S., R. 2 E., M.D.B.&M.
Record obtained from: United States Soil Conservation Service

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1935-36	0.00	0.00	0.00	2.01	0.75	3.12	--	--	--	--	--	--	--
1936-37	0.00	0.00	0.00	1.70	0.00	7.44	6.00	9.97	9.58	1.54	0.13	0.72	37.08
1937-38	0.00	0.00	0.00	0.55	3.18	8.88	3.80	10.49	9.30	1.61	0.28	0.00	38.09
1938-39	0.00	0.00	0.15	3.15	1.40	1.25	5.26	2.86	3.64	0.75	1.55	0.00	19.91
1939-40	0.00	0.00	0.21	1.02	0.35	1.59	15.45	11.40	5.76	0.80	1.37	0.00	37.95
1940-41	0.19	0.00	0.16	1.72	1.05	8.57	8.57	11.32	8.21	5.92	0.98	0.39	47.08
1941-42	0.00	0.00	0.05	1.35	1.54	8.91	6.22	4.36	3.17	6.11	2.98	0.00	34.69
1942-43	0.00	0.00	0.00	0.98	7.01	3.38	8.17	2.53	8.76	2.36	0.00	0.19	33.38
1943-44	0.00	0.00	0.00	0.98	7.11	3.38	4.73	9.22	2.10	2.66	0.84	0.87	31.89
1944-45	0.00	0.00	0.00	2.48	5.91	2.65	1.67	7.93	6.06	0.73	2.05	0.07	29.55
1945-46	0.00	0.00	0.12	2.76	3.06	8.52	1.14	2.50	2.50	0.15	1.12	0.10	21.97
1946-47	0.00	0.00	0.11	0.35	9.05	2.97	0.70	3.16	5.46	0.40	0.59	0.69	23.48
1947-48	0.00	0.00	0.05	5.61	1.08	1.46	0.88	1.95	4.22	7.19		---	----
1948-49	0.00	0.00	0.00	0.51	0.85	6.19	2.21	3.76	7.94	0.00	0.46	0.00	21.92
1949-50	0.28	0.14	0.12	0.00	2.02	3.00	5.85	2.17	2.38	1.56	1.44	0.15	19.11
1950-51	0.00	0.00	1.48	2.90	17.87	6.47	3.84	2.71	2.25	1.34	1.10	0.00	39.96
1951-52	0.00	0.00	0.00	1.68	3.22	9.46	10.89	2.85	3.30	1.76	0.49	0.44	34.09

RECORD OF MONTHLY PRECIPITATION AT HITCHING'S RANCH

County: Santa Cruz
Date established: 1935
Elevation: 550 feet, U.S.G.S. datum

Station number on Plate 3: SCM-9
Location: NE ¼, Sec. 8, T. 11 S., R. 2 E., M.D.B.&M.
Record obtained from: United States Soil Conservation Service

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1935-36	0.00	0.65	0.00	1.60	0.70	2.80	8.15	12.85	2.25	1.95	0.95	0.90	32.80
1936-37	0.15	0.00	0.00	1.05	0.00	7.65	6.40	8.95	10.30	0.75	0.20	0.40	35.85
1937-38	0.00	0.00	0.00	0.20	2.55	9.80	6.50	11.70	7.35	1.75	0.00	0.00	39.85
1938-39	0.05	0.00	0.10	2.75	2.30	1.35	4.75	2.78	4.30	0.50	1.20	0.00	20.08
1939-40	0.00	0.05	0.20	0.65	0.40	1.35	15.90	11.80	6.55	0.50	0.40	0.00	37.80
1940-41	0.00	0.00	0.35	1.70	0.50	10.10	10.50	11.35	9.50	7.30	0.85	0.30	52.43
1941-42	0.00	0.00	0.00	1.05	1.35	12.30	5.35	5.80	3.90	6.50	2.20	0.00	38.45
1942-43	0.00	0.00	0.00	1.00	5.00	4.50	7.60	2.12	6.08	1.75	0.03	0.07	28.15
1943-44	0.00	0.00	0.00	0.84	0.47	2.79	4.92	9.61	1.37	2.62	0.78	0.35	23.75
1944-45	0.05	0.00	0.00	2.74	5.49	2.30	0.62	7.47	5.02	----	0.83	0.10	----
1945-46	0.00	0.02	0.00	2.05	2.49	9.62	1.35	2.61	2.35	0.00	0.83	0.04	21.36
1946-47	0.00	0.00	0.08	0.11	6.75	2.56	0.72	3.11	3.49	0.27	0.37	0.28	17.74
1947-48	0.00	0.00	0.00	4.81	1.02	1.63	0.75	2.51	4.48	5.66	1.37	0.05	22.28
1948-49	0.00	0.00	0.00	0.38	0.82	5.80	2.31	3.12	7.15	0.00	0.27	0.00	19.85
1949-50	0.35	0.07	0.04	0.05	2.12	3.99	7.64	3.94	2.30	0.98	0.79	0.00	22.27
1950-51	0.00	0.00	0.42	1.87	9.98	6.69	3.35	2.99	2.22	1.39	0.45	0.00	29.36
1951-52	0.00	0.00	0.03	1.46	3.15	10.81	10.31	3.78	4.48	1.07	0.27	0.35	35.71

RECORD OF MONTHLY PRECIPITATION AT McGRATH RANCH

County: Santa Cruz
Date established: 1928
Elevation: 150 feet, U.S.G.S. datum

Station number on Plate 3: SCM-10
Location: SW ¼, Sec. 15, T. 11 S., R. 2 E., M.D.B.&M.
Record obtained from: United States Soil Conservation Service

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1928-29	0.00	0.00	0.00	0.00	4.00	4.25	1.25	3.25	0.25	1.00	0.00	2.00	16.00
1930-31	0.00	0.00	0.00	0.00	3.00	1.00	4.00	0.80	1.00	1.00	2.00	0.00	12.80
1931-32	0.00	0.00	0.00	0.75	2.75	15.00	4.00	4.50	0.50	0.25	0.00	0.00	27.75
1932-33	0.00	0.00	0.00	0.00	0.50	2.25	7.50	1.00	0.75	0.09	2.25	0.00	14.25
1933-34	0.00	0.00	0.00	3.00	0.25	6.25	0.66	2.50	----	----	---	-	--
1934-35	0.00	0.00	0.00	1.25	3.25	7.50	5.00	0.15	5.50	3.40	0.00	0.00	26.05
1935-36	0.00	0.00	0.00	0.70	0.00	7.75	6.70	10.55	1.85	1.70	0.30	0.00	29.55
1936-37	0.00	0.00	0.00	0.00	0.00	0.00	5.50	5.65	7.80	1.10	0.00	0.00	20.05
1937-38	0.00	0.00	0.00	0.32	2.45	8.85	7.00	10.20	6.90	1.30	0.00	0.00	37.02
1938-39	0.00	0.00	0.12	2.55	1.30	1.08	3.77	2.40	3.28	0.32	1.34	0.00	16.16
1939-40	0.00	0.00	0.10	0.47	0.36	1.30	14.05	9.85	4.35	0.52	0.70	0.00	31.70
1940-41	0.10	0.00	0.20	1.15	0.75	8.43	8.90	10.90	8.10	5.35	0.56	0.20	44.64
1941-42	0.02	0.00	0.04	0.92	1.11	9.20	4.55	4.70	2.67	4.98	1.58	0.00	29.77
1942-43	0.00	0.00	0.06	0.79	4.20	3.60	6.95	2.08	7.05	2.10	0.00	0.07	26.84
1943-44	0.02	0.00	0.00	0.77	0.55	2.53	4.64	9.75	0.45	2.59	0.92	0.28	22.50
1944-45	0.05	0.10	0.00	2.20	6.08	2.25	0.46	6.29	5.10	.50	0.65	0.05	23.73
1945-46	0.00	0.00	0.00	1.77	2.90	7.65		--		--	--	--	-
1946-47	0.00	0.00	0.05	0.22	7.00	2.35	--	--	---	---	--	0.30	--
1947-48	0.00	0.00	0.00	4.70	1.05	1.50	0.65	2.50	4.65	3.30	--	---	
1948-49	0.00	0.00	0.00	0.40	0.85	5.30	2.35	2.95	4.95	0.00	0.30	0.00	17.10
1949-50		-	-	-	--				--	---	---	----	----
1950-51	0.30	0.00	0.10	0.05	2.05	3.15	5.90	3.70	1.70	1.25	0.65	0.00	18.85
1951-52	0.00	0.00	0.00	1.50	5.25	8.00	10.80	3.80	4.25	1.15	0.20	0.30	35.25

RECORD OF MONTHLY PRECIPITATION AT LARKIN VALLEY

County: Santa Cruz
Date established: 1926
Elevation: 200 feet, U.S.G.S. datum

Station number on Plate 3: SCM-11
Location: NE ¼, Sec. 26, T. 11 S., R. 1 E., M.D.B.&M.
Record obtained from: United States Soil Conservation Service

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1926-27	0.00	0.00	0.00	1.85	5.03	2.25	4.35	10.30	2.77	3.65	0.10	0.45	30.75
1927-28	0.00	0.00	0.10	1.70	3.05	3.95	1.60	3.35	7.10	1.65	0.20	0.00	22.70
1928-29	0.00	0.00	0.00	0.00	3.55	4.90	1.05	2.95	2.05	1.35	0.00	1.70	17.55
1929-30	0.00	0.00	0.00	0.00	0.00	4.95	4.95	5.30	2.80	1.70	0.40	0.00	20.10
1930-31	0.00	0.00	0.20	0.00	2.70	0.60	5.05	1.50	1.25	0.55	1.10	0.30	13.25
1931-32	0.00	0.00	0.00	0.40	3.70	15.05	4.15	5.90	1.00	0.75	0.40	0.00	31.35
1932-33	0.00	0.00	0.10	0.00	0.65	3.45	8.40	1.00	3.70	0.10	1.75	0.20	19.35
1933-34	0.00	0.00	0.00	2.85	0.00	3.90	----	----	----	----	----	----	----
1934-35		--		----		----	---		-				--
1935-36	0.00	0.00	0.00	2.21	0.51	2.75	5.60	10.50	1.80	1.61	0.91	0.55	26.44
1936-37	0.38	0.00	0.00	0.94	0.00	5.19	4.84	6.54	8.81	0.87	0.14	0.24	27.95
1937-38	0.00	0.00	0.00	0.36	2.29	6.92	6.15	8.75	6.63	1.38	0.19	0.00	32.67
1938-39	0.00	0.00	0.24	2.51	1.35	1.14	4.40	2.21	4.06	0.54	1.09	0.00	17.54
1939-40	0.00	0.00	0.27	0.74	0.36	1.03	12.89	8.67	5.04	0.50	0.60	0.00	30.10
1940-41	0.00	0.00	0.30	1.42	0.32	8.61	8.75	10.97	5.68	6.07	1.17	0.30	43.59
1941-42	0.00	0.00	0.00	1.08	1.16	9.94		-	----	----	----	---	-

APPENDIX D

RECORDS OF DAILY RUNOFF AND PERIODIC WEIR MEASUREMENTS IN SANTA CRUZ-MONTEREY AREA NOT PREVIOUSLY PUBLISHED

TABLE OF CONTENTS

RECORDS OF DAILY RUNOFF AND PERIODIC WEIR MEASUREMENTS IN SANTA CRUZ-MONTEREY AREA NOT PREVIOUSLY PUBLISHED

TABLE 1

SAN LORENZO RIVER AT WATERMAN SWITCH, 1948-49

Station number on Plate 3: SCM-1 — Location: NE ¼ Sec. 25, T. 8 S., R. 3 W., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1	0.7	1.1	1.4	1.6	1.1	3.5	9.0	2.6	0.9	0.7	0.7	0.7
2	.7	2.4	1.4	1.4	0.9	74	8.0	2.6	.9	.7	.7	.7
3	.7	2.2	1.7	1.4	1.9	68	7.6	2.4	.8	.7	.7	.7
4	.7	1.9	1.9	1.2	1.9	26	7.1	2.4	.8	.7	.7	.7
5	.7	1.7	2.9	1.1	4.0	15	6.6	2.4	.8	.7	.7	.7
6	.7	1.6	2.9	1.1	3.8	10	6.2	2.4	.8	.7	.7	.7
7	.7	1.4	2.2	1.1	10	8.0	5.8	2.4	.8	.7	.7	.7
8	.7	1.2	2.2	1.1	3.8	6.2	5.8	2.2	.8	.7	.7	.7
9	.7	1.2	2.2	1.1	2.4	5.8	5.4	2.2	.8	.7	.7	.7
10	.7	1.1	1.9	0.9	2.2	241	5.4	2.2	.8	.7	.7	.7
11	.7	1.1	1.9	0.9	1.9	356	5.0	2.2	.8	.7	.7	.7
12	.7	0.9	1.9	0.9	1.7	122	5.0	1.9	.8	.7	.7	.7
13	.7	0.9	2.9	0.9	1.6	42	4.7	1.9	.8	.7	.7	.7
14	.7	0.9	3.5	0.9	1.6	28	4.7	1.7	.8	.7	.7	.7
15	.7	0.8	2.4	0.9	1.4	21	4.7	1.7	.8	.7	.7	.7
16	.7	0.8	2.6	0.9	1.2	20	5.0	1.6	.8	.7	.7	.7
17	.7	0.7	5.0	0.9	1.2	17	5.0	1.9	.8	.7	.7	.7
18	.7	0.7	3.2	0.9	1.2	15	5.0	2.4	.8	.7	.7	.7
19	.8	0.7	2.6	1.9	1.2	62	5.0	2.4	.7	.7	.7	.7
20	.8	0.7	2.4	1.9	1.1	34	5.0	2.2	.7	.7	.7	.7
21	.8	0.7	2.2	1.4	1.1	26	4.7	2.2	.7	.7	.7	.7
22	.8	0.8	2.2	1.7	1.1	25	4.7	2.2	.7	.7	.7	.7
23	.8	0.9	2.2	2.4	1.1	23	4.4	1.9	.7	.7	.7	.7
24	.8	1.1	1.9	1.9	2.6	21	4.0	1.7	.7	.7	.7	.7
25	.8	1.1	2.4	1.7	3.2	19	3.8	1.6	.7	.7	.7	.7
26	.8	1.1	17	1.6	3.2	17	3.5	1.4	.7	.7	.7	.7
27	.8	1.2	9.4	1.4	4.7	15	3.2	1.2	.7	.7	.7	.7
28	.8	1.2	3.5	1.4	4.0	13	3.2	1.2	.7	.7	.7	.7
29	.8	1.2	1.9	1.2	------	12	2.9	1.1	.7	.7	.7	.7
30	.8	1.4	1.7	1.1		10	2.9	1.1	.7	.7	.7	.7
31	.9	----	1.6	1.1		9.4	------	1.1		.7	.7	-
Average	0.7	1.2	3.1	1.3	2.4	44.1	5.1	1.9	0.8	0.7	0.7	0.7
Runoff in acre-feet	46	69	190	79	133	2,710	304	120	46	43	43	42

TABLE 1—Continued

SAN LORENZO RIVER AT WATERMAN SWITCH, 1949-50

Station number on Plate 3: SCM-1 — Location: NE ¼ Sec. 25, T. 8 S., R. 3 W., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1	0.5	0.5	0.5	0.2	1.8	1.5	1.8	NO RECORD	NO RECORD	NO RECORD	NO RECORD	NO RECORD
2	.5	.5	.5	0.2	1.5	1.5	1.8					
3	.5	.5	.5	0.2	1.4	1.5	1.9					
4	.5	.5	.5	0.3	115	1.5	1.6					
5	.5	.5	.5	0.3	64	1.5	1.5					
6	.5	.5	.5	0.3	98	1.5	1.6					
7	.5	.5	.5	0.3	20	1.5	2.4					
8	.5	.5	.5	1.4	10	1.5	2.9					
9	.5	.5	.5	0.6	7.5	1.5	2.2					
10	.5	.5	.5	2.6	6.3	1.5	2.2					
11	.5	.5	.5	1.5	4.9	1.5	2.4					
12	.5	.5	.5	0.4	4.2	1.5	2.2					
13	.5	.5	.5	0.3	3.5	1.5	2.2					
14	.5	.5	.5	30	3.3	1.5	2.1					
15	.5	.5	.5	3.9	2.7	1.4	1.9					
16	.5	.5	.5	2.4	2.6	1.3	1.9					
17	.5	.5	.5	55	2.4	1.3	NO RECORD					
18	.5	.5	.5	5.1	2.2	1.3						
19	.5	.5	.5	2.2	2.1	1.4						
20	.5	.5	.5	1.8	2.1	1.5						
21	.5	.5	.5	1.8	1.9	1.8						
22	.5	.5	.5	1.8	1.8	1.8						
23	.5	.5	.5	1.8	1.6	2.1						
24	.5	.5	.5	1.8	1.5	6.8						
25	.5	.5	.5	1.6	1.5	4.9						
26	.5	.5	.5	1.5	1.5	3.5						
27	.5	.5	.4	1.5	1.5	3.3						
28	.5	.5	.4	12	1.5	2.7						
29	.5	.5	.2	4.1	------	2.4						
30	.5	.5	.2	2.8	------	2.2						
31	.5	------	.2	2.0	------	2.1						
Average	0.5	0.5	0.5	4.6	13.2	2.0	2.0					
Runoff in acre-feet	31	30	28	282	731	124	65					

TABLE 1—Continued

ZAYANTE CREEK AT SEPZ'S HOUSE, 1948-49

Station number on Plate 3: SCM-2 Location: SE ¼, Sec. 15, T. 10 S., R. 2 W., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1	2.3	2.8	3.0	5.4	7.6	15	21	7.7	4.8	3.1	3.0	3.0
2	2.3	2.8	3.2	5.4	7.3	84	20	7.3	4.5	3.1	3.0	3.0
3	2.3	2.8	3.7	5.4	11	132	18	7.3	4.2	3.1	3.0	3.0
4	2.3	2.5	3.7	5.4	11	100	18	7.3	4.2	3.1	3.0	3.0
5	2.3	2.3	6.3	4.5	16	64	17	7.0	4.0	3.1	3.0	3.0
6	2.3	2.1	4.5	3.2	31	60	16	6.7	3.7	3.0	3.0	3.0
7	2.3	2.1	2.8	3.2	61	50	15	6.7	3.7	3.0	3.0	3.0
8	2.3	1.9	2.5	3.2	24	38	14	6.3	3.5	3.0	3.0	3.0
9	2.3	1.9	2.8	3.2	14	35	14	5.5	3.5	3.0	3.0	3.0
10	2.3	1.9	2.5	3.2	14	214	13	5.5	3.5	3.0	3.0	3.0
11	2.3	1.7	2.5	3.2	16	311	12	5.5	3.5	3.0	3.0	3.0
12	2.3	1.6	2.5	3.7	13	311	12	5.3	3.5	3.0	3.0	3.0
13	2.3	1.6	3.0	4.1	12	150	11	5.3	3.5	3.0	3.0	3.0
14	2.3	1.6	4.1	4.1	11	86	11	5.3	3.5	3.0	3.0	3.0
15	2.3	1.9	3.4	4.0	11	54	11	5.3	3.5	3.0	3.0	3.0
16	2.3	1.2	4.8	4.0	9.0	47	10	5.3	3.4	3.0	3.0	3.0
17	2.3	1.9	14	3.7	8.0	40	9.8	5.2	3.4	3.0	3.0	3.0
18	2.3	2.5	5.0	3.7	7.7	36	9.8	5.2	3.4	3.0	3.0	3.0
19	2.3	2.5	3.4	17	7.7	94	9.4	5.2	3.4	3.0	3.0	3.0
20	2.3	2.3	3.2	13	7.7	80	9.1	5.2	3.4	3.0	3.0	3.0
21	2.3	2.1	3.2	9.8	7.7	72	9.1	5.2	3.3	3.0	3.0	3.0
22	2.3	2.1	2.5	12	7.7	70	8.7	5.0	3.3	3.0	3.0	3.0
23	2.4	2.1	2.5	11	7.3	42	8.7	5.0	3.3	3.0	3.0	3.0
24	2.5	2.8	2.5	9.4	17	39	8.4	5.0	3.3	3.0	3.0	3.0
25	2.6	2.8	2.8	8.7	15	34	8.4	5.0	3.3	3.0	3.0	3.0
26	2.8	2.8	91	8.7	18	30	8.0	5.0	3.2	3.0	3.0	3.0
27	2.8	2.8	23	8.7	18	29	8.0	4.8	3.2	3.0	3.0	3.0
28	2.8	2.8	11	8.7	15	27	8.0	4.8	3.2	3.0	3.0	3.0
29	2.8	2.5	7.0	8.3	—	24	7.7	4.8	3.2	3.0	3.0	3.0
30	2.8	2.5	6.6	8.3	—	22	7.7	4.8	3.2	3.0	3.0	3.0
31	2.8	—	5.4	8.0	—	22	—	4.8	—	3.0	3.0	—
Average	2.4	2.2	7.7	6.6	14.5	77.9	11.8	5.6	3.5	3.0	3.0	3.0
Runoff in acre-feet	147	134	473	405	808	4,784	683	346	211	185	184	178

TABLE 1—Continued

SOQUEL CREEK AT SOQUEL, 1949-50

Station number on Plate 3: 3-4 Location: SE ¼, Sec. 10, T. 11 S., R. 1 W., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1	[e]1.5	[e]1.5	[e]5.0	4.0	59	21	19	14	—	—	—	—
2	[e]1.5	[e]1.5	[e]5.0	4.2	52	21	19	14	—	—	—	—
3	[e]1.5	[e]1.5	[e]5.0	5.1	47	21	18	13	—	—	—	—
4	[e]1.5	[e]1.5	[e]5.0	5.8	[e]1,640	20	17	13	—	—	—	—
5	[e]1.5	[e]1.5	[e]5.0	5.8	[e]2,009	20	17	13	—	—	—	—
6	[e]1.5	[e]1.5	[e]5.0	5.8	[e]2,370	19	19	12	—	—	—	—
7	[e]1.5	[e]1.5	[e]5.0	5.8	460	18	19	12	—	—	—	—
8	[e]1.5	[e]2.0	7.0	22	265	18	150	11	—	—	—	—
9	[e]1.5	[e]2.0	6.0	26	177	18	85	11	—	—	—	—
10	[e]1.5	[e]2.0	5.4	22	196	18	45	11	—	—	—	—
11	[e]1.5	[e]2.0	4.5	90	138	17	[e]33	10	—	—	—	—
12	[e]1.5	[e]2.0	4.0	[e]36	107	17	[e]26	10	—	—	—	—
13	[e]1.5	[e]2.0	4.0	[e]47	85	16	[e]26	—	—	—	—	—
14	[e]1.5	[e]2.0	5.1	[e]785	68	16	[e]22	—				
15	[e]1.5	[e]2.0	26	[e]74	57	15	[e]21	—				
16	[e]1.5	[e]2.0	22	[e]64	50	15	[e]19	—				
17	[e]1.5	[e]2.0	33	[e]775	45	15	[e]19	—	NO RECORD	NO RECORD	NO RECORD	NO RECORD
18	[e]1.5	[e]2.0	48	[e]158	42	15	18	—				
19	[e]1.5	[e]2.0	51	[e]64	37	16	18					
20	[e]1.5	[e]2.0	24	[e]42	35	15	17					
21	[e]1.5	[e]3.0	13	[e]30	32	16	17					
22	[e]1.5	[e]3.0	13	[e]26	29	16	17	NO RECORD				
23	[e]1.5	[e]3.0	11	27	28	16	16					
24	[e]1.5	[e]3.0	10	26	26	129	16					
25	[e]1.5	[e]3.0	9.8	23	25	56	16					
26	[e]1.5	[e]3.0	8.9	21	24	29	15					
27	[e]1.5	[e]3.0	8.5	43	22	25	15					
28	[e]1.5	[e]3.0	7.8	292	21	23	14					
29	[e]1.5	[e]3.0	7.8	140	—	21	14					
30	[e]1.5	[e]3.0	7.8	46	—	20	14					
31	[e]1.5		8.0	38		19	—					
Average	1.5	2.2	12.3	83.8	291.0	23.3	26.1	12.0	—	—	—	—
Runoff in acre-feet	92	132	755	5,860	16,200	1,430	1,560	285	—	—	—	—

[e] Estimated.

TABLE 1—Continued

SOQUEL CREEK AT JUNCTION WITH WEST BRANCH, 1948-49

Station number on Plate 3: SCM-3 Location: SW ¼, Sec. 23, T. 10 S., R. 1 W., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1	[e]1.5	[e]1.5	2.0	6.5	5.2	21	54	13	9.8	4.1	[e]2.4	[e]1.7
2	[e]1.5	[e]1.5	2.3	6.0	4.9	147	49	13	9.8	4.1	[e]2.4	[e]1.7
3	[e]1.5	[e]1.5	4.1	4.9	9.9	377	43	12	9.8	3.8	[e]2.4	[e]1.7
4	[e]1.5	[e]1.5	3.8	4.1	7.5	256	41	12	9.4	3.8	[e]2.4	[e]1.7
5	[e]1.5	1.7	5.7	4.5	63	74	39	12	9.4	3.5	[e]2.4	[e]1.7
6	[e]1.5	1.5	7.9	3.5	66	143	35	12	9.0	3.5	[e]2.3	[e]1.7
7	[e]1.5	1.3	5.1	3.3	273	74	32	12	9.0	3.3	[e]2.3	[e]1.7
8	[e]1.5	1.1	4.1	3.3	57	53	31	12	8.7	3.3	[e]2.3	[e]1.7
9	[e]1.5	1.1	3.8	3.3	21	53	29	12	8.7	3.0	[e]2.3	[e]1.7
10	[e]1.5	1.1	3.8	3.3	20	485	29	12	8.3	3.0	[e]2.3	[e]1.6
11	[e]1.5	1.1	3.5	3.5	27	817	28	11	8.0	3.0	[e]2.2	[e]1.6
12	[e]1.5	0.9	3.5	3.3	20	708	26	11	7.7	2.8	[e]2.2	[e]1.6
13	[e]1.5	0.7	6.5	3.5	17	205	26	11	7.3	[e]2.8	[e]2.2	[e]1.6
14	[e]1.5	0.7	9.4	3.3	14	182	25	11	7.0	[e]2.8	[e]2.2	[e]1.6
15	[e]1.5	0.9	8.4	2.8	13	141	24	11	6.6	[e]2.7	[e]2.2	[e]1.6
16	[e]1.5	1.3	9.9	2.8	9.9	178	23	11	6.6	[e]2.7	[e]2.1	[e]1.6
17	[e]1.5	1.7	22	2.5	8.4	140	22	11	6.3	[e]2.7	[e]2.1	[e]1.5
18	[e]1.5	1.7	9.4	2.5	7.4	112	21	11	6.3	[e]2.6	[e]2.1	[e]1.5
19	[e]1.5	1.7	5.7	12	6.9	256	20	11	6.0	[e]2.6	[e]2.1	[e]1.5
20	[e]1.5	2.0	4.5	16	6.5	173	20	11	6.0	[e]2.6	[e]2.1	[e]1.5
21	[e]1.5	2.0	4.1	9.9	6.0	140	19	11	5.6	[e]2.6	[e]2.0	[e]1.5
22	[e]1.5	1.7	3.5	26	6.0	135	17	11	5.6	[e]2.6	[e]2.0	[e]1.5
23	[e]1.5	1.7	3.2	18	6.5	120	17	11	5.3	[e]2.5	[e]1.9	[e]1.5
24	[e]1.5	1.7	3.3	13	35	104	16	11	5.3	[e]2.5	[e]1.9	[e]1.5
25	[e]1.5	1.7	4.1	9.9	24	94	15	11	5.0	[e]2.5	[e]1.9	[e]1.5
26	[e]1.5	1.7	82	7.9	29	82	15	11	4.7	[e]2.5	[e]1.8	[e]1.5
27	[e]1.5	1.7	92	7.4	39	73	15	11	4.7	[e]2.5	[e]1.8	[e]1.5
28	[e]1.5	1.7	22	6.5	26	69	14	10	4.7	[e]2.5	[e]1.8	[e]1.5
29	[e]1.5	2.0	11	6.0	----	63	14	10	4.4	[e]2.5	[e]1.8	[e]1.5
30	[e]1.5	2.0	8.4	5.7	----	62	13	10	4.4	[e]2.5	[e]1.8	[e]1.5
31	[e]1.5	----	6.5	5.2	----	59	----	10	----	[e]2.5	[e]1.8	----
Average	1.5	1.5	11.8	6.8	29.3	180.7	25.7	11.3	7.0	2.9	2.1	1.6
Runoff in acre-feet	92	86	726	415	1,640	11,100	1,530	693	415	179	130	97

[e] Estimated.

TABLE 1—Continued

SOQUEL CREEK AT JUNCTION WITH WEST BRANCH, 1949-50

Station number on Plate 3: SCM-3 Location: SW ¼, Sec. 23, T. 10 S., R. 1 W., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1	[e]1.5	[e]1.5	NO RECORD	5.8	13	16	[e]10	5.8	NO RECORD	NO RECORD	NO RECORD	NO RECORD
2	[e]1.5	[e]1.5		5.2	12	15	[e]9	5.8				
3	[e]1.5	[e]1.5		5.2	11	15	[e]8	5.5				
4	[e]1.5	[e]1.5		[e]4.4	965	14	7.4	5.5				
5	[e]1.5	[e]1.5		[e]4.2	1,072	14	6.8	5.5				
6	[e]1.5	[e]1.5		[e]4.2	4,757	13	9.0	5.5				
7	[e]1.5	1.5	5.5	[e]5.8	298	13	11	5.5				
8	[e]1.5	NO RECORD	5.8	[e]30	150	13	76	5.5				
9	[e]1.5		3.6	[e]15	100	12	43	5.2				
10	[e]1.5		2.9	22	100	12	29	5.2				
11	[e]1.5		2.6	50	82	12	22	5.2				
12	[e]1.5		2.5	22	64	11	19	5.2				
13	[e]1.5		2.5	16	57	11	16	NO RECORD				
14	[e]1.5		2.9	600	38	10	15					
15	[e]1.5		7.4	53	33	10	14					
16	[e]1.5	[e]4.2	5.5	41	30	9.8	13					
17	[e]1.5	4.0	9.0	653	28	10	12					
18	[e]1.5	3.8	33	84	26	9.6	10					
19	[e]1.5	3.6	30	36	25	11	9.6					
20	[e]1.5	3.5	13	24	24	9.0	9.0					
21	[e]1.5	3.5	9.6	17	24	[e]8.1	8.4					
22	[e]1.5	3.2	9.8	15	22	[e]7.4	7.9					
23	[e]1.5	NO RECORD	8.6	12	21	[e]6.8	7.4					
24	[e]1.5		7.9	[e]11	21	[e]53	7.4					
25	[e]1.5		7.4	[e]9.8	19	[e]32	7.4					
26	[e]1.5		7.4	[e]8.1	19	[e]22	6.7					
27	[e]1.5		7.4	[e]13	17	[e]16	6.7					
28	[e]1.5		7.4	138	17	[e]12	6.4					
29	[e]1.5		7.4	40	----	[e]12	6.2					
30	[e]1.5		6.8	23	----	[e]11	6.2					
31	[e]1.5		6.4	----	----	[e]10	----					
Average	1.5	2.6	8.5	63.5	287	13.9	13.9	5.4	----	----	----	----
Runoff in acre-feet	92	72	420	3,910	16,000	855	830	130	----	----	----	----

[e] Estimated.

TABLE 1—Continued

CORRALITOS CREEK AT CORRALITOS, 1946-47

Station number on Plate 3: 3-19 Location: SE ¼, Sec. 12, T. 11 S., R. 1 E., M.D.B.&M.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
	Daily mean flow, in second-feet											
1				0.2		2.1	8.4					
2						8.8	7.8					
3						26	7.8					
4					NO FLOW	50	7.2					
5						49	7.0					
6						18	6.0					
7						14	5.7					
8						13	5.4					
9					0.9	13	5.0					
10					3.8	97	5.0					
11			NO FLOW	NO FLOW	1.3	16	4.5					
12					43	18	6.2					
13					21	17	3.7					
14					8.4	17	3.7					
15					1.2	15	3.2					
16	NO FLOW	NO FLOW			7.2	12	3.2	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
17					9.2	11	2.9					
18					6.5	9.5	2.2					
19					4.8	8.8	2.1					
20					4.2	7.3						
21					3.7	6.7						
22					3.1	5.6						
23					2.9	5.3						
24			0.2		2.7	5.0						
25			1.7		2.5	5.0	NO RECORD					
26			0.9		2.1	6.8						
27			0.8	0.2	1.8	6.8						
28			0.3	0.8	1.5	8.8						
29			0.2	0.2		7.0						
30			0.2	0		12						
31			0.2	0		9.2						
Average			0.4	0	4.7	15.5	5.2					
Runoff in acre-feet			8.9	2.8	260	955	196					

TABLE 1—Continued

CORRALITOS CREEK AT CORRALITOS, 1947-48

Station number on Plate 3: 3-19 Location: SE ¼, Sec. 12, T. 11 S., R. 1 E., M.D.B.&M.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
	Daily mean flow, in second-feet											
1		2.4		0	0	0.3	5.9	26				
2		2.0		2.1	0		7.2	22				
3		1.7		4.2	0		18	19				
4		0.0		2.5	1.0		14	15				
5		0.2		2.5	7.0		21	14				
6		0.2		2.0	6.7		19	12				
7		0.2		1.8	5.2		17					
8	NO RECORD	0.4		1.8	4.2	NO FLOW	17					
9		0.2	NO FLOW	1.3	2.9		49					
10		0.2		1.1	3.2		50					
11		0.2		1.0	2.8		30					
12		0.5		0.9	2.5		21					
13		0		0.7	5.0	3.7	17					
14		0		1.1		9.2	14					
15		0.8		1.0		6.6	12					
16		0.6		0.7		8.3	11					
17	2.1		0.8	0.6		8.3	9.2	NO RECORD	NO FLOW	NO FLOW	NO FLOW	NO FLOW
18	1.1		0.8	0.6		7.2	7.8					
19	1.1		0.3	0.2		8.3	7.0					
20	1.1		2.1			6.6	6.1					
21	1.4		4.8		NO FLOW	5.1	5.1					
22	1.1		3.2			4.3	13					
23	0.8		2.5			7.0	8.5					
24	0.6		2.0			65	5.0					
25	0.6	NO FLOW	1.6			26	3.5					
26	0.6		1.4	NO FLOW		16	2.7					
27	0.6		1.0			14	2.4					
28	1.2		0		3.7	10	5.1					
29	7.3		0.4		1.4	8.9	38					
30	5.5		0.5			7.2	41					
31	2.9		0.3			6.6						
Average	1.9	0.3	0.7	0.8	1.6	7.4	15.9	18.0				
Runoff in acre-feet	56	21	43	52	90	453	950	214				

TABLE 1—Continued

CORRALITOS CREEK AT CORRALITOS, 1948-49

Station number on Plate 3: 3-19 Location: SE ¼, Sec. 12, T. 11 S., R. 1 E., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1		0	0	0.3	0.4	7.4	15	0.6	0.1			
2		0	0	0.6	0.4	40	14	.6	.1			
3		0.7	0.2	0.6	3.2	126	12	.6	.1			
4			0.2	0.6	5.1	118	11	.6				
5			0.2	0.4	32	74	11	.6				
6			0.2	0.3	14	54	10	.5				
7			0	0.3	126	40	10	.5				
8			0	0.2	73	34	8.0	.5				
9			0	0.1	15	30	7.4	.5				
10			0.2		13	74	7.4	.5				
11			0.2		14	167	5.9	.5				
12			0.2		12	190	5.2	.3				
13			1.0	NO FLOW	8.0	100	5.2	.3				
14			3.2		7.4	67	5.2	.3				
15	NO FLOW	NO FLOW	0.4		7.0	50	4.8	.6	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16			0		4.4	48	4.0	.6				
17			5.2		3.6	46	4.0	.5				
18			1.0		3.2	31	3.6	.3				
19				7.5	2.7	67	3.6	.2				
20				10	2.1	52	3.2	.2				
21				3.6	2.1	46	3.2	.2				
22			NO FLOW	7.5	0.8	46	2.8	.1				
23				7.5	0.8	39	2.5	.1				
24				4.0	3.6	36	2.1	.1				
25				3.2	6.4	30	1.8	.1				
26			14	2.5	7.4	27	1.5	.1				
27			23	1.3	9.0	24	1.3	.1				
28			7.0	1.0	8.4	21	1.0	.1				
29			2.5	0.2		20	0.8	.1				
30			1.0	0.1		19	0.6	.1				
31			0.3	0.4		17		.1				
Average		0	2.0	1.7	13.8	56.2	5.4	0.3	0.1			
Runoff in acre-feet		1.4	120	104	763	3,450	333	21	0.6			

TABLE 1—Continued

CORRALITOS CREEK AT CORRALITOS, 1949-50

Station number on Plate 3: 3-19 Location: SE ¼, Sec. 12, T. 11 S., R. 1 E., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1					10	2.7	4.4	6.2				
2					9.5	2.4	3.8	5.8				
3			NO FLOW		8.2	2.4	3.2	5.5				
4				NO FLOW	83	2.4	3.0	4.8				
5					76	2.4	2.7	3.8				
6					105	2.7	3.5	3.2				
7			12		47	2.4	4.4	3.0				
8			7.4	0.6	30	2.4	34	2.4				
9			0	0	20	2.4	20	2.2				
10			0	6.2	20	2.4	15	1.7				
11			0	5.8	20	2.4	17	1.1				
12			0	4.1	15	2.4	16	1.0				
13			0	1.9	16	2.4	16	0.8				
14			7.4	61	11	1.0	15	0.6				
15	NO FLOW	NO FLOW	7.4	1.9	10	0.6	15	0.5	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16			7.4	19	8.6	0.6	13	0.4				
17			7.4	88	7.8	0.8	12	0.3				
18			0.5	34	7.0	0.6	12	0.2				
19			0	18	6.2	1.7	11	0.1				
20			3.5	13	5.8	1.1	11					
21			3.5	12	5.8	0.6	10					
22			2.1	12	4.8	0.8	9.1					
23			0.8	11	4.4	0.6	8.2					
24			0.2	8.6	3.8	25	7.4					
25				7.8	3.5	19	7.4					
26				5.5	3.2	10	7.0	NO FLOW				
27				7.0	3.5	9.5	7.0					
28			NO FLOW	45	3.0	8.2	6.6					
29				24		7.0	6.6					
30				16		5.5	6.2					
31				13		4.8						
Average			1.9	17.3	19.6	4.2	10.3	2.3				
Runoff in acre-feet			118	824	1,090	257	612	86				

TABLE 1—Continued

CASSERLY CREEK NEAR CASSERLY STORE, 1946-47

Station number on Plate 3: SCM-4 Location: SW ¼, Sec. 15, T. 11 S., R. 2 E., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1				0.1	0.1	0.1	0.3					
2				.1	0.1	0.1	.2					
3				.1	0.1	0.8	.2					
4				.2	0.1	3.7	.2					
5				.2	0.1	1.4	.1					
6				.2	0.1	1.1	.1					
7				.2	0.1	1.1	.1					
8				.2	0.1	1.1	.1					
9				.2	1.8	1.1	.1					
10			NO FLOW	.2	14	13	.1					
11				.2	14	7.9	.1					
12				.2	17	5.4	.1					
13				.2	3.8	3.8	.1					
14				.2	1.8	3.5	.1					
15	NO FLOW	NO FLOW		.2	1.1	5.9	.1					
16				.2	0.7	5.7	.1	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
17				.2	0.6	4.8	.1					
18				.2	0.7	3.0	.1					
19				.2	0.5	1.5	.1					
20				.2	0.6	0.7	.1					
21				.2	0.6	0.3						
22			0.2	.2	0.7	0.2						
23			0.2	.2	0.6	0.1						
24			0.4	.2	0.6	0.1						
25			1.1	.2	0.7	0.1	NO FLOW					
26			0.7	.2	0.7	0.1						
27			0.7	.2	0.7	0.1						
28			0.3	.5	0.7	0.7						
29			0.1	.2		0.4						
30			0.1	.2		0.5						
31			0.1	.2		0.5						
Average			0.4	0.2	2.2	2.2	0.1					
Runoff in acre-feet			7.7	12	125	136	4.9					

TABLE 1—Continued

CASSERLY CREEK NEAR CASSERLY STORE, 1947-48

Station number on Plate 3: SCM-4 Location: SW ¼, Sec. 15, T. 11 S., R. 2 E., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1		0.1	0.1	0.1	0.1	0.1	0.8					
2		0.1	.1	.1	.1	.1	0.6					
3		0.1	.1	.1	.1	.1	0.6					
4		0	.1	.1	.1	.1	4.3					
5		0.1	.1	.1	.1	.1	14					
6		0.1	.1	.1	.1	.1	14					
7		0.1	.1	.1	.2	.1	14					
8		0.1	.1	.1	.2	.1	15					
9		0.1	.1	.1	.2	.1	8.8					
10		0.1	.1	.1	.2	.2	2.3					
11		0.1	.1	.2	.2	.2	2.3					
12		0.1	.1	.2	.2	.2	2.3					
13	NO FLOW	0	.1	.2	.2	.2	2.3					
14		0	.1	.1	.2	.2	0.9					
15		0	.1	.2	.2	.2	0.3					
16		0	.1	.2	.2	.2	0.3	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
17		0	.1	.2	.2	.3	0.3					
18		0.1	.2	.2	.2	.3	0.1					
19		0.1	.2	.2	.2	.4						
20		0.1	.2	.2	.2	.4						
21		0.1	.2	.1	.2	.2						
22		0.1	.2	.1	.3	.1						
23		0.1	.2	.1	.3	.2						
24		0.1	.2	.1	.2	.8						
25		0.1	.2	.1	.2	.8	NO FLOW					
26	0.1	0.1	.2	.1	.1	.8						
27	0.1	0.1	.2	.1	.1	.9						
28	0	0.1	.2	.1	.1	.8						
29	0.1	0.1	.2	.1	.1	.8						
30	0.1	0.1	.2	.1		.9						
31	0.1		.1	.1		.9						
Average	0.1	0.1	0.1	0.1	0.2	0.3	4.6					
Runoff in acre-feet	1	4.8	8.7	7.9	9.9	22	165					

TABLE 1—Continued

CASSERLY CREEK NEAR CASSERLY STORE, 1948-49

Station number on Plate 3: SCM-4 Location: SW ¼, Sec. 15, T. 11 S., R. 2 E., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1			0	0.4	1.0	1.2	2.3	0.4				
2			0	0.3	1.0	10	2.1	.4				
3			0	0.3	1.1	25	2.0	.4				
4			0	0.3	1.2	11	1.6	.3				
5			0	0.3	2.0	9.3	1.5	.3				
6			0.2	0.4	2.7	4.3	1.3	.3				
7			0.2	0.4	5.4	3.5	1.2	.2				
8			0.2	0.4	2.7	3.0	1.1	.2				
9			0.2	0.4	2.0	3.0	1.0	.2				
10			0.2	0.4	1.6	9.3	0.8	.1				
11			0.2	0.4	1.5	25	0.7	.1				
12			0.6	0.4	1.3	31	0.7	.1				
13			1.3	0.4	1.1	9.3	0.7					
14			0.8	0.3	0.8	8.6	0.7					
15	NO FLOW	NO FLOW	0.6	0.3	0.8	8.0	0.7		NO FLOW	NO FLOW	NO FLOW	NO FLOW
16			0.4	0.2	0.8	6.6	0.8					
17			0.4	0.2	0.7	5.4	0.8					
18			0.3	0.1	0.7	4.6	0.8					
19			0.2	0.8	0.6	13	0.8					
20			0.1	1.2	0.6	6.2	0.8	NO FLOW				
21			0.1	0.8	0.5	6.2	0.7					
22			0.1	1.1	0.5	6.8	0.7					
23			0	1.1	0.5	3.2	0.7					
24			0	1.0	1.0	3.2	0.6					
25			0	1.0	1.1	3.0	0.6					
26			0.6	1.0	1.2	3.0	0.6					
27			1.8	1.0	1.3	3.0	0.5					
28			1.2	1.0	1.3	3.0	0.5					
29			0.7	1.0		2.7	0.5					
30			0.7	1.0		2.5	0.5					
31			0.5	1.0		2.3						
Average			0.4	0.6	1.3	7.6	1.0	0.3				
Runoff in acre-feet			23	38	73	468	56	6				

TABLE 1—Continued

GREEN VALLEY CREEK AT CONNELL ROAD, 1946-47

Station number on Plate 3: SCM-5 Location: SE ¼, Sec. 17, T. 11 S., R. 2 E., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1				0.1	0.1	0.8	2.0					
2				0.2		1.6	2.0					
3				0.2		6.4	2.0					
4				0.3		6.7	2.0					
5				0.3	NO FLOW	4.9	1.9					
6				0.2		3.1	1.9					
7				0.2		2.7	2.0					
8				0.2		2.5	2.0					
9				0.2	0.7	2.3	1.8					
10			NO FLOW	0.1	7.9	43	1.0					
11				0.1	2.3	18	0.9					
12				0.1	25	8.8	0.9					
13					11	5.5	0.9					
14					3.8	4.2	0.9					
15	NO FLOW	NO FLOW			2.8	3.4	0.8	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16					2.3	2.9	0.8					
17					2.0	2.8	0.7					
18					1.8	2.6	0.5					
19				NO FLOW	1.6	2.5	0.5					
20					1.5	2.4	0.5					
21					1.2	2.3						
22			0.3		1.1	2.1						
23			0.5		1.0	2.0						
24			1.4		0.9	2.0						
25			0.6	0.1	0.9	2.0	NO FLOW					
26			0.5	0.1	0.9	2.0						
27			0.3	0.1	0.8	1.9						
28			0.3	0	0.8	2.3						
29			0.2	0.1		2.0						
30			0.2	0		2.3						
31			0.1	0.1		2.0						
Average			0.4	0.3	2.5	4.9	0.9					
Runoff in acre-feet			8.7	5.3	138	298	52					

TABLE 1—Continued

GREEN VALLEY CREEK AT CONNELL ROAD, 1947-48

Station number on Plate 3: SCM-5 Location: SE ¼, Sec. 17, T. 11 S., R. 2 E., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1			0.2	0.4	0.4	0.4	0.5	9.7				
2			.2	.4	.4	0.4	0.6	5.7				
3			.2	.4	.4	0.4	1.4	4.4				
4			.2	.4	.5	0.4	1.8	3.6				
5			.2	.4	.8	0.4	3.8	3.1				
6			.2	.4	.7	0.4	3.1	2.5				
7			.2	.4	.6	0.4	2.1					
8			.2	.4	.6	0.4	2.0					
9			.2	.3	.4	0.4	4.2					
10			.1	.3	.3	0.4	11					
11		NO FLOW	.2	.3	.4	0.4	5.5					
12			.2	.3	.4	0.4	3.7					
13			.1	.3	.4	0.5	2.8					
14			.1	.4	.4	0.7	2.4					
15	NO FLOW		.1	.4	.4	0.6	2.1	NO RECORD	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16			.1	.4	.4	0.8	1.9					
17			.4	.4	.4	0.8	1.4					
18			.4	.4	.4	0.7	1.2					
19		0.1	.4	.4	.4	1.2	1.1					
20		.1	.5	.4	.4	1.0	1.0					
21		.1	.6	.4	.4	0.8	1.0					
22		.1	.5	.4	.4	0.7	2.3					
23		.1	.5	.4	.4	0.6	2.1					
24		.1	.5	.4	.4	9.7	1.9					
25		.1	.5	.4	.4	3.7	1.8					
26		.1	.5	.4	.4	1.6	1.4					
27		.1	.4	.3	.4	1.1	1.3					
28		.1	.4	.4	.6	0.9	2.3					
29		.1	.4	.4	.4	0.8	16					
30		.1	.4	.4		0.6	22					
31			.4	.4		0.5						
Average		0	0.3	0.4	0.4	1.1	3.5	4.8				
Runoff in acre-feet		2.3	19	24	26	64	209	57				

TABLE 1—Continued

GREEN VALLEY CREEK AT CONNELL ROAD, 1948-49

Station number on Plate 3: SCM-5 Location: SE ¼, Sec. 17, T. 11 S., R. 2 E., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1					0	1.4	2.7	[a]0.3				
2					0	37	2.3	[a]0.3				
3					0	63	2.1	[a]0.2				
4					0.3	34	1.7	[a]0.2				
5					3.2	24	1.6	[a]0.2				
6					8.8	9.6	1.4	[a]0.2				
7					17	8.0	1.2	[a]0.1				
8					5.0	7.4	1.2	[a]0.1				
9				NO FLOW	2.7	7.7	1.2	[a]0.1				
10					1.7	26	1.1	[a]0.1				
11					2.3	39	1.0	0.1				
12					1.7	120	1.0					
13					1.2	39	0.9					
14					0.9	19	0.8					
15					0.8	14	0.7					
16	NO FLOW	NO FLOW	NO FLOW		0.8	10	0.7		NO FLOW	NO FLOW	NO FLOW	NO FLOW
17					0.7	8.0	0.7					
18					0.7	7.4	0.7					
19				2.0	0.7	34	0.7					
20				1.7	0.7	18	0.6					
21				1.0	0.6	12	0.6					
22				2.5	0.5	13	0.5	NO FLOW				
23				1.4	0.4	10	0.5					
24				0.9	1.0	8.6	0.5					
25				0.7	1.2	7.0	0.5					
26			0.1	0.5	1.4	5.6	[a]0.4					
27			1.4	0.4	1.7	5.0	[a]0.4					
28			0.1	0.3	1.4	4.4	[a]0.4					
29			0	0.2		3.8	[a]0.3					
30			0	0.2		3.4	[a]0.3					
31			0	0.2		3.2						
Average			0.3	1.0	2.0	19.4	1.0	0.1				
Runoff in acre-feet			3.2	24	114	1,195	57	3.8				

[a] Estimated.

TABLE 1—Continued

PAJARO RIVER AT McGOWAN RANCH, 1946-47

Station number on Plate 3: SCM-6 Location: SE ¼, Sec. 17, T. 12 S., R. 2 E., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1				12	14	18	38	12				
2				12	13	19	33	11				
3				12	13	30	32	10				
4				11	13	120	31					
5				11	13	300	30					
6				12	13	110	29					
7				12	13	75	28					
8				11	13	58	27					
9				11	15	51	26					
10			NO RECORD	11	27	90	25					
11				11	34	435	25					
12				11	57	222	26					
13				11	357	136	25					
14				11	267	104	24					
15				11	80	86	23					
16	NO RECORD	NO RECORD		11	56	73	22	NO RECORD	NO RECORD	NO RECORD	NO RECORD	NO RECORD
17				11	53	67	22					
18				11	46	61	21					
19				10	40	55	20					
20				11	34	48	19					
21			10	11	30	44	18					
22			10	11	26	41	18					
23			10	11	23	39	17					
24			11	12	22	35	16					
25			13	12	21	32	15					
26			16	12	20	31	15					
27			16	12	19	29	14					
28			18	14	18	30	13					
29			17	15		31	12					
30			14	16		33	12					
31			35	14		35						
Average			15.4	11.7	48.2	81.7	23.8	11.0				
Runoff in acre-feet			340	718	2,680	5,020	1,340	65				

TABLE 1—Continued

PAJARO RIVER AT McGOWAN RANCH, 1947-48

Station number on Plate 3: SCM-6 Location: SE ¼, Sec. 17, T. 12 S., R. 2 E., M.D.B.&M.

Date	Daily mean flow, in second-feet											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1				8	8	9	13	415				
2				8	8	9	13	640				
3				8	8	9	16	300				
4				8	6	9	20	150				
5				8	7	8	24	98				
6				8	8	8	32	63				
7				8	8	8	31	45				
8			NO RECORD	9	9	8	30	39				
9				9	9	8	52	33				
10				8	8	8	85	28				
11				8	12	8	160	23				
12				8	11	7	220	19				
13				8	11	7	117	15				
14				8	10	8	76	14				
15				8	9	8	58	12				
16	NO RECORD	NO RECORD		9	9	8	48	11	NO RECORD	NO RECORD	NO RECORD	NO RECORD
17			7	8	9	10	54	10				
18			7	8	9	10	49	10				
19			7	8	9	10	44	9				
20			7	9	9	11	42	8				
21			7	9	9	10	39					
22			7	8	9	10	40					
23			7	8	9	10	40					
24			11	9	9	36	37					
25			11	10	9	57	36					
26			11	8	9	42	30	NO RECORD				
27			9	8	9	31	20					
28			9	8	10	23	18					
29			8	8	9	19	27					
30			8	8		16	96					
31			8	8		14						
Average			8.3	8.2	8.9	13.8	52.3	97.4				
Runoff in acre-feet			246	508	511	848	3,110	3,860				

TABLE 2

RECORDS OF PERIODIC WEIR MEASUREMENTS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by City of Santa Cruz Water Department

(Discharge in second-feet)

Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
Branciforte Creek near Happy Valley School, 4 miles north of State Highway 1, Southeast ¼ Section 29, Township 10 South, Range 1 West, M. D. B. & M.							
10/20/31	0.9	2/12/32	7.6	5/15/32	1.0	9/26/32	0.9
10/30/31	0.9	2/14/32	5.5	5/22/32	1.2	10/ 2/32	0.7
12/ 2/31	1.0	2/21/32	2.8	5/29/32	1.2	10/ 9/32	0.8
1/ 9/32	3.1	2/28/32	2.3	6/ 5/32	1.1	10/15/32	0.8
1/15/32	32	3/ 6/32	1.9	6/12/32	1.0	10/23/32	0.7
1/18/32	6.2	3/13/32	1.8	6/19/32	1.0	11/ 5/32	0.9
1/24/32	2.9	3/20/32	1.8	6/26/32	1.0	11/17/32	0.9
1/30/32	2.2	3/27/32	1.3	7/ 4/32	0.9	11/27/32	0.9
2/ 7/32	27	4/ 3/32	1.3	7/ 8/32	0.9	12/ 7/32	0.9
2/ 8/32	86	4/20/32	1.2	7/24/32	0.7	12/13/32	1.0
2/ 9/32	28	4/24/32	1.7	8/ 7/32	0.7	12/22/32	1.2
2/10/32	15	5/ 2/32	0.8	8/18/32	0.7	12/26/32	1.0
2/11/32	10	5/ 8/32	0.9	9/ 4/32	0.9		
Laguna Creek at Diversion Dam, 3.5 miles north of State Highway 1, Southwest ¼ Section 30, Township 10 South, Range 2 West, M. D. B. & M.							
10/20/31	0.4	5/ 1/32	3.2	10/23/32	0.9	7/19/41	5.4
10/30/31	0.5	5/ 8/32	2.7	11/ 9/32	0.9	7/26/41	5.0
12/ 2/31	0.7	5/15/32	2.2	11/18/32	0.8	8/ 2/41	4.7
1/ 1/32	11	5/22/32	2.1	11/24/32	0.7	8/ 9/41	4.5
1/ 7/32	3.7	5/29/32	2.0	11/26/32	0.7	8/17/41	4.3
1/17/32	6.2	6/ 5/32	2.0	11/29/32	0.7	8/23/41	4.0
1/24/32	3.3	6/12/32	2.0	12/ 3/32	0.7	8/30/41	3.8
1/30/32	4.1	6/26/32	1.8	12/18/32	0.8	9/ 5/41	3.6
2/ 7/32	22	7/ 1/32	1.8	12/20/32	1.0	9/13/41	3.4
2/14/32	7.5	7/ 9/32	1.5	12/26/32	0.9	9/19/41	3.3
2/21/32	5.0	7/17/32	1.5	5/17/41	13	9/26/41	2.9
2/28/32	4.1	7/24/32	1.5	5/20/41	13	10/ 4/41	3.0
3/ 6/32	3.3	8/ 1/32	1.3	5/24/41	12	10/10/41	2.9
3/13/32	3.5	8/ 7/32	1.3	5/31/41	11	10/17/41	2.8
3/20/32	4.4	8/18/32	1.1	6/ 7/41	9.4	10/24/41	3.0
3/27/32	3.5	8/31/32	1.0	6/14/41	8.3	10/31/41	2.8
4/ 4/32	3.1	9/ 8/32	0.9	6/21/41	7.4	11/ 7/41	2.9
4/10/32	3.1	9/13/32	1.0	6/29/41	7.0	11/14/41	2.6
4/20/32	2.9	10/ 2/32	0.9	7/ 5/41	6.4	11/21/41	2.4
4/24/32	3.1	10/ 9/32	0.9	7/12/41	6.0	11/28/41	2.5
						12/ 6/41	2.7
Liddell Creek at Diversion Dam, 3 miles north of State Highway 1, Southwest ¼ Section 25, Township 10 South, Range 3 West, M. D. B. & M.							
10/21/31	1.3	4/ 4/32	1.4	6/26/32	1.3	10/ 2/32	1.2
1/19/32	1.6	4/10/32	1.4	7/ 1/32	1.3	10/ 9/32	1.2
1/24/32	1.4	4/20/32	1.4	7/ 9/32	1.2	10/23/32	1.2
2/ 7/32	1.9	4/24/32	1.4	7/17/32	1.3	10/30/32	1.2
2/14/32	2.0	5/ 1/32	1.3	7/24/32	1.3	11/ 9/32	1.1
2/21/32	1.7	5/ 8/32	1.1	8/ 1/32	1.2	11/18/32	1.1
2/28/32	1.7	5/15/32	1.1	8/ 7/32	1.2	11/26/32	1.2
3/ 6/32	1.4	5/22/32	1.3	8/18/32	1.2	12/ 3/32	1.1
3/13/32	1.5	5/29/32	1.3	8/31/32	1.2	12/18/32	1.2
3/20/32	1.5	6/ 5/32	1.1	9/ 8/32	1.2	12/26/32	1.3
3/27/32	1.4	6/12/32	1.2				

TABLE 2—Continued

RECORDS OF PERIODIC WEIR MEASUREMENTS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by City of Santa Cruz Water Department

(Discharge in second-feet)

Majors Creek at Diversion Dam, 2 miles north of State Highway 1, Southeast ¼ Section 6, Township 11 South, Range 2 West, M. D. B. & M.

Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
10/20/31	0.1	5/ 8/32	1.3	10/23/32	0.8	8/ 9/41	2.6
10/30/31	0.1	5/15/32	1.1	10/30/32	0.8	8/17/41	2.4
12/ 2/31	0.7	5/22/32	1.0	11/ 9/32	0.8	8/23/41	2.4
1/ 7/32	2.1	5/30/32	1.1	11/18/32	0.7	8/30/41	2.3
1/17/32	4.3	6/ 5/32	0.8	11/26/32	0.7	9/ 5/41	2.2
1/24/32	1.7	6/12/32	1.0	12/ 3/32	0.7	9/13/41	2.2
1/30/32	2.3	6/26/32	0.8	12/18/32	0.8	9/19/41	2.1
2/ 7/32	16	7/ 1/32	0.9	12/20/32	1.0	9/26/41	2.0
2/14/32	5.8	7/ 9/32	0.9	12/26/32	0.8	10/ 4/41	1.9
2/21/32	2.1	7/17/32	0.7	6/ 7/41	4.6	10/10/41	1.9
2/28/32	1.8	7/24/32	0.7	6/14/41	4.2	10/17/41	1.9
3/ 6/32	1.5	8/ 1/32	0.8	6/21/41	3.7	10/24/41	1.9
3/13/32	1.3	8/ 7/32	0.8	6/29/41	3.5	10/31/41	2.0
3/20/32	1.3	8/18/32	0.7	7/ 5/41	3.4	11/ 7/41	2.1
3/27/32	1.5	8/31/32	0.7	7/12/41	3.3	11/14/41	2.0
4/20/32	1.2	9/ 8/32	0.8	7/19/41	3.2	11/21/41	1.9
4/24/32	1.8	10/ 2/32	0.8	7/26/41	3.0	11/28/41	2.2
5/ 1/32	1.3	10/ 9/32	0.8	8/ 2/41	2.7	12/ 6/41	2.2

Reggiardo Creek at Diversion Dam, 4 miles north of State Highway 1, Northeast ¼ Section 25, Township 10 North, Range 3 West, M. D. B. & M.

Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
10/20/31	0.2	5/15/32	0.4	11/ 9/32	0.3	8/ 2/41	0.1
10/30/31	0.2	5/22/32	0.4	11/18/32	0.3	8/ 9/41	0.1
12/ 2/31	0.2	5/29/32	0.4	11/21/32	0.3	8/17/41	0.1
1/21/32	0.6	6/ 5/32	0.4	11/24/32	0.3	8/23/41	0.1
1/24/32	0.4	6/12/32	0.4	12/ 3/32	0.3	8/30/41	0.1
1/30/32	0.4	6/26/32	0.4	12/18/32	0.3	9/ 5/41	0.1
2/ 7/32	1.0	7/ 1/32	0.3	12/20/32	0.3	9/13/41	0.1
2/14/32	0.5	7/ 9/32	0.3	12/26/32	0.3	9/19/41	0.1
2/21/32	0.4	7/17/32	0.3	5/17/41	1.7	9/26/41	0.1
2/28/32	0.5	7/24/32	0.3	5/24/41	1.3	10/ 4/41	0.1
3/ 6/32	0.4	8/ 1/32	0.3	5/31/41	1.1	10/10/41	0.1
3/13/32	0.4	8/ 7/32	0.3	6/ 7/41	0.8	10/17/41	0.1
3/20/32	0.4	8/18/32	0.3	6/14/41	0.6	10/24/41	0.1
3/27/32	0.4	8/31/32	0.3	6/21/41	0.5	10/31/41	0.5
4/ 4/32	0.4	9/ 8/32	0.3	6/29/41	0.3	11/ 7/41	0.5
4/10/32	0.4	10/ 2/32	0.3	7/ 5/41	0.2	11/14/41	0
4/20/32	0.4	10/ 9/32	0.2	7/12/41	0.2	11/21/41	0
4/24/32	0.4	10/23/32	0.3	7/19/41	0.2	11/28/41	0.1
5/ 1/32	0.4	10/ 3/32	0.3	7/26/41	0.1	12/ 6/41	0.1
5/ 8/32	0.4						

TABLE 3

RECORDS OF PERIODIC WEIR MEASUREMENTS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by San Lorenzo Valley County Water District
(Discharge in second-feet)

Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
San Lorenzo River at Waterman Switch, 6 miles above town of Boulder Creek, Southwest ¼ Section 25, Township 8 South, Range 3 West, M. D. B. & M.							
10/ 4/45	0.8	8/ 3/48	1.0	3/18/50	1.8	12/29/50	5.3
10/16/45	0.5	9/12/48	0.4	3/25/50	5.8	1/ 7/51	3.8
11/11/45	1.9	10/10/48	0.9	4/ 2/50	2.4	1/14/51	5.9
11/24/45	1.7	11/ 8/48	0.7	4/ 9/50	3.3	1/21/51	14
1/18/46	610	12/12/48	0.7	4/15/50	2.3	1/28/51	7.9
1/28/46	6.0	1/12/49	1.6	4/21/50	1.8	2/ 4/51	5.3
2/10/46	6.0	7/11/49	0.7	4/30/50	1.4	2/11/51	11
3/ 8/46	4.3	7/19/49	0.6	5/ 7/50	1.5	2/18/51	5.3
3/30/46	24	7/31/49	0.8	5/13/50	1.3	2/25/51	5.0
4/ 5/46	16	8/ 7/49	0.6	5/21/50	1.2	3/ 3/51	5.6
4/20/46	11	8/14/49	0.7	5/27/50	1.1	3/10/51	16
5/ 8/46	3.9	8/21/49	0.6	6/ 3/50	0.9	3/18/51	7.6
6/11/46	2.4	8/31/49	0.6	6/10/50	0.9	3/24/51	5.6
6/29/46	1.9	9/ 3/49	0.4	6/17/50	0.9	3/31/51	5.0
7/ 8/46	1.7	9/11/49	0.4	6/25/50	0.7	4/ 7/51	4.1
7/20/46	1.3	9/18/49	0.3	7/ 2/50	0.5	4/14/51	3.6
9/ 6/46	1.1	9/25/49	0.4	7/ 7/50	0.4	4/22/51	3.1
10/10/46	1.0	10/ 2/49	0.2	7/18/50	0.4	4/27/51	2.8
11/ 5/46	7.7	10/ 9/49	0.2	7/21/50	0.4	5/ 5/51	3.3
12/ 4/46	3.1	10/16/49	0.4	7/28/50	0.4	5/13/51	2.5
1/13/47	1.5	10/23/49	0.4	8/ 5/50	0.3	5/18/51	2.3
2/ 9/47	3.8	10/30/49	0.2	8/12/50	0.3	5/26/51	2.1
3/ 9/47	5.1	11/ 6/49	0.5	8/19/50	0.2	6/ 1/51	1.6
4/12/47	e2.5	11/13/49	0.5	8/26/50	0.2	6/10/51	1.4
6/ 8/47	2.0	11/20/49	0.5	9/ 2/50	0.2	6/16/51	1.4
7/ 7/47	1.0	11/26/49	0.4	9/10/50	0.2	6/24/51	1.3
8/ 3/47	0.5	12/ 3/49	0.5	9/16/50	0.2	6/30/51	1.1
9/30/47	0.7	12/10/49	0.7	9/22/50	0.2	7/ 7/51	1.3
11/ 7/47	1.0	12/17/49	2.0	10/ 1/50	0.2	7/15/51	1.3
11/15/47	1.5	12/19/49	1.3	10/ 8/50	0.2	7/21/51	1.3
12/ 7/47	1.5	12/26/49	0.8	10/15/50	0.2	7/27/51	1.1
12/28/47	1.2	1/ 8/50	1.7	10/20/50	0.2	8/ 4/51	1.1
1/12/48	1.7	1/14/50	9.0	10/27/50	1.1	8/12/51	0.8
2/ 8/48	1.6	1/20/50	3.6	11/ 5/50	0.4	8/18/51	0.7
3/ 7/48	1.2	1/29/50	6.6	11/12/50	0.3	8/28/51	0.7
4/ 5/48	28	2/ 5/50	31	11/19/50	43	9/ 4/51	0.7
4/10/48	12	2/16/50	4.4	11/26/50	5.3	9/ 9/51	0.7
5/ 8/48	4.0	2/24/50	2.8	12/ 2/50	2.3	9/16/51	0.7
6/13/48	1.8	2/28/50	2.4	12/ 9/50	49	9/21/51	0.7
6/20/48	1.5	3/ 4/50	2.1	12/16/50	17	9/28/51	0.7
7/ 1/48	1.5	3/10/50	2.1	12/23/50	8.3		
Newell Creek near Ben Lomond, 1.1 miles above junction with San Lorenzo River, Northwest ¼ Section 3, Township 10 South, Range 2 West, M. D. B. & M.							
10/ 1/45	0.3	11/ 8/48	0.9	4/23/50	1.6	1/ 7/51	4.0
10/21/45	0.1	12/12/48	1.0	4/30/50	1.5	1/14/51	5.2
11/11/45	1.6	1/ 3/49	1.8	5/ 7/50	1.4	1/21/51	16
11/24/45	1.4	7/31/49	0.3	5/13/50	1.3	1/28/51	7.7
1/18/46	6.0	8/14/49	0.3	5/21/50	1.1	2/ 4/51	4.9
2/10/46	5.5	8/21/49	0.2	5/27/50	1.0	2/11/51	8.1
3/ 8/46	4.4	8/21/49	0.1	6/ 3/50	0.9	2/18/51	5.5
3/23/46	4.4	9/ 3/49	0.2	6/10/50	0.8	2/25/51	4.0
3/30/46	21	9/11/59	0.2	6/18/50	0.7	3/ 3/51	4.9
4/ 5/46	7.9	9/18/49	0.1	6/25/50	0.6	3/10/51	15
4/20/46	4.4	9/25/49	0.1	7/ 2/50	0.3	3/17/51	6.6
5/ 8/46	4.4	10/ 2/49	0.2	7/ 3/50	0.3	3/24/51	3.7
6/11/46	2.2	10/ 9/49	0.2	7/ 4/50	0.4	3/31/51	2.7
7/19/46	1.9	10/16/49	0.2	7/ 7/50	0.4	4/ 7/51	2.3
8/31/46	0.4	10/23/49	0.3	7/18/50	0.3	4/14/51	1.8
9/16/46	0.4	10/29/49	0.3	7/21/50	0.3	4/22/51	1.3
10/10/46	0.4	11/ 6/49	0.3	7/28/50	0.3	4/27/51	1.3
11/ 3/46	0.4	11/13/49	0.6	8/ 5/50	0.3	5/ 5/51	2.7
2/ 8/46	4.7	11/20/49	0.4	8/12/50	0.3	5/13/51	1.3
1/13/47	2.4	11/26/49	0.4	8/19/50	0.2	5/18/51	1.0
2/ 9/47	4.4	12/ 3/49	0.4	8/26/50	0.2	5/25/51	0.6
3/13/47	4.7	12/10/49	0.6	9/ 2/50	0.2	6/ 1/51	2.3
1/11/47	5.5	12/19/49	3.8	9/10/50	0.2	6/10/51	2.1
4/27/47	1.6	12/26/49	0.7	9/17/50	0.3	6/16/51	1.8
5/11/47	1.6	1/ 8/50	4.2	9/22/50	0.2	6/24/51	1.4
6/ 7/47	1.1	1/14/50	24	10/ 1/50	0.2	6/30/51	1.4
7/ 7/47	0.6	1/20/50	4.0	10/ 8/50	0.2	7/ 7/51	1.0
18/ 3/47	0.6	1/29/50	13	10/15/50	0.2	7/15/51	1.0
10/13/47	0.5	2/ 5/50	115	10/22/50	0.3	7/21/51	0.8
1/ 7/47	0.9	2/17/50	8.1	10/27/50	2.0	7/27/51	0.6
1/11/48	1.3	2/23/50	4.2	11/ 5/50	1.4	8/ 4/51	0.7
2/ 9/48	1.8	2/28/50	3.4	11/12/50	1.1	8/12/51	0.6
3/ 7/48	0.9	3/ 4/50	1.6	11/19/50	19	8/18/51	0.6
4/ 4/48	34	3/10/50	2.5	11/26/50	5.9	8/28/51	0.5
5/ 8/48	4.4	3/18/50	1.8	12/ 2/50	2.9	9/ 4/51	0.5
6/13/48	1.0	3/25/50	3.9	12/ 9/50	54	9/ 9/51	0.4
7/ 2/48	1.0	4/ 2/50	1.4	12/16/50	21	9/16/51	0.5
8/ 4/48	0.4	4/ 9/50	4.2	12/23/50	8.5	9/21/51	0.4
9/12/48	0.5	4/15/50	2.1	12/29/50	4.9	9/28/51	0.6
10/ 4/48	0.7						

TABLE 3—Continued

RECORDS OF PERIODIC WEIR MEASUREMENTS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by San Lorenzo Valley County Water District
(Discharge in second-feet)

Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
Kings Creek near Town of Boulder Creek, 4.5 miles above junction with San Lorenzo River, Northeast ¼ Section 30, Township 8 South, Range 2 West, M. D. B. & M.							
11/ 5/46	0.2	4/12/47	2.4	1/10/48	1.4	6/12/48	2.1
11/15/46	0.2	5/ 9/47	1.4	2/ 8/48	1.4	6/20/48	1.9
12/ 5/46	0.6	6/ 8/47	1.2	3/ 7/48	1.2	8/ 3/48	0.1
1/13/47	0.3	7/ 7/47	0.3	4/ 6/48	14	11/ 7/48	0.1
2/ 9/47	2.5	11/ 7/47	0.9	4/11/48	6.8	12/12/48	0.7
3/ 9/47	2.8	12/ 7/47	1.4	5/ 8/48	3.5	1/10/49	1.8
Boulder Creek at China Grade, 4.5 miles north of Town of Boulder Creek, Southwest ¼ Section 2, Township 9 South, Range 3 West, M. D. B. & M.							
11/11/45	0.3	4/ 5/46	3.8	1/13/47	0.1	1/ 4/48	0.1
11/24/45	0.4	4/20/46	2.1	2/ 9/47	1.7	2/ 8/48	0.3
1/18/46	0.4	5/ 3/46	1.1	3/ 9/47	1.3	3/ 7/48	0.1
2/11/46	1.3	6/11/46	0.3	4/11/47	1.1	4/10/48	4.9
3/ 8/46	1.5	7/ 9/46	0.2	5/11/47	0.2	6/13/48	0.5
3/30/46	10	12/ 5/46	0.1	6/ 7/47	0.2	7/ 6/48	0.1
Fall Creek near Felton, 1 mile northwest of Felton, Southeast ¼ Section 16, Township 10 South, Range 2 West, M. D. B. & M.							
10/ 5/45	2.8	5/ 8/46	9.4	1/ 8/47	5.3	9/29/47	2.3
11/11/45	4.7	6/11/46	8.3	1/13/47	5.9	10/13/47	2.3
11/24/45	5.2	7/19/46	6.9	2/ 9/47	5.9	11/ 7/47	2.3
1/18/46	5.5	8/31/46	5.0	3/ 9/47	7.3	11/30/47	2.3
2/10/46	10	9/ 6/46	5.0	4/12/47	6.9	12/10/47	5.0
3/ 7/46	9.4	10/10/46	3.6	5/11/47	6.2	2/ 8/48	3.5
3/23/46	9.8	11/ 3/46	4.6	6/ 8/47	6.2	3/ 7/48	3.1
3/30/46	15	11/12/46	4.7	7/ 7/47	4.7	4/ 5/48	8.7
4/ 5/46	12	12/ 5/46	7.1	8/ 4/47	4.1	5/16/48	0.3
4/20/46	9.8	12/29/46	7.1	9/22/47	2.3		
Bear Creek near Town of Boulder Creek, 1.7 miles above junction with San Lorenzo River, Northwest ¼ Section 21, Township 9 South, Range 2 West, M. D. B. & M.							
10/ 4/45	0.5	7/ 9/46	1.7	7/ 7/47	0.7	4/10/48	45
11/11/45	2.1	9/ 6/46	0.5	8/ 3/47	0.1	5/ 8/48	13
11/24/45	1.9	10/ 9/46	0.5	8/31/47	0.3	6/13/48	2.6
1/18/46	14	11/ 5/46	1.5	9/30/47	0.1	7/11/48	2.0
2/11/46	9.4	12/ 4/46	4.4	11/ 7/47	3.3	8/ 3/48	1.1
3/ 8/46	6.8	1/13/47	4.9	12/ 6/47	2.1	9/11/48	0.1
3/30/46	35	2/ 9/47	17	1/ 4/48	3.4	10/10/48	0.4
4/ 5/46	16	3/ 9/47	9.4	2/ 6/48	4.4	11/ 8/48	1.2
4/20/46	7.5	4/12/47	6.8	3/ 6/48	4.4	12/12/48	1.2
5/ 8/46	5.3	5/11/47	3.3	4/ 5/48	94	1/10/49	4.7
6/11/46	4.1	6/ 8/47	2.0				

[e] Estimated.

TABLE 4

RECORDS OF INTERMITTENT MEASUREMENTS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Santa Cruz Portland Cement Company

(Discharge in secand-feet)

Date	Discharge	Date	Discharge
San Vicente Creek at Santa Cruz Portland Cement Company Dam, 3 miles north of Davenport, Southwest ¼ Section 15, Township 10 South, Range 3 West, M.D.B.&M.			
4/12/46	8.6	9/22/48	1.6
5/23/46	6.0	10/18/48	1.4
6/12/46	4.4	10/29/48	1.4
7/30/46	2.4	11/ 4/48	1.8
8/22/46	2.0	11/22/48	1.2
10/ 2/46	1.4	12/ 6/48	2.2
10/30/46	1.6	12/20/48	2.7
12/18/46	2.3	1/ 5/49	4.3
1/ 8/47	2.0	2/23/49	7.4
2/ 6/47	2.0	3/18/49	25.0
3/14/47	6.0	3/26/49	21.0
4/22/47	3.1	4/21/49	10.0
5/28/47	2.0	5/ 3/49	8.3
6/24/47	1.3	5/11/49	7.4
7/ 8/47	1.8	6/ 7/49	5.3
8/12/47	1.1	6/28/49	4.0
9/ 3/47	0.7	7/14/49	3.1
9/26/47	0.6	8/29/49	2.2
10/31/47	2.1	9/14/49	1.9
11/12/47	1.5	10/18/49	1.8
12/15/47	1.6	11/15/49	2.0
1/14/48	3.1	11/30/49	1.8
2/10/48	3.7	12/ 5/49	1.9
3/ 6/48	1.9	12/22/49	2.9
3/22/48	3.7	12/29/49	3.0
4/13/48	10.4	2/22/50	12.6
5/ 5/48	10.4	4/19/50	8.3
7/ 7/48	3.4	9/ 5/50	1.3
8/13/48	2.0	4/26/51	13.2
8/24/48	2.0		

APPENDIX E

RECORDS OF DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

TABLE OF CONTENTS

RECORDS OF DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

The wells were numbered by the system utilized by the United States Geological Survey. An explanation of the numbering system is given on page 32 of this bulletin.

Reference point elevations given to the nearest foot have been estimated from United States Geological Survey topographic maps. Reference point elevations given to the nearest 0.1 foot have been established by field surveys.

TABLE 1

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

10S/1W-26E1—Reference point—top of casing, elevation 280 feet. 0.05 mile west of Olive Springs Road, 0.45 mile northeast of Soquel-San Jose Road. 12/14/48, 63.4; 2/16/49, 72.5; 5/5/49, 63.7; 6/3/49, 66.0; 11/14/49, 65.0; 11/13/50, 66.6; 3/30/51, 63.2; 12/5/51, 68.0.

10S/1W-27J1—Reference point—slot in base, elevation 197.5 feet. 200 feet west of Soquel-San Jose Road, 0.2 mile south of junction of Soquel-San Jose and Olive Springs Roads. 12/14/48, 60.6; 4/12/49, 60.8; 11/14/49, 61.0; 3/23/50, 61.5; 4/6/52, 62.5.

10S/1W-34A1—Reference point—bottom flange of pump base, elevation 175 feet. 100 feet east of Soquel-San Jose Road, 0.7 mile south of junction of Soquel-San Jose and Olive Springs Roads. 12/14/48, 75.2; 1/15/49, 75.2; 2/16/49, 75.8; 4/12/49, 75.8; 5/5/49, 76.1; 6/3/49, 77.9; 7/1/49, 76.9; 8/3/49, 78.8; 9/2/49, 78.9; 11/10/49, 75.8; 3/23/50, 76.1; 11/13/50, 76.6; 3/30/51, 82.4; 12/5/51, 76.3; 4/6/52, 79.6.

10S/1W-34Q1—Reference point—2-inch plug on side of pump, elevation 137.6 feet. 0.1 mile west of Soquel-San Jose Road, 1.1 miles north of Hill Top Road. 10/20/48, 57.2; 12/17/48, 57.3; 4/12/49, 56.6; 11/10/49, 57.7; 3/23/50, 57.0; 11/13/50, 57.6; 3/30/51, 56.7; 12/5/51, 58.1; 4/6/52, 57.4.

11S/1W-3A1—Reference point—½-inch hole in pump base, elevation 84.6 feet. 0.15 mile west of Cherry Vale Road, 1.0 mile north of junction of Glen Haven and Cherry Vale Roads. 10/20/48, 24.0; 12/17/48, 19.6; 1/15/49, 19.3; 2/16/49, 19.9; 4/12/49, 18.7; 5/5/49, 29.3 (oper.); 6/3/49, 19.4; 7/1/49, 19.6; 8/3/49, 31.6 (oper.); 9/2/49, 20.1; 11/10/49, 20.0; 3/23/50, 18.8; 11/13/50, 20.2; 3/30/51, 20.8; 12/5/51, 18.9; 4/6/52, 19.1.

11S/1W-3B1—Reference point—top of casing, elevation 130.0 feet. 300 feet west of Soquel-San Jose Road, 1.0 mile north of Hill Top Road. 12/17/48, 66.5; 4/12/49, 64.7; 11/10/49, 67.1; 3/23/50, 70.4; 3/30/51, 66.9; 12/5/51, 67.7; 4/4/52, 69.0.

11S/1W-3G1—Reference point—top of casing (lift cover), elevation 111.6 feet. 400 feet west of Soquel-San Jose Road, 0.6 mile north of Hill Top Road. 10/29/48, 38.1; 12/17/48, 37.8; 1/15/49, 37.7; 2/16/49, 37.4; 4/12/49, 37.1; 5/5/49, 39.5; 6/3/49, 37.5; 7/1/49, 37.6; 8/3/49, 37.6; 9/2/49, 37.8; 11/10/49, 38.1; 3/23/50, 37.5; 11/13/50, 38.2; 3/30/51, 37.0; 12/5/51, 38.2; 4/6/52, 37.2.

11S/1W-3H1—Reference point—top of casing, elevation 93.2 feet. 100 feet west of Cherry Vale Road, 0.6 mile north of junction of Cherry Vale and Glen Haven Roads. 12/23/48, 41.4; 4/12/49, 39.9; 11/10/49, 44.5; 3/23/50, 40.9; 3/30/51, 39.0; 12/5/51, 39.7.

11S/1W-3R1—Reference point—top of casing, elevation 53.1 feet. 250 feet west of Cherry Vale Road, 0.24 mile north of junction of Cherry Vale and Glen Haven Roads. 12/23/48, 5.5; 4/12/49, 4.7; 11/10/49, 7.2; 3/23/50, 5.9; 3/30/51, 2.9; 12/5/51, 2.3; 4/6/52, 0.2.

11S/1W-9L1—Reference point—slot under pump base, elevation 125 feet. 100 feet south of State Highway 56B, 0.10 mile east of Chanticlear Avenue. 12/23/48, 74.1; 1/15/49, 74.0; 2/16/49, 73.7; 4/12/49, 72.6; 5/5/49, 76.9; 6/3/49, 77.2; 7/1/49, 77.8; 8/3/49, 71.5; 9/2/49, 71.2; 11/10/49, 73.3; 3/23/50, 73.8; 11/13/50, 77.2; 3/30/51, 65.8; 12/5/51, 61.3; 4/6/52, 78.2.

11S/1W-10A1—Reference point—hole in concrete base, elevation 105.0 feet. 0.1 mile due south of junction of Cherry Vale and Glen Haven Roads. 12/21/48, 64.0; 4/12/49, 62.8; 3/30/51, 61.9; 12/5/51, 63.3.

11S/1W-10C1—Reference point—slot in concrete pump base, elevation 91.6 feet. 0.18 mile west of Soquel-San Jose Road, 0.35 mile north of intersection of State Highway 56B and Soquel-San Jose Road. 12/21/48, 75.7; 2/16/49, 63.4; 4/12/49, 61.4; 5/5/49, 65.5; 6/3/49, 64.3; 11/14/49, 65.0; 3/23/50, 69.3; 11/13/50, 67.1; 3/30/51, 61.6; 12/5/51, 64.8; 4/6/52, 63.1.

11S/1W-10Q1—Reference point—top of 4″ x 6″ cross brace, elevation 75 feet. 0.15 mile west of Capitola Avenue, 0.3 mile south of State Highway 56B. 12/22/48, 83.4; 1/15/49, 78.5; 2/16/49, 78.6; 4/12/49, 77.6; 5/5/49, 78.2; 6/3/49, 80.0; 7/1/49, 78.9; 8/3/49, 81.7; 9/2/49, 79.4; 11/10/49, 82.0; 3/23/50, 80.8; 11/13/50, 80.2; 3/30/51, 77.2; 12/3/51, 78.2.

11S/1W-15B1—Reference point—oval hole in pump base, elevation 36.0 feet. 300 feet northeast of Bay Street, 0.2 mile southeast of turn in Porter Road. 11/22/48, 15.0; 4/12/49, 13.1; 11/10/49, 15.0; 3/30/51, 11.7; 12/5/51, 13.2; 4/6/52, 10.2.

11S/1W-15E1—Reference point—hole in side of pump base, elevation 86.6 feet. 0.15 mile west of 41st Street, 0.2 mile north of Lower Soquel Road. 12/23/48, 71.8; 4/12/49, 60.1; 11/10/49, 63.2; 11/13/50, 72.1; 3/30/51, 69.3; 12/4/51, 63.9.

11S/1W-15F1—Reference point—top of 6″ x 6″ cross brace, elevation 95.1 feet on southwest corner of intersection of Rodeo Street and 46th Avenue. 12/22/48, 79.4; 4/12/49, 70.3; 11/10/49, 73.4; 3/23/50, 70.5; 11/13/50, 75.3; 3/30/51, 84.2; 12/4/51, 76.0.

11S/1W-15H1—Reference point—edge of concrete base, elevation 92.2 feet. 150 feet west of Monterey Avenue, 0.2 mile northeast of junction of Monterey Avenue and Bay Street. 12/21/48, 43.1; 3/23/50, 50.9; 3/30/51, 45.3; 12/5/51, 41.8; 4/6/52, 45.6.

11S/1W-15L1—Reference point—top of casing, elevation 76.1 feet. 0.15 mile west of 41st Street, 0.10 mile south of Lower Soquel Road. 12/22/48, 51.0; 1/15/49, 50.8; 2/16/49, 50.4; 4/5/49, 51.0; 7/1/49, 95.6 (oper.); 9/2/49, 57.7; 11/10/49, 55.8; 3/23/50, 60.9; 11/13/50, 58.7; 12/4/51, 56.5.

11S/1W-15N1—Reference point—top of steel support (take up floor boards), elevation 62.9 feet. 150 feet west of 41st Avenue, 900 feet north of Southern Pacific Railroad. 12/23/48, 42.8; 4/2/49, 42.5; 11/10/49, 42.8; 3/23/50, 45.2; 3/30/51, 41.8; 12/5/51, 41.5; 4/6/52, 40.2.

11S/1W-15P1—Reference point—½-inch hole in pump base, elevation 79.2 feet. 100 feet north of Garnet Street, 0.1 mile west of 49th Avenue. 12/23/48, 71.3; 4/12/49, 58.8; 3/30/51, 66.9; 12/5/51, 82.2.

11S/1W-16R1—Reference point—top of casing, elevation 58.0 feet. 100 feet south of Bulb Avenue, 0.13 mile east of Thompson Avenue. 12/23/48, 38.6; 4/12/49, 38.0; 11/10/49, 38.7; 3/23/50, 36.3; 11/13/50, 39.1; 12/5/51, 37.2; 4/6/52, 37.6.

11S/1W-21B1—Reference point—top of casing, elevation 55.6 feet. 600 feet east of Houghton Avenue, 0.15 mile north of Capitola Drive. 12/24/48, 39.8; 1/15/49, 38.7; 2/16/49, 39.4; 4/12/49, 38.8; 11/9/49, 39.4; 3/30/51, 42.0; 12/5/51, 38.0; 4/6/52, 35.5.

11S/1W-21H1—Reference point—top of flange on base of pump, elevation 39.3 feet. 0.1 mile west of 38th Avenue, 400 feet north of Capitola Drive. 12/27/48, 20.9; 4/12/49, 21.4; 5/5/49, 21.0; 6/3/49, 20.5; 7/1/49, 20.9; 8/3/49, 20.5; 9/2/49, 20.6; 11/10/49, 20.5; 3/23/50, 19.7; 11/13/50, 19.9; 3/30/51, 18.6; 12/5/51, 19.1; 4/6/52, 17.1.

11S/1W-21K1—Reference point—top of blocks in pit, elevation 8.2 feet. 150 feet east of Houghton Avenue, 0.17 mile south of Capitola Drive. 12/24/48, 1.2; 11/9/49, 3.8; 3/30/51, 3.9; 12/5/51, 2.8.

11S/1E-12M1—Reference point—top of casing, elevation 400 feet. 0.60 mile west of intersection of Happy Valley and West Corralitos Roads. 12/4/47, 52.5; 3/12/48, 52.5; 12/6/48, 52.2; 4/8/49, 54.7; 11/4/49, 52.2.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

11S/1E-12Q1—Reference point—hole in pump base, elevation 260.4 feet. On west side of West Corralitos Road, 0.20 mile south of Happy Valley Road. 3/25/47, 93.8; 8/7/47, 102.7; 11/18/47, 105.4; 3/11/48, 112.0; 12/6/48, 110.0; 4/8/49, 110.2; 11/4/49, 112.0; 3/21/50, 105.2; 11/12/50, 113.4; 3/28/51, 91.5; 11/19/51, 105.1; 4/6/52, 82.9.

11S/1E-12R1—Reference point—top of casing, elevation 260 feet. West side of East Corralitos Road, 1.12 miles north of Varni Road. 7/29/47, 86.8; 11/18/47, 91.3; 2/25/48, 91.3; 12/6/48, 95.7; 1/15/49, 96.3; 3/25/49, 27.3; 11/3/49, 95.4.

11S/1E-13A1—Reference point—top of casing, elevation 241.8 feet. On east side of West Corralitos Road, 0.42 mile south of Happy Valley Road. 3/25/49, 110.2; 7/21/49, 114.0; 11/3/49, 113.6; 11/12/50, 115.5.

11S/1E-13C1—Reference point—hole in pump base, elevation 325.0 feet. 0.63 mile west of West Corralitos Road, 0.35 mile south of Happy Valley Road. 12/4/47, 48.9; 3/2/48, 59.0; 4/8/49, 67.0; 11/4/49, 79.4.

11S/1E-13G1—Reference point—top of casing, elevation 237 feet. 0.10 mile west of West Corralitos Road. 3/25/47, 94.1; 8/7/47, 98.9; 11/18/47, 101.4; 3/12/48, 102.5; 12/6/48, 104.2; 4/8/49, 105.8; 11/4/49, 112.0; 3/21/50, 104.2; 11/12/50, 114.2; 3/28/51, 103.9; 11/19/51, 109.8; 4/6/52, 86.8.

11S/1E-13H1—Reference point—top of casing, elevation 240.2 feet. 0.10 mile east of West Corralitos Road, 0.68 mile south of Happy Valley Road. 11/3/49, 77.7.

11S/1E-13J1—Reference point—top of casing, elevation 224.3 feet. On west side of West Corralitos Road, 0.68 mile north of Varni Road. 7/29/47, 58.1; 11/18/47, 57.3; 3/12/48, 58.5; 12/2/48, 63.9.

11S/1E-13J2—Reference point—hole in side of pump base, elevation 228.7 feet. 0.08 mile east of West Corralitos Road, 0.60 mile north of Varni Road. 3/21/47, 61.7; 8/7/47, 64.6; 11/18/47, 65.1; 3/11/48, 67.0; 12/2/48, 68.5; 3/25/49, 64.0; 7/21/49, 69.7; 11/9/49, 69.0; 3/22/50, 70.8; 11/12/50, 73.8; 4/3/51, 53.2; 11/19/51, 68.0; 4/7/52, 55.9.

11S/1E-24F1—Reference point—top of casing, elevation 195.0 feet. 0.06 mile west of Freedom Boulevard, 0.15 mile northwest of West Corralitos Road. 10/2/47, 14.9; 12/4/47, 15.9; 12/5/47, 19.9; 3/12/48, 19.0.

11S/1E-24H1—Reference point—base of pump, elevation 198 feet. 0.19 mile east of West Corralitos Road, 0.25 mile south of Varni Road. 7/29/47, 47.9; 12/4/47, 43.6; 12/2/48, 45.9; 3/25/49, 43.8.

11S/1E-24H2—Reference point—hole in top of casing, elevation 185.7 feet. 0.09 mile northeast of Freedom Boulevard, 0.28 mile southeast of West Corralitos Road. 3/21/47, 34.6; 6/26/47, 56.6; 7/29/47, 45.5; 12/2/47, 37.7; 1/25/48, 37.8; 2/16/48, 37.7; 12/2/48, 40.0; 1/15/49, 39.8; 2/17/49, 39.5; 3/25/49, 37.9; 11/3/49, 41.7; 3/22/50, 38.8; 11/12/50, 42.1.

11S/1E-24J1—Reference point—plug in pipe, elevation 181 feet. On southwest side of Freedom Boulevard, 0.34 mile southeast of West Corralitos Road. 3/20/47, 32.1; 8/7/47, 37.6; 12/2/47, 35.1; 1/28/48, 34.3; 2/16/48, 34.7; 12/2/48, 37.0; 1/15/49, 36.9; 2/17/49, 36.5; 4/8/49, 35.0; 5/3/49, 39.9; 6/2/49, 40.1; 6/29/49, 92.0 (oper.); 8/3/49, 44.5; 9/2/49, 39.4; 11/1/49, 38.8; 3/21/50, 36.4; 11/12/50, 39.7; 3/28/51, 31.2; 11/19/51, 34.7; 4/6/52, 31.2.

11S/1E-24J2—Reference point—top of casing, elevation 177.5 feet. On southwest side of Freedom Boulevard, 0.49 mile southeast of West Corralitos Road. 7/29/47, 23.0; 12/2/47, 16.9; 3/12/48, 17.4; 12/2/48, 19.2; 4/8/49, 12.1; 11/4/49, 15.7.

11S/1E-24P1—Reference point—top of casing, elevation 300 feet. On southwest side of Calabasas Road, 2.15 miles northwest of Freedom Boulevard. 7/29/47, 45.1; 12/4/47, 71.6.

11S/1E-24P2—Reference point—top of casing, elevation 280 feet. On northeast side of Calabasas Road, 2.15 miles northwest of Freedom Boulevard. 7/29/47, 157.8; 12/4/47, 150.0; 12/5/47, 158.6; 1/28/48, 154.4; 2/17/48, 159.0; 12/14/48, 161.4; 4/8/49, 165.2.

11S/1E-24Q1—Reference point—base of pump, elevation 181.7 feet. 0.1 mile northeast of Calabasas Road, 0.25 mile northwest of intersection of Calabasas and West Corralitos Roads. 8/20/47, 42.4; 12/4/47, 37.3; 3/12/48, 39.0; 12/2/48, 39.0; 4/8/49, 38.2; 11/4/49, 41.1; 3/21/50, 40.1; 11/19/51, 39.5.

11S/1E-24R1—Reference point—top of casing, elevation 173.0 feet. 0.25 mile southwest of Freedom Boulevard, 0.60 mile southeast of West Corralitos Road. 3/25/47, 26.0; 5/15/47, 30.2; 7/29/47, 34.9; 12/2/47, 30.3; 3/12/48, 33.0; 12/2/48, 36.1; 4/8/49, 34.7; 11/4/49, 42.5.

11S/1E-24R2—Reference point—hole in pump base, elevation 175.6 feet. 0.05 mile southwest of Freedom Boulevard, 0.55 mile southeast of West Corralitos Road. 3/25/47, 27.9; 4/25/47, 28.9; 5/2/47, 28.4; 5/9/47, 34.9; 5/15/47, 32.1; 5/22/47, 32.9; 5/28/47, 33.0; 6/4/47, 32.3; 6/9/47, 32.0; 6/11/47, 31.3; 6/18/47, 42.7; 6/25/47, 50.2; 7/2/47, 47.1; 7/10/47, 40.4; 7/16/47, 36.3; 7/23/47, 40.4; 7/30/47, 35.8; 8/6/47, 34.4; 8/13/47, 38.6; 8/20/47, 37.7; 8/27/47, 32.6; 9/3/47, 32.3; 9/10/47, 32.0; 9/17/47, 32.3; 9/23/47, 32.4; 9/30/47, 32.4; 10/7/47, 32.2; 10/14/47, 31.7; 10/22/47, 31.5; 10/28/47, 31.4; 11/4/47, 31.3; 11/12/47, 31.2; 11/18/47, 31.2; 12/2/47, 30.9; 3/12/48, 31.0; 12/2/48, 33.0; 4/8/49, 31.4; 6/13/49, 41.5; 6/20/49, 50.2; 11/9/49, 44.8; 3/21/50, 42.5; 11/12/50, 35.1; 3/21/51, 31.3; 11/19/51, 15.5; 4/6/52, 31.8.

11S/1E-25A1—Reference point—hole in pump base, elevation 230 feet. 500 feet northeast of Calabasas Road, 0.2 mile southeast of Calabasas School. 10/2/47, 75.0; 12/2/47, 74.0; 3/12/48, 73.7; 12/2/48, 75.9; 4/8/49, 77.3; 11/4/49, 78.0.

11S/1E-25G1—Reference point—hole in pump base, elevation 205 feet. 0.25 mile southwest of Calabasas Road, 0.40 mile southeast of West Corralitos Road. 10/30/47, 69.9; 12/4/47, 69.4; 3/8/48, 69.0; 12/2/48, 71.1; 1/15/49, 71.0; 2/17/49, 70.7; 4/8/49, 73.5; 11/4/49, 73.0.

11S/1E-24H1—Reference point—top of casing, elevation 202 feet. On southwest side of Calabasas Road, 0.32 mile southeast of West Corralitos Road. 3/12/48, 63.5; 12/2/48, 66.2; 4/8/49, 61.1; 11/4/49, 74.2.

11S/1E-25R1—Reference point—hole in pump base, elevation 750 feet. On south side of Buena Vista Drive, 0.90 mile west of Calabasas Road. 3/25/47, 167.8; 7/29/47, 170.2; 12/23/47, 168.0; 3/12/48, 168.2; 12/14/48, 169.0; 4/8/49, 173.2; 11/3/49, 188.7.

11S/1E-36J1—Reference point—top of casing, elevation 230 feet. 0.12 mile north of State Highway No. 1, 0.52 mile east of Buena Vista Drive. 2/27/47, 79.5; 7/16/47, 115.6; 8/4/47, 131.7; 12/15/47, 131.1; 12/22/47, 129.8; 3/13/48, 130.0; 12/15/48, 127.6; 11/4/49, 136.0.

11S/1E-36P1—Reference point—top of casing, elevation 175 feet. On east side of Buena Vista Drive, 0.40 mile south of State Highway No. 1. 2/26/47, 172.4; 7/16/47, 174.4; 12/22/47, 173.5; 3/13/48, 176.4; 11/19/48, 176.4; 12/16/48, 184.1; 3/30/49, 173.0.

11S/2E-8D1—Reference point—hole in side of pump, elevation 335.0 feet. 0.3 mile west of Green Valley Road, 1.5 miles north of Murphy Road. 3/22/47, 222.3; 6/26/47, 212.0; 7/27/47, 209.2; 11/5/47, 211.8; 1/25/48, 213.0; 2/17/48, 216.0; 12/8/48, 213.3; 9/2/49, 215.3; 11/2/49, 222.0; 11/12/50, 224.0; 4/4/51, 219.1; 11/20/51, 224.9.

11S/2E-8F1—Reference point—top of casing, elevation 260.0 feet. 200 feet east of Green Valley Road, 1.1 miles north of Murphy Road. 3/22/47, 36.6; 8/20/47, 38.7; 11/14/47, 38.8; 3/10/48, 41.0; 4/6/49, 38.3; 11/12/49, 36.2.

11S/2E-8F2—Reference point—hole in base, elevation 260.0 feet. 200 feet west of Green Valley Road, 1.0 mile north of Murphy Road. 5/8/47, 184.6; 6/26/47, 186.5; 8/7/47, 185.9; 11/14/47, 186.3; 2/17/48, 186.0; 12/8/48, 188.9; 5/3/49, 191.5; 6/2/49, 189.9; 9/2/49, 193.8; 11/2/49, 193.8.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

11S/2E-8L1—Reference point—hole in casing, elevation 240.0 feet. 100 feet west of Green Valley Road, 0.7 mile north of Murphy Road. 3/22/47, 168.3; 8/7/47, 171.1; 11/5/47, 170.2; 1/25/48, 170.0; 2/17/48, 170.0; 3/10/48, 170.0; 12/8/48, 173.9; 4/6/49, 174.2; 4/14/49, 174.3; 5/3/49, 174.8; 7/1/49, 180.3; 8/3/49, 176.4; 9/2/49, 176.6; 11/2/49, 176.4; 3/22/50, 176.7; 11/12/50, 179.5; 4/4/51, 170.6; 11/20/51, 178.3; 4/7/52, 173.8.

11S/2E-8P1—Reference point—hole in pump base, elevation 225.0 feet. 200 feet west of Green Valley Road, 0.4 mile north of Murphy Road. 7/27/47, 166.2; 11/14/47, 166.1; 3/10/48, 168.0.

11S/2E-14P1—Reference point—top of casing, elevation 285.0 feet. 1.1 miles east of Hazel Dell Road, 0.2 mile north of Mt. Madonna Road. 3/12/47, 243.0; 7/27/47, 244.1; 11/16/47, 246.5; 3/10/48, 244.2; 12/9/48, 245.9; 11/1/49, 269.0.

11S/2E-15F1—Reference point—hole in top of casing, elevation 165.0 feet. 250 feet west of Hazel Dell Road, 0.2 mile north of Connell Road. 3/14/47, 68.2; 8/6/47, 67.4; 11/16/47, 60.4; 12/9/48, 66.2; 4/6/49, 65.6; 11/1/49, 66.0.

11S/2E-15L1—Reference point—top of casing, elevation 141.5 feet. 150 feet east of Hazel Dell Road, 0.3 mile south of Connell Road. 7/27/47, 61.3; 3/10/48, 52.0; 12/17/48, 55.0; 11/9/49, 51.7.

11S/2E-15M1—Reference point—hole in pump base, elevation 111.5 feet. 50 feet south of Connell Road, 0.35 mile west of Hazel Dell Road. 5/15/47, 57.2; 8/20/47, 74.4; 11/14/47, 49.8; 12/23/47, 40.9; 1/21/48, 37.5; 3/10/48, 45.0; 4/6/49, 39.3; 7/1/49, 68.4; 11/9/49, 80.0; 4/3/51, 81.9.

11S/2E-15M2—Reference point—top of casing, elevation 108.0 feet. 0.1 mile south of Connell Road, 0.2 mile west of Hazel Dell Road. 4/6/49, 47.6.

11S/2E-15Q1—Reference point—hole in pump base, elevation 151.7 feet. 200 feet east of Hazel Dell Road, 0.35 mile south of Connell Road. 3/14/47, 85.2; 7/27/47, 120.0; 11/16/47, 95.0; 3/10/48, 88.8; 12/9/48, 92.0; 3/24/49, 82.1; 7/5/49, 124.1; 7/11/49, 122.2; 11/9/49, 118.7; 3/22/50, 111.1; 11/12/50, 113.5; 4/3/51, 109.1; 11/20/51, 111.7; 4/4/52, 102.5.

11S/2E-15Q2—Reference point—slot in concrete base, elevation 136.3 feet. 50 feet east of Hazel Dell Road, 0.6 mile south of Connell Road. 3/14/47, 37.2; 7/27/47, 53.5; 10/11/47, 45.6; 11/5/47, 44.8; 11/16/47, 44.7; 1/25/48, 45.3; 2/16/48, 45.0; 12/9/48, 47.0; 1/15/49, 46.5; 2/17/49, 45.9; 3/24/49, 42.1; 11/1/49, 46.8; 3/22/50, 50.5; 11/11/50, 53.7; 11/20/51, 49.0; 4/4/52, 39.5.

11S/2E-16M1—Reference point—top of casing, elevation 180.0 feet. 0.1 mile north of Connell Road, 0.1 mile east of Murphy Road. 3/22/47, 21.4; 7/27/47, 23.1; 11/16/47, 22.9; 3/10/48, 22.0; 12/9/48, 20.2; 4/6/49, 14.2; 11/1/49, 17.7.

11S/2E-16N1—Reference point—air gage hole, elevation 131.1 feet. 0.15 mile south of Connell Road, 0.2 mile east of Murphy Road. 3/14/47, 47.0; 7/27/47, 65.1; 11/16/47, 55.8; 3/10/48, 52.0; 12/9/48, 54.3; 3/24/49, 46.2; 11/2/49, 74.5; 3/22/50, 56.9; 4/3/51, 57.8; 11/20/51, 86.6; 4/4/52, 73.6.

11S/2E-16P1—Reference point—top of casing, elevation 123.0 feet. 0.15 mile south of Connell Road, 0.25 mile east of Murphy Road. 3/14/47, 55.0; 11/16/47, 55.7.

11S/2E-17A1—Reference point—top of casing, elevation 230.0 feet. 150 feet east of Murphy Road, 0.5 mile north of Green Valley Road. 6/18/47, 19.3; 6/23/47, 20.4; 6/25/47, 21.0; 7/2/47, 20.8; 7/7/47, 20.2.

11S/2E-17E1—Reference point—opening between 1″ blocks under pump base, elevation 195 feet. 0.20 mile west of Green Valley Road, 0.15 mile south of Murphy Road. 11/16/47, 149.4; 3/10/48, 149.0; 12/9/48, 151.1; 4/6/49, 150.5; 11/2/49, 156.3; 3/22/50, 154.0; 11/12/50, 155.6; 4/3/51, 132.1; 11/20/51, 164.6; 4/7/52, 154.8.

11S/2E-17F1—Reference point—hole in side of pump, elevation 202.0 feet. 150 feet west of junction of Green Valley and Murphy Roads. 3/22/47, 143.2; 7/27/47, 160.3; 11/14/47, 159.6; 3/10/48, 157.0; 11/2/49, 169.1.

11S/2E-17K1—Reference point—top of casing, elevation 195.0 feet. 150 feet east of Green Valley Road, 0.25 mile north of Varni Road. 3/22/47, 142.7; 5/8/47, 135.3; 12/5/47, 135.5; 1/25/48, 135.1; 3/10/48, 135.0.

11S/2E-17R1—Reference point—hole in side of pump, elevation 150.9 feet. On west side of Connell Road, 0.15 mile south of Murphy Road. 3/14/47, 59.2; 8/7/47, 117.0; 11/5/47, 119.7; 1/25/48, 115.8; 2/17/48, 117.2; 12/9/48, 120.2; 3/24/49, 118.3; 4/14/49, 120.5; 6/2/49, 159.0; 7/1/49, 145.0; 8/3/49, 131.0; 11/1/49, 128.1; 3/22/50, 125.3; 11/12/50, 126.8; 4/3/51, 129.4; 11/20/51, 140.0; 4/4/52, 129.9.

11S/2E-19B1—Reference point—top of casing, elevation 220.0 feet. 0.2 mile east of East Corralitos Road, 0.5 mile south of Varni Road. 3/15/47, 75.8; 7/27/47, 88.7; 12/2/47, 90.0; 12/5/47, 70.6; 2/25/48, 70.4; 12/9/48, 75.0; 3/25/49, 70.8; 11/9/49, 78.3.

11S/2E-19C1—Reference point—top of casing, elevation 250 feet. 200 feet west of East Corralitos Road, 0.2 mile south of Varni Road. 3/15/47, 130.2; 7/27/47, 134.3; 11/10/47, 134.9; 2/25/48, 135.5; 3/25/49, 84.9; 11/3/49, 100.7.

11S/2E-19D1—Reference point—top of casing, elevation 190.0 feet. 0.1 mile north of Varni Road, 0.4 mile east of West Corralitos Road. 8/20/47, 27.7; 12/4/47, 27.8; 2/25/48, 28.1; 12/7/48, 30.0; 3/25/49, 20.2; 11/3/49, 33.6; 3/22/50, 27.6; 11/12/50, 33.8; 4/3/51, 17.3; 11/20/51, 28.1; 4/7/52, 15.6.

11S/2E-19H1—Reference point—top of casing, elevation 175.0 feet. 0.2 mile east of East Corralitos Road, 1.5 miles north of junction of East Corralitos and Green Valley Roads. 7/27/47, 1.9; 12/1/48, 1.2.

11S/2E-19N1—Reference point—hole in pump base, elevation 172.4 feet. 50 feet west of State Highway No. 56A, 1.4 miles north of junction of Larkin Valley Road and Highway 56A. 3/25/47, 26.1; 7/29/47, 35.0; 12/2/47, 29.2; 3/12/48, 28.8; 12/1/48, 31.1; 1/15/49, 30.8; 2/17/49, 30.4; 4/12/49, 30.5; 3/2/50, 27.7; 11/12/50, 33.2; 3/28/51, 28.5; 11/20/51, 29.6; 4/6/52, 25.3.

11S/2E-19Q1—Reference point—top of casing, elevation 170.0 feet. 0.2 mile west of East Corralitos Road, 1.4 miles north of junction of Green Valley and East Corralitos Roads. 3/15/47, 23.1; 7/27/47, 29.8; 12/4/47, 26.2; 3/10/48, 26.5; 12/1/48, 28.3; 3/25/49, 26.6.

11S/2E-20A1—Reference point—hole in pump base, elevation 196.3 feet. 0.1 mile west of Green Valley Road, 0.2 mile south of Connell Road. 3/15/47, 85.2; 7/27/47, 88.1; 11/16/47, 94.8; 3/10/48, 94.5; 12/7/48, 98.7; 1/15/49, 98.4; 2/17/49, 97.9; 3/24/49, 97.6; 11/2/49, 122.7.

11S/2E-21C1—Reference point—hole in casing, elevation 201.1 feet. 0.3 mile south of Connell Road, 0.3 mile east of Murphy Road. 3/14/47, 160.9; 7/27/47, 178.0; 11/5/47, 171.8; 1/25/48, 171.5; 2/17/48, 170.2; 12/7/48, 173.4; 3/24/49, 171.2; 6/7/48, 206.8 (oper.); 7/1/49, 208.0 (oper.); 9/2/49, 207.0 (oper.); 11/3/49, 207.3; 11/12/50, 177.8; 4/4/51, 174.0; 4/4/52, 169.6.

11S/2E-21G1—Reference point—top of casing, elevation 155.0 feet. 0.5 mile east of junction of Connell Road and Murphy Road, 0.6 mile south on farm road. 3/14/47, 119.5; 6/26/47, 149.0; 7/27/47, 149.7; 11/5/47, 144.2; 1/25/48, 143.8; 2/17/48, 140.8; 12/7/48, 144.6; 3/24/49, 141.7; 11/3/49, 161.0.

11S/2E-21M1—Reference point—hole in casing, elevation 135.3 feet. 0.2 mile east of Green Valley Road, 0.7 mile south of Connell Road. 12/1/47, 110.9; 3/10/48, 91.0; 12/7/48, 98.1; 3/24/49, 110.5; 11/3/49, 117.0; 11/12/50, 110.0; 4/3/51, 108.2; 11/20/51, 108.2.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

11S/2E-21N1—Reference point—top of casing, elevation 131.0 feet. 0.2 mile east of Green Valley Road, 0.9 mile south of Connell Road. 3/14/47, 88.3; 7/27/47, 104.5; 12/1/47, 100.7; 3/10/48, 99.5; 12/7/48, 104.0; 3/24/49, 100.7; 11/3/49, 107.8.

11S/2E-21P1—Reference point—top of casing, elevation 65.0 feet. 0.35 mile east of Green Valley Road, 1.0 mile south of Connell Road. 12/1/47, 50.8; 3/8/48, 45.0; 12/7/48, 58.2; 3/24/49, 50.1; 11/3/49, 60.7.

11S/2E-21P2—Reference point—hole in pump base, elevation 121.8 feet. 0.45 mile east of Green Valley Road, 1.0 mile south of Connell Road. 7/11/47, 104.7; 7/27/47, 109.9; 12/1/47, 94.7; 3/8/48, 93.0; 12/7/48, 100.0; 4/6/49, 98.5; 11/3/49, 105.1; 3/22/50, 100.1; 11/12/50, 108.4; 4/3/51, 101.4; 4/7/52, 97.9.

11S/2E-21Q1—Reference point—top of casing, elevation 110.0 feet. 0.5 mile east of Green Valley Road, 1.0 mile south of Connell Road. 3/13/47, 85.1; 8/48/47, 97.3; 12/1/47, 89.2; 3/8/48, 88.0; 12/3/48, 91.1; 1/24/49, 88.1; 11/4/49, 97.2.

11S/2E-22K1—Reference point—hole in casing, elevation 147.2 feet. 0.4 mile west of Casserly Road, 0.5 mile north of Green Valley Road. 3/12/47, 77.7; 7/27/47, 71.5; 11/16/47, 79.9; 3/10/48, 79.0; 12/3/48, 80.9; 1/15/49, 80.4; 2/17/49, 80.0; 3/23/49, 79.8; 11/1/49, 82.3; 3/22/50, 81.0; 11/11/50, 85.3; 4/3/51, 86.0; 11/30/51, 86.4; 4/4/52, 84.7.

11S/2E-22L1—Reference point—top of casing, elevation 70.0 feet. 0.6 mile west of Casserly Road, 0.6 mile north of San Jose Road. 9/16/47, 57.4; 11/16/47, 51.2; 3/10/48, 49.6.

11S/2E-22R2—Reference point—top of casing, elevation 116.9 feet. 0.15 mile north of San Jose Road, 0.25 mile south of Casserly Road. 3/12/47, 56.3; 8/7/47, 88.4; 12/5/47, 90.0; 3/23/49, 89.0.

11S/2E-23D1—Reference point—pipe in concrete base, elevation 207.6 feet. 50 feet south of Webb Road, 0.4 mile east of Casserly Road. 3/12/47, 133.8; 7/27/47, 140.4; 11/16/47, 139.2; 3/10/48, 140.0; 12/9/48, 138.3; 3/23/49, 139.3; 11/1/49, 142.8; 3/22/50, 149.0; 4/4/51, 140.0; 11/30/51, 139.0; 4/4/52, 136.0.

11S/2E-23E1—Reference point—top of casing, elevation 174.6 feet. 0.1 mile northeast of intersection of Casserly and Paulsen Roads. 11/16/47, 28.5; 3/10/48, 88.0; 12/9/48, 91.3; 1/15/49, 90.7; 2/17/49, 90.2; 3/23/49, 88.5; 7/11/49, 94.2; 7/18/49, 95.8; 11/1/49, 31.1.

11S/2E-23G1—Reference point—pipe in concrete floor, elevation 230.0 feet. 0.1 mile north of San Jose Road, 0.5 mile east of San Jose Road. 11/16/47, 69.4; 3/8/48, 67.0; 12/9/48, 67.1; 3/25/49, 76.5; 11/1/49, 68.8.

11S/2E-23G2—Reference point—top of casing, elevation 255.0 feet. 0.1 mile north of San Jose Road, 0.6 mile east of Casserly Road. 9/15/47, 12.9; 11/16/47, 12.7; 3/8/48, 19.0; 12/9/48, 40.6; 3/25/49, 21.6; 11/3/49, 70.3; 3/22/50, 31.2; 11/11/50, 46.2; 4/3/51, 11.2; 11/30/51, 43.0.

11S/2E-23K1—Reference point—hole in casing, elevation 185.0 feet. 0.1 mile south of San Jose Road, 0.3 mile east of Casserly Road. 12/24/48, 45.0; 11/16/49, 94.0.

11S/2E-23M1—Reference point—top of casing, elevation 165.0 feet. 0.1 mile southwest of junction of Paulsen and Casserly Roads. 4/14/49, 100.5; 5/3/49, 98.8; 6/2/49, 97.0; 7/1/49, 121.3; 8/2/49, 126.2; 11/1/49, 97.5; 3/22/50, 96.0; 11/11/50, 101.8.

11S/2E-23N1—Reference point—top of casing, elevation 130.0 feet. 0.1 mile north of San Jose Road, 0.1 mile east of Casserly Road. 11/16/47, 68.8; 3/10/48, 56.3.

11S/2E-25E3—Reference point—0.7 foot above top of casing for register, elevation 186.5 feet. 0.1 mile north on Peckham Road from junction of Carlton and Peckham Roads. 6/25/47, 170.6; 7/24/47, 173.5; 11/19/47, 167.8; 3/4/48, 164.2; 12/9/48, 180.2; 1/8/49, 166.6; 3/21/50, 169.5; 11/11/50, 176.7; 3/29/51, 167.3; 11/30/51, 171.5; 4/3/52, 169.2.

11S/2E-25F1—Reference point—hole in pump base, elevation 147.5 feet. 0.45 mile north on Peckham Road from junction of Carlton and Peckham Roads. 3/11/47, 153.5; 7/24/47, 164.1; 11/19/47, 160.8; 3/4/48, 157.3; 12/17/48, 161.2; 11/14/49, 165.7; 3/21/50, 160.5 11/11/50, 167.6; 4/4/51, 158.0; 11/30/51, 162.5.

11S/2E-25K1—Reference point—top of casing, elevation 170.0 feet. 0.35 mile south of Peckham Road, 0.45 mile east of Carlton Road. 3/6/47, 61.7; 7/24/47, 141.1 (oper.); 11/19/47, 66.3; 3/4/48, 64.2; 12/9/48, 73.0; 1/14/49, 72.0; 2/17/49, 70.5; 4/9/49, 70.7; 11/4/49, 71.6.

11S/2E-25M1—Reference point—hole in side of pump, elevation 147.8 feet. 50 feet south of Peckham Road, 0.25 mile east of Carlton Road. 3/11/47, 123.2; 8/6/47, 137.6; 11/19/47, 130.2; 3/4/48, 128.0; 12/17/48, 130.4; 11/14/49, 141.2.

11S/2E-25N1—Reference point—top of casing, elevation 135.9 feet. 250 feet south of Carlton Road, 0.15 mile south of Peckham Road. 3/6/47, 112.7; 3/24/47, 127.6; 11/19/47, 117.8; 3/4/48, 115.0; 12/16/48, 118.6; 4/9/49, 116.8; 11/14/49, 123.2; 3/21/50, 119.9; 11/28/51, 119.5; 4/3/52, 113.0.

11S/2E-25N2—Reference point—hole in side of pump, elevation 128.8 feet. 50 feet south of Carlton Road, 0.2 mile south of Peckham Road. 3/6/47, 104.2; 7/24/47, 120.1; 11/18/47, 110.9; 3/4/48, 108.2; 12/16/48, 111.4; 4/9/49, 113.2; 11/14/49, 113.9.

11S/2E-25N4—Reference point—top of casing, elevation 126.5 feet. 50 feet south of Carlton Road, 0.35 mile west of Peckham Road. 3/6/47, 101.7; 8/6/47, 117.0; 11/19/47, 102.8; 3/4/48, 105.0; 12/16/48, 106.4; 4/9/49, 110.7; 11/9/49, 113.9.

11S/2E-25P1—Reference point—hole in pump base, elevation 133.2 feet. 0.45 mile south of junction of Carlton and Peckham Roads. 5/–/47, 113.0; 8/24/47, 123.2; 11/19/47, 115.1; 3/4/48, 110.5; 12/16/48, 115.5; 4/9/49, 112.8; 11/9/49, 120.8; 3/21/50, 115.8; 11/11/50, 121.7; 4/4/51, 113.1; 11/28/51, 116.5.

11S/2E-26F1—Reference point—hole in 6″ x 6″ timber under pump base, elevation 107.0 feet. 0.4 mile south of San Jose Road, 0.3 mile southwest of Carlton Road. 3/11/47, 87.8; 5/16/47, 89.0; 11/5/47, 84.6; 1/25/48, 84.9; 2/16/48, 85.0; 1/14/49, 86.4.

11S/2E-26G1—Reference point—hole in pump base, elevation 141.5 feet. 150 feet northeast of Carlton Road, 0.6 mile southeast of San Jose Road. 5/11/47, 117.8; 11/18/47, 124.2; 3/4/48, 121.3; 12/9/48, 125.0; 11/14/49, 129.0.

11S/2E-26G2—Reference point—hole in pump base, elevation 140.0 feet. 50 feet northeast of Carlton Road, 0.6 mile southeast of San Jose Road. 3/11/47, 117.2; 7/24/47, 134.0; 11/18/47, 123.4; 3/4/48, 120.4; 12/9/48, 124.1; 11/14/49, 128.4; 3/29/51, 124.3; 11/28/51, 128.0; 4/3/52, 113.0.

11S/2E-26J3—Reference point—top of casing, elevation 145.2 feet. 50 feet southwest of Carlton Road, 250 feet northwest of San Jose Road. 3/6/47, 121.3; 8/6/47, 136.5; 11/19/47, 126.6; 3/4/48, 122.2; 12/17/48, 122.4; 4/9/49, 130.9; 11/14/49, 131.5.

11S/2E-26R1—Reference point—hole in pump base, elevation 135.0 feet. 0.35 mile southeast Lakeview Road, 0.30 mile southwest of Carlton Road. 3/6/47, 110.5; 7/24/47, 123.0; 8/6/47, 129.0; 11/19/47, 123.5; 3/4/48, 122.5; 12/17/48, 124.3; 4/9/49, 120.4; 11/14/49, 124.0; 11/11/50, 125.8; 3/29/51, 125.8; 11/28/51, 124.6; 4/3/52, 123.2.

11S/2E-28C1—Reference point—top of casing, elevation 102.0 feet. 1.5 miles northwest of San Jose Road, 0.4 mile north of Holohan Road. 3/13/47, 80.0; 8/7/47, 96.6; 12/23/47, 90.3; 3/24/49, 91.3; 11/2/49, 92.8.

11S/2E-28E1—Reference point—slot in casing, elevation 103.4 feet. 0.1 mile southeast of Green Valley Road, 0.6 mile from junction of Green Valley and Holohan Roads. 12/7/48, 56.5; 1/15/49, 57.5; 3/24/49, 54.6; 11/2/49, 59.0; 3/22/50, 63.2; 11/12/50, 58.1.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

11S/2E-28K1—Reference point—top of casing, elevation 90.0 feet. 0.55 mile north of Holohan Road, 0.65 mile east of Green Valley Road. 3/13/47, 60.8; 8/7/47, 69.6; 12/1/47, 61.3; 3/10/48, 61.2; 12/3/48, 63.0; 3/23/49, 58.2; 11/2/49, 67.1.

11S/2E-28K2—Reference point—top of casing, elevation 105.0 feet. 0.33 mile north of Holohan Road, 0.7 mile northwest of East Lake Avenue. 3/13/47, 44.8; 7/25/47, 59.6; 12/1/47, 45.1; 12/3/48, 47.9.

11S/2E-28M1—Reference point—top of casing, elevation 98.0 feet. 0.3 mile east of Green Valley Road, 0.4 mile north of Holohan Road. 3/13/47, 82.8; 7/25/47, 89.3; 12/1/47, 81.3; 3/10/48, 80.7; 12/3/48, 83.0; 3/24/49, 80.3.

11S/2E-28N1—Reference point—hole in base of pump, elevation 99.8 feet. 0.3 mile east of Green Valley Road, 0.15 mile north of Holohan Road. 3/13/47, 81.0; 7/25/47, 89.4; 12/1/47, 82.1; 3/8/48, 82.0; 12/3/48, 84.3; 3/23/49, 80.7; 11/2/49, 87.9; 3/22/50, 83.9; 11/12/50, 90.9; 4/3/51, 95.4.

11S/2E-28P1—Reference point—hole in pump base, elevation 89.1 feet. 0.2 mile north of Holohan Road, 0.6 mile east of Green Valley Road. 3/13/47, 67.8; 5/8/47, 74.4; 6/26/47, 82.1; 8/7/47, 79.4; 12/1/47, 71.1; 1/25/48, 72.2; 2/17/48, 70.0; 12/3/48, 73.7; 1/15/49, 71.8; 2/17/49, 70.9; 3/23/49, 70.2; 4/14/49, 75.7; 5/3/49, 77.4; 6/2/49, 77.4; 7/1/49, 110.6; 7/21/49, 84.2; 8/2/49, 84.3; 9/2/49, 80.6; 3/22/50, 72.6; 11/12/50, 77.5; 4/3/51, 78.8; 11/28/51, 74.8; 4/7/52, 79.6.

11S/2E-28Q1—Reference point—top of casing, elevation 105.0 feet. 0.3 mile north of Holohan Road, 0.7 mile west of junction with San Jose Road. 12/1/47, 44.3; 3/10/48, 46.0; 12/3/48, 47.9; 4/6/49, 47.8.

11S/2E-29E1—Reference point—hole in pump base, elevation 130.0 feet. 0.3 mile south of East Corralitos Road, 0.4 mile west of Green Valley Road. 7/27/47, 110.5; 12/1/47, 93.6; 3/10/48, 93.0; 12/6/48, 97.8; 3/25/49, 108.0; 11/3/49, 56.4; 3/22/50, 106.8; 11/12/50, 120.6; 4/3/51, 86.5; 11/28/51, 123.0.

11S/2E-29L1—Reference point—hole in casing, elevation 120.0 feet. 0.3 mile south of East Corralitos Road, 0.4 mile northeast of Green Valley Road. 12/1/47, 57.9; 3/10/48, 44.4; 12/6/48, 42.3; 4/6/49, 41.8; 11/3/49, 46.5.

11S/2E-29N1—Reference point—groove in concrete floor, elevation 133.7 feet. 50 feet north of Freedom Boulevard, 70 feet northeast of Green Valley Road. 3/21/47, 112.5; 8/15/47, 123.3; 12/4/47, 115.2; 12/6/48, 117.0; 7/21/49, 119.6.

11S/2E-30C1—Reference point—top of casing under floor of pumphouse, elevation 130.0 feet. 0.1 mile north of Freedom Boulevard, 1.6 miles northwest of Green Valley Road. 3/21/47, 5.3; 7/29/47, 9.5; 12/2/47, 7.6; 3/11/48, 7.2; 12/1/48, 8.4; 3/25/49, 7.1.

11S/2E-30L1—Reference point—hole in side of pump base, elevation 157.3 feet. 0.30 mile south of Freedom Boulevard, 1.5 miles northwest of Green Valley Road. 3/23/47, 20.9; 7/29/47, 49.1; 12/2/47, 29.6; 3/12/48, 23.3; 12/1/48, 30.0; 1/15/49, 26.9; 2/17/49, 25.0; 4/8/49, 23.7; 11/3/49, 32.7; 3/21/50, 25.8; 11/12/50, 32.8; 11/28/51, 29.6; 4/6/52, 29.6.

11S/2E-30N1—Reference point—hole in side of pump base, elevation 180.0 feet. 50 feet north of Larkin Valley Road, 0.7 mile east of Calabasas Road. 5/8/47, 169.6; 7/29/47, 164.0; 10/2/47, 104.0.

11S/2E-31J1—Reference point—hole in pump base, elevation 128.0 feet. 0.8 mile south of Freedom Boulevard, 0.2 mile northwest of Green Valley Road. 3/12/47, 112.7; 7/17/47, 114.8; 12/15/47, 115.1; 3/12/48, 113.0; 12/15/48, 116.1; 4/1/49, 115.0; 11/4/49, 118.5.

11S/2E-31K1—Reference point—hole in pump base, elevation 127.0 feet. 1.0 mile southwest of Freedom Boulevard, 0.4 mile northwest of Green Valley Road. 3/11/47, 46.5; 7/16/47, 46.2; 12/15/47, 45.2; 3/12/48, 45.2; 11/22/48, 45.1; 1/13/49, 46.1; 2/15/49, 45.3; 4/1/49, 45.4; 11/4/49, 68.8.

11S/2E-31P1—Reference point—hole in pump base, elevation 133.0 feet. 1.3 miles southwest of Freedom Boulevard, 0.4 mile northwest of Green Valley Road. 3/12/47, 122.0; 7/16/47, 130.0; 12/15/47, 122.2; 3/12/48, 121.0; 12/16/48, 121.0; 4/1/49, 126.8; 11/4/49, 135.0.

11S/2E-31P2—Reference point—top of casing, elevation 130.0 feet. 1.35 miles southwest of Freedom Boulevard, 0.4 mile northwest of Green Valley Road. 3/12/47, 119.2; 7/16/47, 123.7; 12/15/47, 122.8; 3/12/48, 123.0; 12/11/48, 122.0; 9/1/49, 120.2; 11/4/49, 124.6.

11S/2E-31Q1—Reference point—hole in pump base, elevation 124.0 feet. 1.0 mile southwest of Freedom Boulevard, 0.4 mile northwest of Green Valley Road. 3/12/47, 45.4; 7/16/47, 62.4; 12/15/47, 50.8; 3/12/48, 51.0; 11/22/48, 49.0; 11/4/49, 59.0; 3/18/50, 38.0; 3/27/51, 36.4; 11/28/51, 54.7; 4/2/52, 31.2.

11S/2E-32E1—Reference point—top of casing, elevation 90.0 feet. 0.3 mile southwest of Freedom Boulevard, 0.15 mile northwest of Green Valley Road. 8/4/47, 80.0; 12/15/47, 75.1.

11S/2E-32P1—Reference point—hole in casing, elevation 50.0 feet. 0.5 mile southwest of Freedom Boulevard, 0.3 mile southeast of Green Valley Road. 3/12/47, 31.0; 7/17/47, 32.7; 12/15/47, 28.7; 3/12/48, 27.3; 11/19/48, 33.5; 4/1/49, 27.3; 11/4/49, 36.6; 11/12/50, 36.8; 3/27/51, 29.1; 11/28/51, 34.6; 4/2/52, 28.0.

11S/2E-33A1—Reference point—pipe in concrete base, elevation 78.0 feet. 0.4 mile northwest of San Jose Road, 100 feet south of Holohan Road. 3/13/47, 51.9; 7/25/47, 67.0; 12/1/47, 56.1; 3/8/48, 56.0; 12/3/48, 58.3; 3/23/49, 54.9; 11/2/49, 62.8.

11S/2E-33B1—Reference point—slot in concrete base, elevation 84.7 feet. 250 feet north of Holohan Road, 0.7 mile west of San Jose Road. 3/13/47, 64.9; 7/25/47, 75.0; 12/1/47, 64.8; 3/8/48, 65.0; 12/3/48, 67.1; 3/23/49, 66.0; 11/2/49, 71.3; 3/22/50, 67.1; 11/12/50, 72.8; 4/3/51, 70.0; 11/28/51, 68.1; 4/7/52, 66.8.

11S/2E-33B2—Reference point—top of casing, elevation 75.4 feet. 50 feet south of Holohan Road, 0.5 mile west of San Jose Road. 7/17/47, 26.2; 12/1/47, 50.3; 8/15/47, 57.0; 8/19/47, 57.6; 8/27/47, 57.0; 9/3/47, 56.0; 9/10/47, 54.7; 11/16/49, 56.2.

11S/2E-33F1—Reference point—top of casing, elevation 78.0 feet. 0.3 mile south of Holohan Road, 0.75 mile west of San Jose Road. 12/1/47, 30.5; 11/16/49, 57.0.

11S/2E-33F2—Reference point—top of casing, elevation 77.0 feet. 0.3 mile south of Holohan Road, 0.75 mile west of junction of Holohan and San Jose Roads. 3/11/47, 26.7; 7/17/47, 72.0; 8/13/47, 71.1; 9/10/47, 70.1; 9/17/47, 69.6; 9/23/47, 70.0; 9/30/47, 69.3; 10/7/47, 68.4; 10/14/47, 67.5; 12/1/47, 62.6; 3/4/48, 61.8; 11/30/48, 63.2; 4/12/49, 64.6; 11/16/49, 68.0.

11S/2E-33K1—Reference point—hole in base, elevation 80.8 feet. 0.5 mile west of San Jose Road, 0.5 mile south of Holohan Road. 5/10/47, 52.6; 5/13/47, 52.5; 5/15/47, 52.8; 5/22/47, 53.2; 5/28/47, 52.4; 6/4/47, 52.7; 6/9/47, 53.2; 6/11/47, 53.0; 6/18/47, 55.3; 6/25/47, 57.5; 7/21/47, 58.4; 8/9/47, 57.6; 8/17/47, 57.6; 12/1/47, 52.4; 3/4/48, 53.2; 12/1/48, 58.2; 4/7/49, 56.4; 4/16/49, 63.0; 3/20/50, 48.4; 11/11/50, 62.2; 3/28/51, 55.1; 11/28/51, 40.5; 4/3/52, 35.2.

11S/2E-33N1—Reference point—hole in base, elevation 68.5 feet. 0.1 mile northeast of Freedom Boulevard, 0.9 mile southwest of Green Valley Road. 8/6/47, 59.7; 12/2/47, 52.7; 12/17/48, 56.0; 4/8/49, 44.5; 11/16/49, 54.5.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

11S/2E-33N2—Reference point—top of casing, elevation 70.0 feet. 0.15 mile northeast of Freedom Boulevard, 0.95 mile southwest of Green Valley Road. 12/2/47, 23.2; 3/4/48, 51.1; 12/4/48, 54.5; 4/8/49, 52.5; 7/21/49, 61.8; 8/2/49, 83.9; 9/2/49, 63.6; 11/16/49, 61.5; 11/11/50, 59.1; 3/28/51, 52.7; 11/28/51, 56.5; 4/3/52, 54.4.

11S/2E-33R1—Reference point—top of casing, elevation 72.1 feet. 0.2 mile east of San Jose Road, 0.6 mile south of junction of Holohan and San Jose Roads. 5/11/47, 50.1; 8/13/47, 65.1; 12/1/47, 53.4; 1/25/48, 54.2; 2/16/48, 52.0; 3/4/48, 53.2; 12/17/48, 54.8; 1/14/49, 53.7; 4/7/49, 55.3; 11/16/49, 32.5; 3/20/50, 36.6; 11/11/50, 64.2; 3/28/51, 54.6; 11/28/51, 56.5; 4/3/52, 54.9.

11S/2E-34D2—Reference point—hole in base, elevation 72.0 feet. 50 feet north of Holohan Road, 0.2 mile east of junction of Holohan and San Jose Roads. 7/25/47, 73.5; 12/1/47, 50.5; 12/3/48, 53.1; 3/23/49, 64.7; 11/2/49, 57.8; 3/22/50, 52.0; 11/12/50, 57.6; 4/3/51, 54.5; 11/28/51, 54.3; 4/7/52, 50.8.

11S/2E-35H1—Reference point—hole in side of pump base, elevation 102.0 feet. 0.6 mile southeast of Lakeview Road, 0.4 mile northeast of Carlton Road. 7/24/47, 98.0; 11/25/47, 89.7.

11S/2E-35K1—Reference point—hole in side of pump base, elevation 64.8 feet. 0.25 mile northwest of Coward Road, 0.8 mile northwest of Carlton Road. 3/6/47, 40.1; 7/23/47, 58.0; 11/25/47, 45.6; 3/2/48, 43.6; 11/30/48, 47.5; 4/9/49, 47.8; 11/16/49, 50.4; 3/21/50, 47.2; 11/11/50, 51.6; 3/29/51, 50.6; 11/28/51, 53.5.

11S/2E-35P1—Reference point—hole in pump base, elevation 48.0 feet. 0.35 mile west of Coward Road, 0.5 mile north of Chittenden Road. 3/6/47, 28.1; 8/6/47, 46.9; 11/25/47, 32.9; 3/2/48, 31.3; 11/16/49, 28.8.

11S/2E-36B1—Reference point—hole in side of base, elevation 114.7 feet. 100 feet northeast of Thompson Road, 0.3 mile southeast of Coward Road. 3/6/47, 90.2; 7/24/47, 104.7; 11/19/47, 98.6; 3/4/48, 94.3; 11/30/48, 99.5; 4/9/49, 94.0; 11/9/49, 104.0; 11/11/50, 104.9; 4/2/51, 92.7; 11/28/51, 99.1; 4/3/52, 89.2.

11S/2E-36B2—Reference point—top of casing, elevation 122.8 feet. 100 feet northeast of Thompson Road, 0.25 mile southeast of Coward Road. 3/6/47, 97.7; 7/24/47, 111.9; 11/19/47, 105.1; 3/4/48, 101.7; 12/16/48, 105.3; 4/19/49, 104.2; 11/9/49, 111.1; 3/21/50, 105.8.

11S/2E-36B3—Reference point—ground level under pump base, elevation 129.6 feet. 100 feet northeast of Thompson Road, 0.15 mile southeast of Coward Road. 3/6/47, 104.2; 7/24/47, 119.0; 11/19/47, 111.9; 3/4/48, 108.1; 4/9/49, 108.5; 11/9/49, 117.8.

11S/2E-36C1—Reference point—hole in side of pump base, elevation 121.9 feet. 100 feet southeast of Coward Road, 0.15 mile south of Thompson Road. 3/6/47, 96.9; 8/6/47, 113.5; 11/18/47, 103.9; 3/4/48, 101.2; 11/30/48, 104.5; 4/9/49, 110.3; 11/9/49, 111.1; 3/21/50, 104.7; 11/11/50, 110.7; 3/29/51, 99.6; 11/28/51, 105.5; 4/3/52, 95.0.

11S/2E-36C2—Reference point—top of casing, elevation 108.1 feet. 100 feet northwest of Coward Road, 0.25 mile southwest of Thompson Road. 3/6/47, 74.2; 7/24/47, 101.5; 11/25/47, 90.2; 3/4/48, 89.0; 11/30/48, 92.4; 4/9/49, 90.4; 11/9/49, 99.2.

11S/2E-36E1—Reference point—hole in plate at top of casing, elevation 86.7 feet. 300 feet northwest of Coward Road, 0.5 mile southwest of Carlton Road. 3/6/47, 61.1; 8/6/47, 87.3; 11/25/47, 67.2; 3/2/48, 65.2; 11/30/48, 58.2; 1/14/49, 67.3; 2/17/49, 67.1; 4/9/49, 69.0; 11/9/49, 76.0.

11S/2E-36G1—Reference point—hole in side of pump, elevation 92.1 feet. 100 feet southeast of Thompson Road, 0.45 mile northeast of junction of Chittenden and Thompson Roads. 3/5/47, 66.7; 7/21/47, 82.0; 11/24/47, 73.3; 3/4/48, 71.5; 11/30/48, 75.4; 1/14/49, 73.7; 2/17/49, 71.8; 4/9/49, 71.0; 11/9/49, 80.9; 3/20/50, 80.2; 11/10/50, 83.5; 4/2/51, 79.9; 11/28/51, 79.8; 4/3/52, 70.5.

11S/2E-36G2—Reference point—top of casing, elevation 94.1 feet. 500 feet southeast of Thompson Road, 0.5 mile northwest of Chittenden Road. 3/5/47, 68.3; 7/24/47, 83.9; 11/24/47, 75.4; 11/30/48, 77.4; 4/9/49, 72.4; 11/9/49, 81.4.

11S/2E-36J1—Reference point—hole in side of pump, elevation 66.2 feet. 0.4 mile southeast of Thompson Road, 0.4 mile southwest of Chittenden Road. 3/5/37, 37.8; 8/13/47, 82.8; 11/24/47, 47.0; 3/5/48, 48.3; 11/30/48, 51.6; 4/12/49, 49.5; 11/14/49, 49.5.

11S/2E-36M1—Reference point—top of casing, elevation 78.0 feet. 0.1 mile southeast of Coward Road, 0.55 mile northeast of junction of Carlton and Coward Roads. 11/30/48, 62.2; 4/9/49, 60.7; 11/9/49, 65.7.

11S/2E-36M2—Reference point—hole in pump base, elevation 75.2 feet. 2.15 miles southeast of Thompson Road, 0.6 mile northeast of Carlton Road. 3/6/47, 60.2; 7/23/47, 70.2; 11/25/47, 56.5; 3/2/48, 54.5; 11/30/48, 58.7; 4/9/49, 59.7; 11/9/49, 62.3; 3/21/50, 62.6; 11/11/50, 68.0; 11/28/51, 58.0.

11S/2E-36M3—Reference point—side of pump base, elevation 71.0 feet. 100 feet northwest of Thompson Road, 0.6 mile northeast of Carlton Road. 3/6/47, 47.4; 7/23/47, 68.1; 11/25/47, 57.2; 3/2/48, 52.4; 11/30/48, 55.2; 4/12/49, 56.1; 11/16/49, 59.0.

11S/2E-36N1—Reference point—hole in side of pump base, elevation 69.0 feet. 250 feet southeast of Thompson Road, 0.75 mile southwest of Carlton Road. 3/6/47, 37.8; 7/23/47, 55.7; 11/25/47, 43.8; 3/2/48, 41.8; 11/30/48, 46.0.

11S/2E-36P1—Reference point—top of casing, elevation 74.4 feet. 0.15 mile southeast of Chittenden Road, 250 feet southwest of Thompson Road. 3/6/47, 49.0; 7/23/47, 66.0; 11/25/47, 55.1; 3/4/48, 53.3; 11/30/48, 57.3; 4/9/49, 54.8; 11/9/49, 61.7.

11S/2E-36P2—Reference point—hole in pump base, elevation 70.5 feet. 100 feet east of intersection of Chittenden and Thompson Roads. 3/5/47, 44.1; 7/23/47, 62.8; 11/24/47, 51.5; 3/7/48, 49.3; 11/30/48, 53.7; 1/14/49, 51.6; 2/17/49, 50.1; 4/9/49, 50.7; 11/9/49, 57.2; 3/20/50, 56.0; 11/10/50, 59.0; 3/29/51, 49.0; 11/28/51, 52.9; 4/3/52, 45.6.

11S/2E-36P3—Reference point—slot under base of pump, elevation 67.6 feet. 250 feet due south of junction of Chittenden and Thompson Roads. 8/13/47, 58.9; 11/25/47, 48.7; 3/4/48, 47.2; 11/29/48, 50.7; 4/9/49, 47.9; 11/16/49, 55.0.

11S/2E-36P4—Reference point—hole in base of pump, elevation 61.3 feet. 200 feet southeast of Chittenden Road, 0.2 mile southwest of Thompson Road. 3/2/47, 35.9; 8/13/47, 51.7; 11/25/47, 42.1; 3/4/48, 40.0; 11/29/48, 44.2; 4/9/49, 41.7; 11/16/49, 47.0.

11S/2E-36Q1—Reference point—top of casing, elevation 67.0 feet. 0.1 mile northeast of Chittenden Road, 0.1 mile southwest of junction of Chittenden and Thompson Roads. 3/5/47, 41.4; 7/23/47, 58.5; 8/6/47, 59.5; 11/24/47, 48.1; 3/5/48, 49.3; 11/29/48, 50.4; 4/9/49, 51.0; 11/14/49, 53.4.

11S/3E-31M1—Reference point—hole in side of pump base, elevation 58.0 feet. 0.55 mile southwest of Chittenden Road, 0.6 mile southeast of junction of Thompson and Chittenden Roads. 3/5/47, 32.7; 8/6/47, 49.3; 11/24/47, 39.5; 3/5/48, 36.6; 11/30/48, 41.7; 4/12/49, 41.0; 11/14/49, 54.7; 3/20/50, 39.8; 11/10/50, 47.8; 4/2/51, 41.6; 11/28/51, 40.8.

11S/3E-31P1—Reference point—hole in side of pump, elevation 58.0 feet. 0.5 mile northeast of Chittenden Road, 0.85 mile southeast of Thompson Road. 3/5/47, 40.6; 8/21/47, 56.0; 11/24/47, 47.3; 3/5/48, 45.0; 11/29/48, 49.8; 4/12/49, 50.7; 11/14/49, 52.5.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

11S/3E-31Q1—Reference point—hole in base, elevation 58.8 feet. 0.6 mile northeast of Chittenden Road, 0.15 mile northwest of junction of Silliman and Chittenden Roads. 3/5/47, 32.3; 7/24/47, 47.9; 11/24/47, 40.8; 3/5/48, 38.0; 11/30/48, 41.0; 11/14/49, 45.6.

11S/3E-31Q3—Reference point—hole in side of pump, elevation 68.0 feet. 0.55 mile northeast of Chittenden Road, 200 feet northwest of junction of Silliman and Chittenden Roads. 3/5/47, 40.5; 8/13/47, 55.9; 11/24/47, 47.4; 3/5/48, 44.8; 11/30/48, 49.7; 4/9/49, 47.2; 11/14/49, 42.8; 3/20/50, 47.7; 11/10/50, 55.2; 4/2/51, 45.9; 11/28/51, 48.7; 4/3/52, 44.4.

11S/3E-31R1—Reference point—hole in casing, elevation 124.4 feet. 0.25 mile northeast of Silliman Road, 0.2 mile southeast of junction of Silliman Road and farm road. 3/5/47, 96.5; 7/24/47, 109.8; 11/24/47, 103.8; 3/5/48, 100.0; 12/16/48, 105.0; 4/9/49, 101.8; 11/14/49, 109.2.

12S/1E-1A1—Reference point—top of casing, elevation 23.0 feet. 0.45 mile east of Hill Road, 0.45 mile south of Harkins Slough Road. 11/3/49, 0.3.

12S/1E-1C1—Reference point—hole in side of casing, elevation 150.0 feet. 350 feet due west of Hill Road, 0.6 mile north of Harkins Slough Road. 2/26/47, 24.5; 5/16/47, 27.5; 7/16/47, 29.1; 12/22/47, 28.1; 2/17/48, 27.7; 11/19/48, 30.2; 1/13/49, 28.0; 2/15/49, 28.8; 3/30/49, 27.9; 11/4/49, 31.4.

12S/1E-1H1—Reference point—hole in base of pump, elevation 23.0 feet. 0.3 mile northeast of Harkins Slough Road, 0.35 mile southeast of Hill Road. 2/26/47, 1.0; 7/16/47, 4.6; 12/15/47, 2.4; 3/13/48, 2.0; 11/19/48, 3.7; 3/30/49, 1.8; 11/4/49, 6.2; 3/18/50, 3.2; 11/9/50, 5.9; 3/27/51, 2.7; 11/28/51, 4.8; 4/2/52, 2.0.

12S/1E-1R1—Reference point—top of casing, elevation 18.0 feet. 300 feet south of Harkins Slough Road, 0.75 mile southwest of Hill Road. 2/25/47, 22.5; 8/4/47, 16.5; 12/16/47, 13.7; 3/5/48, 13.4; 11/19/48, 14.8; 3/30/49, 14.1; 11/4/49, 12.4; 3/18/50, 14.7; 3/27/51, 13.9; 11/28/51, 20.0.

12S/1E-2L1—Reference point—pipe in concrete base, elevation 245.0 feet. 0.1 mile east of San Andreas Road, 0.3 mile southeast of Harkins Slough Road. 2/27/47, 206.5; 4/16/47, 221.3; 12/23/47, 235.0; 3/5/48, 223.0; 11/15/49, 192.0.

12S/1E-13A1—Reference point—top of casing, elevation 13.0 feet. 0.5 mile east of San Andreas Road, 2.4 miles southeast of Harkins Slough Road. 2/27/47, 1.7; 8/14/47, 7.8.

12S/1E-24A1—Reference point—hole in casing, elevation 10.0 feet. 100 feet northwest of Beach Road, 0.4 mile southwest of San Andreas Road. 3/25/49, 0.5; 6/26/49, 14.6; 8/14/49, 18.8; 11/2/49, 7.7.

12S/1E-24G1—Reference point—hole in casing, elevation 9.4 feet. 100 feet northwest of Beach Road, 0.75 mile southwest of San Andreas Road. 2/22/47, 1.4; 5/13/47, 14.6; 6/9/47, 11.0; 7/31/47, 24.6; 12/16/47, 3.4; 1/28/48, 3.4; 2/16/48, 2.0; 3/1/48, 4.6; 11/12/48, 6.8; 1/13/49, 2.9; 2/15/49, 2.6; 3/22/49, 2.1; 11/2/49, 9.0; 11/9/50, 5.2; 3/27/51, 5.0; 11/14/51, 5.2; 4/1/52, 5.0.

12S/1E-24J1—Reference point—hole in side of pump base, elevation 12.4 feet. 0.4 mile southeast of Beach Road, 0.5 mile northeast of Rodgers Road. 7/8/47, 21.6; 12/16/47, 6.7; 3/1/48, 11.0; 11/12/48, 7.5; 3/25/49, 3.7; 11/2/49, 13.1; 3/17/50, 11.7; 11/9/50, 11.0; 3/27/51, 8.3; 11/14/51, 7.7; 4/1/52, 7.9.

12S/1E-24R1—Reference point—breather pipe in concrete base, elevation 10.5 feet. 0.5 mile southeast of Beach Road, 0.25 mile northeast of Rodgers Road. 2/22/47, 2.7; 12/17/47, 4.4; 2/26/48, 11.5; 11/12/48, 5.0; 3/22/49, 1.3; 5/1/49, 13.5; 6/1/49, 11.8; 6/26/49, 14.5; 7/17/49, 17.7; 8/14/49, 19.1; 11/2/49, 11.7.

12S/1E-25A1—Reference point—base of pump under 2″ domestic line, elevation 10.7 feet. 0.8 mile southeast of Beach Road, 0.2 mile northeast of Rodgers Road. 2/22/47, 3.3; 12/17/47, 6.0; 2/26/48, 6.6; 11/10/48, 6.7; 3/22/49, 4.6; 11/15/49, 5.5.

12S/1E-25A2—Reference point—hole in base, elevation 9.3 feet. 0.8 mile southeast of Beach Road, 200 feet northeast of Rodgers Road. 5/9/47, 11.8; 5/15/47, 14.3; 5/22/47, 9.4; 5/28/47, 10.8; 6/4/47, 9.8; 6/9/47, 11.9; 6/11/47, 16.4; 6/18/47, 18.9; 6/26/47, 19.3; 6/25/47, 16.4; 12/17/47, 5.5; 7/2/47, 16.1; 7/9/47, 14.6; 7/16/47, 17.1; 7/23/47, 16.6; 7/30/47, 20.2; 8/6/47, 13.7; 8/13/47, 19.3; 8/19/47, 17.0; 8/27/47, 18.1; 9/3/47, 12.7; 9/10/47, 12.9; 9/17/47, 15.2; 9/25/47, 11.0; 9/30/47, 14.5; 10/8/47, 9.9; 10/15/47, 7.3; 10/22/47, 6.5; 10/26/47, 6.1; 11/4/47, 5.7; 11/12/47, 5.6; 11/18/47, 5.2; 11/25/47, 5.2; 12/2/47, 5.7; 12/7/47, 5.6; 2/26/48, 6.5; 11/12/48, 5.8; 3/25/49, 3.6; 11/15/49, 4.0; 3/17/50, 14.2; 11/8/50, 5.5.

12S/1E-25B1—Reference point—hole in casing, elevation 7.0 feet. 0.7 mile northeast of Beach Road, 0.1 mile southwest of Rodgers Road. 5/14/47, 12.0; 6/9/47, 23.7; 8/1/47, 18.2; 12/17/47, 1.9; 1/28/48, 1.1; 2/16/48, 0.5; 2/26/48, 6.0; 11/10/48, 3.2; 1/13/49, 0.6; 2/15/49, 0.2; 3/25/49, 0.4; 4/14/49, 9.8; 5/1/49, 7.7; 5/31/49, 8.6; 6/26/49, 9.7; 7/17/49, 11.4; 8/14/49, 12.3; 9/1/49, 23.7; 11/15/49, 2.3; 3/17/50, 5.2; 11/8/50, 4.7; 3/27/51, 0.3; 11/14/51, 3.4.

12S/1E-25Q1—Reference point—top of casing, elevation 9.5 feet. 2.0 miles due south of Beach Road, 0.5 mile southwest of San Andreas Road. 3/24/47, 4.6; 7/31/47, 9.0; 12/19/47, 5.7; 2/25/48, 4.9; 12/10/48, 6.3; 3/18/49, 4.5; 6/26/49, 7.8; 8/14/49, 9.3; 11/8/49, 8.0; 3/17/50, 5.3; 11/9/50, 7.3; 3/26/51, 5.2; 11/14/51, 6.2; 4/1/52, 4.5; 4/17/52, 4.3.

12S/1E-26A1—Reference point—top of casing, elevation 35.5 feet. 2.25 miles due south of Beach Road, 0.3 mile southwest of San Andreas Road. 5/24/47, 30.7; 6/14/47, 33.1; 7/15/47, 33.7; 12/19/47, 32.0; 1/27/48, 30.9; 2/16/48, 30.9; 3/1/48, 31.0; 11/9/48, 32.7; 3/18/49, 30.4; 4/11/49, 31.1; 5/2/49, 31.6; 6/1/49, 32.8; 8/2/49, 37.4; 9/1/49, 38.0; 11/8/49, 33.5.

12S/2E-1A1—Reference point—top of casing, elevation 55.8 feet. 250 feet southeast of Chittenden Road, 0.4 mile northwest of junction of Silliman and Chittenden Roads. 3/5/47, 29.8; 7/24/47, 46.1; 11/24/47, 36.2; 3/5/48, 33.6; 11/29/48, 38.0; 4/9/49, 37.4; 11/14/49, 41.0.

12S/2E-1B1—Reference point—hole in side of pump, elevation 56.5 feet. 100 feet northwest of Chittenden Road, 0.55 mile southeast of Silliman Road. 3/2/47, 30.0; 5/14/47, 42.0; 7/23/47, 50.4; 11/24/47, 36.0; 2/16/48, 33.6; 11/29/48, 38.4; 1/14/49, 37.4; 2/17/49, 35.7; 4/8/49, 37.5; 6/1/49, 42.2; 8/2/49, 53.0; 11/14/49, 40.9; 3/20/50, 36.8; 11/10/50, 42.2.

12S/2E-1D1—Reference point—hole in pump base, elevation 49.0 feet. 0.1 mile southeast of Chittenden Road, 0.5 mile southwest of junction of Thompson and Chittenden Roads. 3/2/47, 19.3; 7/23/47, 45.9; 11/25/47, 29.7; 3/5/48, 28.3; 11/29/48, 30.3 4/9/49, 31.6.

12S/2E-1D3—Reference point—hole in pump base, elevation 51.2 feet. 350 feet southeast of Chittenden Road, 0.25 mile southwest of junction of Thompson and Chittenden Roads. 3/2/47, 27.5; 7/23/47, 44.3; 11/25/47, 33.5; 3/4/48, 31.6; 11/29/48, 35.6; 4/9/49, 33.8; 11/16/49, 38.0; 3/20/50, 36.9; 11/10/50, 39.4; 3/29/51, 31.3; 11/27/51, 34.8.

12S/2E-1G1—Reference point—top of casing, elevation 50.0 feet. 0.35 mile southwest of Chittenden Road, 0.65 mile southeast of Thompson Road. 3/2/47, 20.7; 8/13/47, 40.6; 11/24/47, 29.2; 3/5/48, 27.4; 11/29/48, 31.5; 4/9/49, 31.8; 11/14/49, 34.1.

12S/2E-2G1—Reference point—hole in pump base, elevation 45.2 feet. 250 feet northwest of Chittenden Road, 1.5 miles northeast of Coward Road. 3/6/47, 22.2; 8/6/47, 45.7; 11/25/47, 27.2; 3/5/48, 26.4; 11/29/48, 29.2; 4/9/49, 34.2; 11/16/49, 31.6; 3/20/50, 30.4; 11/10/50, 35.2; 3/29/51, 34.9; 11/27/51, 34.2.

12S/2E-2H1—Reference point—hole in pump base, elevation 45.0 feet. 100 feet southeast of Chittenden Road, 0.3 mile northeast of Coward Road. 3/2/47, 20.5; 11/25/47, 25.9; 3/5/48, 24.7; 11/29/48, 28.0; 4/9/49, 30.7; 11/16/49, 31.0.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

12S/2E-2H2—Reference point—hole in top of casing by air gauge, elevation 44.9 feet. 0.1 mile southeast of Chittenden Road. 0.3 mile northeast of Coward Road. 3/2/47, 21.5; 8/13/47, 41.0; 11/25/47, 26.6; 3/4/48, 25.0; 11/29/48, 28.4; 4/9/49, 29.3; 11/16/49, 28.5; 3/20/50, 27.0; 11/10/50, 30.6; 4/4/51, 27.9; 11/27/51, 27.1.

12S/2E-2K1—Reference point—slot in concrete base, elevation 43.4 feet. 0.30 mile south of Chittenden Road at Coward Road. 3/2/47, 20.5; 8/6/47, 42.7; 11/25/47, 25.0. 1/25/48, 24.1; 2/16/48, 23.0; 3/2/48, 23.9; 11/29/48, 25.9; 1/14/49, 26.7; 4/9/49, 32.8; 6/1/49, 35.6; 7/1/49, 46.3; 9/1/49, 40.9; 11/16/49, 30.0; 3/20/50, 26.3; 11/10/50, 31.6; 4/27/51, 28.2; 4/3/52, 29.6.

12S/2E-3A1—Reference point—hole in concrete base, elevation 49.8 feet. 250 feet east of Lakeview Road, 0.5 mile north of Chittenden Road. 7/23/47, 44.1; 11/24/47, 32.3; 3/2/48, 31.2; 11/30/48, 34.2; 1/15/49, 32.5; 2/17/49, 31.0; 4/7/49, 34.5; 5/3/49, 39.1; 6/2/49, 40.4; 9/1/49, 45.4; 11/16/49, 37.3; 11/10/50, 37.5; 3/29/51, 33.6; 11/27/51, 33.6.

12S/2E-3E1—Reference point—hole in base, elevation 38.5 feet. 0.25 mile southeast of East Lake Avenue, 1.1 miles south of Holohan Road. 3/11/47, 18.8; 8/4/47, 35.9; 12/1/47, 21.9; 3/2/48, 21.7; 11/30/48, 24.4; 4/7/49, 25.8; 11/16/49, 26.8; 3/20/50, 25.0; 11/10/50, 27.7; 3/28/51, 23.6; 11/27/51, 23.4.

12S/2E-3J1—Reference point—hole in base, elevation 39.6 feet. 250 feet south of Chittenden Road, 0.15 mile east of East Lake Avenue. 3/6/47, 18.9; 7/23/47, 39.2; 11/24/47, 23.2; 3/2/48, 22.4; 11/30/48, 25.1; 4/9/49, 28.6; 11/16/49, 27.0.

12S/2E-3J2—Reference point—top of casing, elevation 27.5 feet. 0.15 mile north of Chittenden Road, 250 feet east of Lakeview Road. 3/2/47, 7.6; 7/23/47, 26.0; 11/24/47, 11.8; 3/2/48, 11.3; 11/29/48, 13.7; 4/9/49, 16.7; 11/16/49, 15.6; 3/20/50, 13.8; 11/10/50, 16.9; 6/5/52, 25.0; 4/2/51, 13.6; 11/27/51, 13.5; 4/3/52, 11.2.

12S/2E-3K1—Reference point—hole in concrete base, elevation 37.4 feet. 100 feet northwest of Chittenden Road, 0.15 mile southwest of junction of Lakeview and Chittenden Roads. 3/11/47, 20.2; 7/23/47, 35.2; 11/24/47, 27.1; 3/2/48, 21.5; 11/29/48, 23.7; 1/14/49, 22.8; 2/17/49, 21.1; 4/9/49, 26.2; 11/16/49, 26.0; 3/1/50, 24.0; 11/10/50, 28.4; 11/27/51, 23.7; 4/3/52, 23.9.

12S/2E-3K3—Reference point—hole in base, elevation 38.2 feet. 100 feet northwest of Chittenden Road, 350 feet southwest of Lakeview Road. 3/11/47, 18.3; 7/23/47, 36.5; 11/24/47, 22.5; 3/2/48, 21.6; 11/29/48, 24.5; 4/9/49, 27.4; 11/16/49, 26.5.

12S/2E-3M1—Reference point—hole in base, elevation 34.1 feet. 0.1 mile north of Chittenden Road, 0.85 mile southwest of Lakeview Road. 3/11/47, 14.4; 7/17/47, 25.3; 12/1/47, 18.5; 3/2/48, 18.6; 11/29/48, 23.7; 1/14/49, 18.8; 2/17/49, 17.5; 4/7/49, 20.2; 7/17/49, 33.6; 11/16/49, 23.6; 3/20/50, 23.4.

12S/2E-4B1—Reference point—hole under pump base, elevation 56.0 feet. 0.4 mile due west of East Lake Avenue, 0.85 mile south of Holohan Road. 8/15/47, 50.1; 12/2/47, 40.1.

12S/2E-4D1—Reference point—top of casing, elevation 68.0 feet. 0.2 mile due east of Freedom Boulevard, 0.9 mile southeast of Green Valley Road. 7/17/47, 57.7; 12/1/47, 48.5; 3/4/46, 47.6; 12/14/48, 49.8; 1/14/49, 48.3; 2/15/49, 47.5; 4/8/49, 47.8; 5/3/49, 56.4; 6/2/49, 55.1; 7/1/49, 59.1.

12S/2E-5C1—Reference point—top of casing, elevation 60.0 feet. 0.55 mile southwest of Freedom Boulevard, 0.7 mile southeast of Green Valley Road. 3/12/47, 40.6; 8/4/47, 44.4; 12/15/47, 33.2; 3/12/48, 33.8; 11/19/48, 25.8; 4/1/49, 33.6.

12S/2E-5D1—Reference point—top of curb, elevation 23.0 feet. 0.9 mile southwest of Freedom Boulevard, 0.5 mile southeast of Green Valley Road. 3/12/47, 6.6; 7/17/47, 13.8; 12/15/47, 8.2; 12/16/48, 9.2; 4/1/49, 7.1; 11/15/49, 12.0; 11/9/50, 12.6.

12S/2E-6D1—Reference point—hole in casing, elevation 105.0 feet. On west side of State Highway 1, 0.7 mile north of intersection of Harkins Slough and Lee Roads. 2/26/47, 105.9; 8/4/47, 111.1; 12/15/47, 108.0; 3/12/48, 106.0; 12/16/48, 106.3; 4/1/49, 106.0; 11/4/49, 111.7; 3/18/50, 109.0; 11/9/50, 111.9; 3/27/51, 108.2; 11/28/51, 111.2; 4/2/52, 107.0.

12S/2E-6E1—Reference point—hole in base, elevation 110.0 feet. 0.18 mile southwest of State Highway 1, 2.0 miles northwest of Watsonville city limits. 2/26/47, 106.0; 7/16/47, 110.5; 12/15/47, 107.7; 3/12/48, 105.0; 12/16/48, 99.0; 4/1/49, 106.8; 11/1/49, 111.0.

12S/2E-6K1—Reference point—top of casing, elevation 25 feet. On north side of Harkins Slough Road, 0.25 mile east of Lee Road. 8/15/47, 10.7; 12/15/47, 4.2; 3/8/48, 4.0; 3/18/48, 5.1; 3/29/49, 3.0; 11/3/49, 7.9; 3/18/50, 2.9; 11/10/50, 8.3; 3/28/51, 3.8; 11/29/51, 6.5; 4/2/52, 3.4.

12S/2E-6L1—Reference point—hole in base, elevation 100.0 feet. 0.15 mile north of intersection of Lee and Harkins Slough Roads. 7/16/47, 89.3; 12/15/47, 85.2; 3/5/48, 84.5; 11/18/48, 86.9; 3/30/49, 85.2; 11/5/49, 88.0.

12S/2E-6P1—Reference point—hole in base, elevation 28.0 feet. 0.10 mile west of Lee Road, 0.28 mile south of Harkins Slough Road. 11/18/48, 11.8; 3/30/49, 9.8; 11/15/49, 13.0.

12S/2E-7B1—Reference point—hole in casing, elevation 28.0 feet. On west side of Lee Road, 0.52 mile south of Harkins Slough Road. 2/25/47, 8.9; 12/16/47, 7.1; 3/5/48, 7.0; 11/18/48, 8.6; 11/3/49, 15.9.

12S/2E-7E1—Reference point—hole in pump base, elevation 60.0 feet. 0.75 mile south of Harkins Slough Road, 0.60 mile west of Lee Road. 2/25/47, 62.4; 6/2/47, 66.0; 8/15/47, 69.2; 12/16/47, 62.9; 1/28/48, 62.5; 2/16/48, 62.3; 4/19/48, 65.0; 1/13/49, 63.0; 2/15/49, 63.4; 3/30/49, 62.0; 11/3/49, 66.3; 3/18/50, 65.2; 11/9/50, 66.0; 3/27/51, 63.6; 11/28/51, 68.1.

12S/2E-8A1—Reference point—top of casing, elevation 15.3 feet. 0.15 mile southeast of Beach Road, 0.20 mile northeast of Harkins Slough Road. 2/25/47, 1.6; 7/14/47, 16.9; 12/16/47, 4.1; 3/1/48, 5.5; 11/18/48, 7.0; 3/29/49, 2.7; 8/14/49, 20.0; 11/3/49, 12.4.

12S/2E-8B1—Reference point—top of 4" x 6" pump support, elevation 21.8 feet. 0.21 mile south of Harkins Slough Road, 0.60 mile northwest of Beach Road. 2/25/47, 9.0; 7/14/47, 17.5; 12/16/47, 11.1; 2/27/48, 12.0; 11/19/48, 13.6; 3/29/49, 10.0; 7/17/49, 19.7; 11/3/49, 15.3; 3/18/50, 13.6; 11/10/50, 16.7; 3/28/51, 12.0; 11/28/51, 13.8; 4/2/52, 9.8.

12S/2E-8C1—Reference point—hole in pump base, elevation 24.8 feet. 0.30 mile northwest of Beach Road, 0.60 mile northwest of Lee Road. 2/25/47, 13.9; 7/14/47, 19.8; 12/16/47, 15.5; 2/27/48, 15.3; 11/18/48, 17.4; 3/29/49, 13.2; 7/17/49, 21.5; 11/3/49, 20.0; 4/12/52, 14.8.

12S/2E-8D1—Reference point—wood curb top, elevation 20.0 feet. 0.60 mile east of Lee Road, 0.39 mile south of Harkins Slough Road. 7/15/47, 5.0; 11/23/48, 0.5; 11/15/49, 2.0.

12S/2E-8E1—Reference point—top of casing, elevation 11.3 feet. 0.09 mile north of bend in Lee Road, 0.41 mile northwest of Beach Road. 7/15/47, 8.5; 12/16/47, 0.1; 2/27/48, 1.2; 11/18/48, 2.0; 7/17/49, 9.9; 11/3/49, 5.5; 3/18/50, 2.6; 11/9/50, 4.3; 3/27/51, 1.1; 11/29/51, 2.8.

12S/2E-8F2—Reference point—hole in pump base, elevation 15.6 feet. 0.40 mile northeast of Lee Road, 0.28 mile northwest of Beach Road. 2/25/47, 2.1; 7/14/47, 13.2; 12/16/47, 3.1; 2/27/48, 6.0; 11/18/48, 5.9; 3/29/49, 1.9; 11/15/49, 7.0.

12S/2E-8F3—Reference point—cement curb top, elevation 20.0 feet. 0.30 mile northeast of Lee Road, 0.33 mile northeast of Beach Road. 2/25/47, 11.6; 8/14/47, 25.4; 12/16/47, 13.5; 2/27/48, 15.7; 11/18/48, 15.4; 3/29/49, 11.9; 11/3/49, 18.8.

12S/2E-8G1—Reference point—top of casing, elevation 15.1 feet. On north side of Beach Road, 0.50 mile northeast of Judd Road. 2/24/47, 1.6; 7/31/47, 19.6; 12/16/47, 3.8; 2/27/48, 8.5; 12/15/48, 5.4; 3/29/49, 2.4; 11/16/49, 8.0.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

12S/2E-8G2—Reference point—hole in pump base, elevation 17.0 feet. On southeast side of Beach Road, 0.35 mile southwest of Pine Street. 2/24/47, 2.8; 7/14/47, 21.0; 12/16/47, 7.4; 11/18/48, 10.3; 3/29/49, 5.5; 6/26/49, 20.6; 7/17/49, 22.3; 11/1/49, 13.8; 3/18/50, 11.7; 11/9/50, 14.6; 3/26/51, 8.8; 11/14/51, 11.7; 4/1/52, 7.5.

12S/2E-8K1—Reference point—hole in pump base, elevation 16.9 feet. On south side of Beach Road, 0.36 mile southwest of Pine Street. 2/24/47, 2.9; 5/13/47, 2.5; 6/9/47, 3.9; 7/14/47, 3.4; 12/16/47, 3.8; 1/27/48, 3.7; 2/16/48, 3.1; 2/27/48, 2.8; 11/18/48, 4.2; 1/13/49, 2.8; 2/15/49, 2.6; 3/29/49, 2.1; 11/1/49, 13.0.

12S/2E-8K2—Reference point—top of casing, elevation 18.8 feet. 0.10 mile southeast of Beach Road, 0.51 mile northeast of Judd Road. 2/24/47, 15.6; 5/15/47, 16.1; 6/9/47, 13.0; 12/16/47, 7.4; 1/27/48, 8.3; 2/16/48, 6.3; 2/27/48, 12.7; 11/18/48, 10.8; 1/13/49, 7.9; 2/15/49, 6.7; 3/29/49, 6.6; 4/14/49, 15.4; 5/2/49, 14.8; 5/31/49, 16.6; 6/26/49, 22.9; 7/17/49, 23.3; 8/2/49, 21.7; 9/1/49, 39.7; 11/2/49, 14.1; 3/18/50, 12.9; 3/26/51, 9.2; 11/14/51, 11.0; 3/1/52, 10.8.

12S/2E-8L1—Reference point—hole in side of pump base, elevation 16.2 feet. On northwest side of Southern Pacific Railroad, 0.25 mile northeast of Lee Road. 2/24/47, 3.0; 8/14/47, 19.0; 12/16/47, 4.8; 3/1/48, 5.4; 11/18/48, 7.5; 3/29/49, 3.5; 11/3/49, 11.0; 3/18/50, 9.2; 11/9/50, 9.9; 3/27/51, 6.0; 11/14/51, 8.3.

12S/2E-8L2—Reference point—top of 6″ x 6″ pump support, elevation 16.5 feet. On northwest side of Beach Road, 0.21 mile northeast of Lee Road. 9/26/47, 13.3; 12/16/47, 5.3; 3/1/48, 6.2; 11/18/48, 8.0; 3/29/49, 3.9; 11/1/49, 11.1.

12S/2E-8N1—Reference point—top of casing, elevation 14.4 feet. On northwest corner of Beach and Lee Roads. 2/24/47, 1.8; 7/10/47, 2.7; 12/16/47, 3.7; 2/27/48, 2.7; 11/18/48, 4.4; 3/29/49, 1.9; 11/2/49, 3.9.

12S/2E-8P1—Reference point—hole in base of pump, elevation 16.5 feet. On northwest side of Beach Road, 0.11 mile northeast of Lee Road. 2/24/47, 3.0; 8/14/47, 21.2; 12/16/47, 5.4; 2/27/48, 10.6; 11/18/48, 8.0; 3/29/49, 4.0; 6/26/49, 18.3; 7/17/49, 22.9; 8/14/49, 21.6; 11/1/49, 11.0.

12S/2E-9F1—Reference point—hole in pump base, elevation 25.2 feet. On south corner of First and Locust Streets. 12/16/47, 13.4; 3/1/48, 15.0; 11/18/48, 16.7; 3/29/49, 12.7; 11/3/49, 20.6.

12S/2E-9M1—Reference point—hole in side of pump, elevation 24.8 feet. 0.10 mile southeast of First Street, 0.31 mile southwest of Locust Street. 2/24/47, 10.7; 12/17/47, 27.1; 2/26/48, 15.7; 11/18/48, 15.9; 3/29/49, 11.0; 11/3/49, 20.0; 11/9/50, 21.6; 3/26/51, 14.3; 11/14/51, 14.8; 4/1/52, 12.9.

12S/2E-9M2—Reference point—top of casing, elevation 24.0 feet. 0.25 mile southeast of First Street, 0.32 mile southwest of Locust Street. 2/24/47, 10.7; 7/14/47, 28.1; 10/5/47, 19.5; 10/15/47, 16.3; 10/22/47, 15.0; 10/28/47, 14.3; 11/4/47, 13.8; 11/12/47, 13.1; 11/18/47, 12.9; 11/25/47, 12.5; 12/2/47, 12.2; 12/7/47, 12.0; 12/12/47, 12.3; 12/17/47, 12.3; 12/24/47, 11.8; 12/31/47, 11.6; 2/26/48, 15.3; 11/18/48, 15.3; 3/29/49, 11.4; 11/3/49, 21.2.

12S/2E-9N1—Reference point—base of pump, elevation 27.5 feet. 0.86 mile northeast of Judd Road, 0.24 mile southeast of First Street. 2/24/47, 13.5; 4/22/47, 18.8; 4/24/47, 18.2; 5/2/47, 18.1; 5/9/47, 21.6; 5/15/47, 21.5; 5/22/47, 22.3; 5/28/47, 22.7; 6/4/47, 23.0; 6/9/47, 19.5; 6/11/47, 17.9; 6/18/47, 15.1; 6/20/47, 16.8; 6/25/47, 17.5; 7/2/47, 21.5; 7/9/47, 23.4; 7/16/47, 25.5; 7/23/47, 27.3; 7/30/47, 28.2; 8/11/47, 30.1; 12/16/47, 17.5; 2/26/48, 15.9.

12S/2E-9N2—Reference point—slot in top of casing, elevation 27.0 feet. 0.82 mile northeast of Judd Road, 0.29 mile southeast of First Street. 11/18/48, 14.8; 3/29/49, 12.3; 11/2/49, 13.1.

12S/2E-10A3—Reference point—hole in pump base, elevation 13.0 feet. On south side of Pajaro River, 0.40 mile east of Lewis Road. 3/1/47, 13.0; 7/21/47, 35.6; 4/3/47, 20.1; 3/2/48, 20.7; 11/23/48, 22.5; 4/6/49, 22.0; 11/15/49, 26.8; 3/20/50, 24.7; 11/10/50, 26.7; 3/29/51, 25.2; 11/29/51, 22.9; 4/2/52, 19.3.

12S/2E-10B1—Reference point—hole in pump base, elevation 33.0 feet. 0.20 mile north of intersection of Lewis and San Juan Roads. 8/21/47, 33.4; 12/4/47, 19.8.

12S/2E-10C2—Reference point—hole in casing, elevation 33.0 feet. 0.20 mile north of San Juan Road, 0.23 mile west of Lewis Road. 3/1/47, 15.5; 7/17/47, 36.0; 12/3/47, 18.7; 3/2/48, 18.6; 11/22/48, 21.2; 4/12/49, 23.8; 7/17/49, 34.0; 11/15/49, 23.5; 11/10/50, 21.7; 3/29/51, 18.5; 11/29/51, 18.6.

12S/2E-10E1—Reference point—hole in side of pump base, elevation 31.8 feet. 0.18 mile north of San Juan Road, 0.40 mile east of bridge on Pajaro River. 3/1/47, 15.4; 8/4/47, 35.3; 12/3/47, 18.0; 3/1/48, 18.5; 11/23/48, 20.5; 11/15/49, 23.3.

12S/2E-10E3—Reference point—hole in side of pump base, elevation 30.2 feet. On north side of San Juan Road, 0.25 mile east of bridge on Pajaro River. 3/1/47, 12.7; 7/17/47, 26.6; 12/3/47, 14.5; 3/2/48, 14.4; 11/23/48, 15.5; 1/13/49, 13.3; 2/15/49, 12.5; 4/7/49, 13.0; 7/17/49, 27.1; 11/15/49, 17.4; 3/20/50, 13.9; 11/10/50, 15.7; 4/4/51, 15.0; 11/21/51, 20.4; 4/2/52, 9.3.

12S/2E-10E4—Reference point—hole in pump base, elevation 29.5 feet. On south side of San Juan Road, 0.31 mile east of bridge on Pajaro River. 3/1/47, 7.0; 8/4/47, 9.5; 12/3/47, 8.5; 3/2/48, 8.0; 11/23/48, 8.9; 4/2/49, 5.4; 11/15/49, 8.6.

12S/2E-10E5—Reference point—hole in side of pump base, elevation 29.4 feet. On south side of San Juan Road, 0.46 mile east of bridge on Pajaro River. 3/1/47, 11.8; 7/17/47, 33.4; 12/3/47, 15.6; 11/23/48, 18.2; 4/7/49, 19.5; 11/15/49, 19.2.

12S/2E-10F1—Reference point—hole in concrete base, elevation 31.3 feet. On south side of San Juan Road, 0.29 mile west of Lewis Road. 7/1/47, 14.3; 12/3/47, 17.4; 3/2/48, 16.9; 11/23/48, 19.8; 4/12/49, 22.2; 11/15/49, 22.1.

12S/2E-10J1—Reference point—hole in side of pump base, elevation 31.4 feet. On west side of Storm Road, 0.20 mile south of San Juan Road. 3/1/47, 14.8; 12/3/47, 16.8; 3/2/48, 15.7; 11/26/48, 19.6; 4/6/49, 19.1; 11/7/49, 22.7; 3/20/50, 20.3; 11/12/50, 22.2; 3/29/51, 21.5; 11/28/51, 21.7; 4/2/52, 16.3.

12S/2E-10J2—Reference point— slot in concrete base, elevation 32.6 feet. On west side of Storm Road, 0.28 mile south of San Juan Road. 3/1/47, 14.5; 7/22/47, 34.4; 12/3/47, 17.8; 3/2/48, 17.0; 11/26/48, 20.4; 4/6/49, 20.2; 11/7/49, 23.0.

12S/2E-10K1—Reference point—hole in side of pump base, elevation 31.0 feet. 0.10 mile east of Allison Road, 0.25 mile south of San Juan Road. 3/1/47, 14.4; 8/4/47, 36.2; 12/3/47, 17.9; 3/2/48, 17.0; 11/23/48, 20.3; 4/6/49, 20.3; 11/7/49, 23.1.

12S/2E-10N3—Reference point—hole in pump base, elevation 29.1 feet. 0.09 mile north of Railroad Avenue, 0.33 mile west of Allison Road. 3/1/47, 13.9; 7/25/47, 35.6; 12/3/47, 18.0; 3/1/48, 16.3; 11/23/48, 18.8; 4/6/49, 18.3; 11/15/49, 12.0; 3/20/50, 19.2; 11/10/50, 22.1; 4/2/51, 22.7; 11/28/51, 19.6.

12S/2E-10Q1—Reference point—hole in casing, elevation 26.3 feet. 0.05 mile west of Allison Road, 0.12 mile south of Railroad Avenue. 2/28/47, 11.3; 7/18/47, 29.6; 12/3/47, 13.2; 2/27/48, 18.6; 11/22/48, 15.7.

12S/2E-10Q2—Reference point—hole in pump base, elevation 27.5 feet. On east side of Allison Road, 0.08 mile south of Railroad Avenue. 2/28/47, 11.3; 7/18/47, 29.3; 12/3/47, 13.4; 2/27/48, 18.9; 11/22/48, 16.2; 4/6/49, 15.4; 11/7/49, 18.7.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

12S/2E-10R1—Reference point—hole in side of pump base, elevation 34.0 feet. On west side of Storm Road, 0.45 mile south of San Juan Road. 2/28/47, 16.0; 7/22/47, 38.6; 12/3/47, 19.4; 3/1/48, 18.6; 11/22/48, 17.5; 4/11/49, 17.6; 7/17/49, 33.0; 11/4/49, 24.8.

12S/2E-11C1—Reference point—hole in base of pump, elevation 40.9 feet. 0.41 mile north of San Juan Road, 0.49 mile east of Storm Road. 3/1/47, 19.1; 12/2/47, 22.5; 3/2/48, 21.6; 11/26/48, 24.7; 4/7/49, 26.3; 11/15/49, 27.8; 3/20/50, 26.4; 11/10/50, 29.0; 11/29/51, 24.6; 4/3/52, 24.7.

12S/2E-11E2—Reference point—between pump blocks under discharge, elevation 35.6 feet. 0.11 mile north of San Juan Road, 0.17 mile east of Storm Road. 3/1/47, 17.2; 8/4/47, 38.1; 12/3/47, 20.0; 1/27/48, 23.3; 2/16/48, 18.0; 3/2/48, 19.0; 11/26/48, 23.0; 1/13/49, 21.7; 2/15/49, 19.5; 4/6/49, 22.6; 6/1/49, 32.0; 8/2/49, 36.8; 9/1/49, 42.2; 11/7/49, 26.8.

12S/2E-11F1—Reference point—hole in side of pump base, elevation 35.7 feet. On south side of San Juan Road, 0.32 mile east of Storm Road. 3/1/47, 16.3; 7/22/47, 38.1; 12/3/47, 19.9; 3/25/48, 18.5; 11/26/48, 22.2; 4/6/49, 22.3; 11/7/49, 25.0; 3/20/50, 22.2; 11/10/50, 25.5; 3/29/51, 23.5; 11/28/51, 22.0; 3/4/52, 19.8.

12S/2E-11H1—Reference point—top of casing, elevation 41.4 feet. On north side of San Juan Road, 0.81 mile east of Storm Road. 3/1/47, 20.6; 12/3/47, 23.6; 3/2/48, 22.6; 4/12/49, 29.2.

12S/2E-11H2—Reference point—hole in pump base, elevation 44.3 feet. On north side of San Juan Road, 0.89 mile east of Storm Road. 3/1/47, 23.2; 7/22/47, 43.3; 12/3/47, 27.0; 3/2/48, 26.0; 11/26/48, 29.0; 11/9/49, 32.1; 11/10/50, 34.4; 11/28/51, 31.5; 4/3/52, 29.3.

12S/2E-11K1—Reference point—hole in pump base, elevation 42.0 feet. On south side of San Juan Road, 0.77 mile east of Storm Road. 3/1/47, 19.1; 12/3/47, 24.2; 3/2/48, 12.3; 11/26/48, 13.0; 4/7/49, 14.0; 11/9/49, 16.9.

12S/2E-11L1—Reference point—top of casing, elevation 35.8 feet. 0.06 mile north of Southern Pacific Railroad, 0.43 mile east of Storm Road. 3/1/47, 16.5; 7/22/47, 34.8; 12/3/47, 20.1; 3/2/48, 18.6; 11/26/48, 22.0; 4/7/49, 22.8; 11/14/49, 25.0; 3/20/50, 22.0; 11/10/50, 25.5; 3/29/51, 22.9; 11/28/51, 22.1; 4/3/52, 18.0.

12S/2E-11M1—Reference point—hole in side of pump base, elevation 32.6 feet. On east side of Storm Road, 0.19 mile south of San Juan Road. 3/1/47, 14.4; 7/22/47, 34.6; 12/3/47, 18.1; 3/2/48, 17.0; 11/26/48, 20.8; 4/6/49, 19.9; 11/7/49, 23.0.

12S/2E-11P1—Reference point—top of casing, elevation 37.9 feet. 0.30 mile east of Storm Road, 0.47 mile south of San Juan Road. 2/28/47, 18.5; 12/3/47, 21.6; 3/1/48, 20.6; 11/26/48, 23.5; 1/14/49, 22.4; 2/15/49, 30.5; 4/1/49, 20.9; 11/10/50, 27.1; 4/2/51, 27.5; 11/16/51, 25.0; 4/3/52, 21.9.

12S/2E-12C1—Reference point—hole in pump base, elevation 40.0 feet. 0.44 mile north of San Juan Road, 0.80 mile west of San Miguel Canyon Road. 3/1/47, 21.3; 7/22/47, 38.8; 12/3/47, 25.5; 3/2/48, 24.5; 11/26/48, 27.8; 11/15/49, 30.2.

12S/2E-12E1—Reference point—hole in casing, elevation 48.7 feet. 0.07 mile north of San Juan Road, 0.86 mile west of San Miguel Canyon Road. 3/1/47, 23.9; 7/22/47, 40.4; 12/3/47, 27.8; 3/2/48, 27.0; 11/26/48, 29.7; 4/7/49, 36.4; 11/15/49, 31.7; 3/20/50, 28.8; 11/10/50, 33.4; 3/29/51, 32.0; 11/28/51, 28.8.

12S/2E-12F1—Reference point—hole in side of pump, elevation 51.0 feet. 0.19 mile north of San Juan Road, 0.84 mile west of San Miguel Canyon Road. 3/1/47, 23.8; 7/22/47, 47.4; 12/3/47, 28.1; 3/2/48, 27.0; 12/16/48, 29.5; 4/12/49, 38.0; 11/15/49, 35.0.

12S/2E-12F2—Reference point—hole in side of pump base, elevation 51.0 feet. 0.25 mile north of San Juan Road, 0.70 mile west of San Miguel Canyon Road. 3/1/47, 23.8; 12/3/47, 28.8; 1/27/48, 29.7; 2/16/48, 28.0; 3/2/48, 27.6; 11/26/48, 30.0; 4/12/49, 41.6; 11/15/49, 33.7.

12S/2E-12H1—Reference point—hole in side of casing, elevation 52.0 feet. 0.30 mile north of San Juan Road, 0.19 mile west of San Miguel Canyon Road. 3/1/47, 33.0; 12/3/47, 33.8; 3/2/48, 33.6; 11/26/48, 37.9; 4/7/49, 43.0; 11/15/49, 38.4.

12S/2E-12J1—Reference point—hole in side of pump base, elevation 57.3 feet. On north side of San Juan Road, 0.23 mile west of San Miguel Canyon Road. 3/1/47, 30.1; 7/22/47, 46.4; 12/3/47, 34.3; 3/2/48, 33.7; 11/26/48, 36.8; 11/9/49, 39.0; 3/20/50, 35.1; 10/10/50, 41.2; 3/29/51, 38.3; 11/28/51, 39.0; 4/3/52, 34.3.

12S/2E-12K1—Reference point—hole in pump base, elevation 55.5 feet. On south side of San Juan Road, 0.31 mile west of San Miguel Canyon Road. 3/1/47, 27.2; 7/22/47, 45.3; 12/3/47, 32.7; 3/2/48, 32.1; 11/26/48, 35.2; 4/7/49, 43.9; 11/9/49, 37.7.

12S/2E-12L1—Reference point—hole in side of pump base, elevation 54.1 feet. On south side of San Juan Road, 0.60 mile west of San Miguel Canyon Road. 3/1/47, 28.6; 7/22/47, 44.2; 12/3/47, 32.9; 3/2/48, 32.0; 11/26/48, 35.2; 1/14/49, 35.1; 2/15/49, 32.5; 4/12/49, 42.9; 5/3/49, 48.1; 6/2/49, 44.4; 7/1/49, 52.0; 9/1/49, 46.1; 11/9/49, 37.4; 3/20/50, 33.7; 11/10/50, 38.2; 11/28/51, 34.4; 4/3/52, 34.9.

12S/2E-13A1—Reference point—top of casing, elevation 55.0 feet. 0.27 mile west of San Miguel Canyon Road, 0.35 mile south of San Juan Road. 3/1/47, 27.9; 7/22/47, 44.1; 11/26/47, 31.0; 3/2/48, 31.0; 11/26/48, 33.5; 4/7/49, 38.5; 11/15/49, 35.7;

12S/2E-14D1—Reference point—top of casing, elevation 35.0 feet. 0.11 mile east of Storm Road, 0.73 mile south of San Juan Road. 2/28/47, 21.0; 11/22/48, 24.9; 4/1/49, 23.1; 11/7/49, 28.9.

12S/2E-15A1—Reference point—hole in side of pump base, elevation 33.8 feet. On northwest corner of Hays and Storm Roads. 2/28/47, 16.3; 7/22/47, 33.4; 12/3/47, 19.9; 3/1/48, 19.1; 11/22/48, 22.2; 4/1/49, 18.3; 11/7/49, 24.9.

12S/2E-15A2—Reference point—top of casing, elevation 32.7 feet. On north side of Hays Road, 0.11 mile west of Storm Road. 7/22/47, 32.4; 12/3/47, 18.8; 3/1/48, 19.2; 11/22/48, 19.2; 4/1/49, 17.2; 11/7/49, 23.8.

12S/2E-15A3—Reference point—hole in pump base, elevation 35.9 feet. On west side of Storm Road, 0.06 mile south of Hays Road. 2/28/47, 18.8; 7/22/47, 38.8; 12/3/47, 22.0; 3/1/48, 21.7; 11/22/48, 24.6; 1/13/49, 24.4; 2/15/49, 20.6; 4/1/49, 20.3; 5/3/49, 30.0; 6/1/49, 30.4; 7/1/49, 38.8; 7/17/49, 34.3; 8/2/49, 36.9; 9/1/49, 32.0; 11/7/49, 26.3; 3/20/50, 24.7; 11/10/50, 24.7; 4/2/51, 25.9; 11/16/51, 25.2; 4/2/52, 20.2.

12S/2E-15B1—Reference point—top of casing, elevation 25.8 feet. On west side of Allison Road, at Hays Road. 2/28/47, 9.7; 7/18/47, 26.8; 12/3/47, 12.8; 2/27/48, 17.2; 11/22/48, 15.2; 4/1/49, 11.3; 11/7/49, 17.8; 3/18/50, 19.9; 11/10/50, 18.4; 4/2/51, 18.4; 4/2/52, 10.9.

12S/2E-15C2—Reference point—top of casing, elevation 25.7 feet. 0.20 mile west of Allison Road, 0.19 mile south of Railroad Avenue. 2/28/47, 10.7; 7/18/47, 28.3; 12/3/47, 13.2; 2/27/48, 18.7; 11/22/48, 15.6; 4/6/49, 14.9; 11/15/49, 18.0.

12S/2E-15D1—Reference point—pressure tank pipe at base of pump, elevation 25.3 feet. 0.17 mile south of Railroad Avenue, 0.20 mile east of Salinas-Watsonville Highway. 2/28/47, 11.1; 7/18/47, 31.5; 12/3/47, 13.9; 2/27/48, 19.4; 11/22/48, 16.5; 4/6/49, 14.2; 11/15/49, 19.7.

12S/2E-15D2—Reference point—top of casing, elevation 25.7 feet. 0.10 mile south of Railroad Avenue, 0.17 mile east of Salinas-Watsonville Highway. 2/28/47, 9.9; 7/18/47, 19.7; 4/6/49, 8.3.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

12S/2E-15D3—Reference point—top of casing under pump base, elevation 24.0 feet. 0.25 mile south of Railroad Avenue, 0.18 mile east of Salinas-Watsonville Highway. 2/28/47, 9.4; 5/13/47, 23.2; 7/18/47, 27.9; 12/3/47, 12.3; 1/27/48, 11.7; 2/16/48, 10.6; 11/22/48, 14.7; 1/13/49, 12.0; 2/15/49, 11.0; 4/1/49, 10.3; 7/17/49, 28.0; 11/15/49, 17.0; 3/18/50, 18.9; 11/10/50, 17.8; 4/2/51, 18.8; 11/16/51, 16.0; 4/2/52, 11.0.

12S/2E-15G1—Reference point—top of casing under pump, elevation 28.5 feet. On east side of Allison Road, 0.15 mile south of Hays Road. 2/27/47, 12.3; 7/18/47, 29.3; 12/3/47, 15.8; 2/27/48, 19.4; 11/22/48, 17.7; 4/1/49, 13.7; 7/17/49, 30.1; 11/7/49, 20.1.

12S/2E-15G2—Reference point—top of casing, elevation 26.4 feet. On west side of Allison Road, 0.14 mile south of Hays Road. 2/28/47, 10.7; 7/18/47, 28.6; 11/7/49, 19.2.

12S/2E-15G5—Reference point—hole in side of pump base, elevation 29.5 feet. 0.13 mile east of Allison Road, 0.32 mile south of Hays Road. 2/27/47, 13.3; 12/3/47, 16.6; 3/1/48, 16.1; 11/22/48, 19.0; 4/1/49, 14.8; 11/7/49, 21.6 3/20/50, 19.5; 11/10/50, 23.3; 4/2/51, 21.9; 11/16/51, 20.8; 4/2/52, 13.1.

12S/2E-15H1—Reference point—top of casing, elevation 30.2 feet. 0.25 mile south of Hays Road, 0.24 mile east of Allison Road. 2/27/47, 13.9; 7/22/47, 30.0; 12/3/47, 17.0; 3/1/48, 16.4; 11/22/48, 19.3; 4/1/49, 15.1; 11/7/49, 22.0.

12S/2E-15H2—Reference point—hole in base of pump, elevation 33.0 feet. 0.04 mile west of Storm Road, 0.18 mile south of Hays Road. 2/28/47, 16.0; 7/22/47, 32.1; 12/3/47, 19.3; 3/1/48, 18.8; 11/23/48, 19.3; 4/1/49, 17.8; 11/7/49, 24.1.

12S/2E-15L1—Reference point—hole in casing, elevation 24.6 feet. 0.10 mile west of Allison Road, 0.56 mile south of Hays Road. 2/27/47, 9.7; 7/18/47, 25.8; 12/3/47, 12.7; 2/27/48, 16.4; 11/22/48, 14.2; 4/1/49, 10.6; 11/7/49, 17.7; 3/18/50, 19.6; 11/10/50, 19.6; 4/2/51, 18.1; 11/16/51, 17.5; 4/2/52, 11.0.

12S/2E-15M1—Reference point—top of casing, elevation 21.8 feet. 0.14 mile east of intersection of Trafton and Salinas-Watsonville Roads. 7/18/47, 24.9; 12/3/47, 10.2; 1/27/48, 10.1; 2/16/48, 8.6; 2/27/48, 14.1; 11/22/48, 12.3; 1/13/49, 9.4.

12S/2E-16A1—Reference point—top of casing, elevation 25.2 feet. 0.12 mile west of intersection of Railroad Avenue and Salinas-Watsonville Road. 7/14/47, 31.9; 8/11/47, 34.0; 8/18/47, 28.0; 8/25/47, 29.4; 9/2/47, 26.8; 9/10/47, 23.6; 9/17/47, 26.5; 9/23/47, 22.9; 12/18/47, 13.0; 2/26/48, 15.9; 11/23/48, 15.5; 3/25/49, 11.0; 7/17/49, 32.4; 8/14/49, 27.4; 11/3/49, 19.8; 3/18/50, 20.0; 11/9/50, 18.6; 3/26/51, 16.2; 11/16/51, 17.1.

12S/2E-16C1—Reference point—top of casing, elevation 27.9 feet. 0.13 mile east of Pajaro River, 0.71 mile north of Trafton Road. 7/14/47, 32.7; 11/10/48, 17.2; 3/25/49, 13.3; 7/17/49, 23.4; 8/14/49, 22.2.

12S/2E-16H2—Reference point—hole in base of pump, elevation 21.6 feet. 0.06 mile west of Salinas-Watsonville Road, 0.18 mile north of Trafton Road. 2/21/47, 7.0; 12/18/47, 4.7; 2/26/48, 4.3; 11/10/48, 13.9; 3/22/49, 5.9; 5/2/49, 3.1; 5/31/49, 2.7; 6/26/49, 22.6; 11/3/49, 16.6.

12S/2E-16J1—Reference point—hole in base of pump, elevation 21.3 feet. On southwest corner of Trafton Road and Salinas-Watsonville Road. 2/20/47, 7.3; 7/31/47, 24.4; 12/10/47, 10.4; 2/26/48, 14.5; 11/10/48, 13.7; 4/1/49, 8.4; 6/26/49, 23.1; 7/17/49, 26.1; 8/14/49, 24.2; 9/1/49, 22.5; 11/3/49, 16.1; 11/8/50, 15.4; 3/26/51, 12.7; 11/14/51, 14.1; 4/2/52, 9.5.

12S/2E-16L1—Reference point—top of casing, elevation 20.7 feet. 0.11 mile north of Trafton Road, 0.62 mile west of Salinas-Watsonville Road. 2/20/47, 8.0; 6/23/47, 23.8; 7/31/47, 25.2; 12/18/47, 8.5; 1/27/48, 9.8; 2/16/48, 7.8; 3/1/48, 9.1; 11/10/48, 12.2; 1/13/49, 9.5; 2/15/49, 8.5; 3/22/49, 7.4; 5/1/49, 19.7; 5/31/49, 18.8; 7/17/49, 26.4; 8/14/49, 24.9; 9/1/49, 22.4; 11/8/49, 15.6; 3/17/50, 17.5; 11/8/50, 14.3; 3/26/51, 11.7; 11/14/51, 14.0; 4/2/52, 12.3.

12S/2E-16R1—Reference point—hole in side of pump, elevation 22.1 feet. On west side of Salinas-Watsonville Road, 0.30 mile south of Trafton Road. 2/27/47, 9.4; 5/13/47, 16.0; 12/3/47, 12.2; 1/27/48, 12.9; 2/16/48, 10.3; 2/27/48, 12.8; 11/22/48, 14.0; 1/13/49, 11.9; 2/15/49, 11.0; 4/1/49, 11.0; 11/7/49, 16.2; 3/18/50, 14.2; 11/10/50, 16.5; 4/2/51, 14.2; 11/16/51, 14.3; 4/2/52, 10.1.

12S/2E-17D1—Reference point—hole in base of pump, elevation 17.5 feet. 0.07 mile southeast of Beach Road, 0.13 mile southwest of Judd Road. 2/23/47, 5.0; 12/16/47, 6.9; 2/27/48, 10.6; 11/18/48, 9.3; 3/23/49, 5.3; 11/2/49, 12.1.

12S/2E-17D2—Reference point—hole in base of pump, elevation 17.2 feet. 0.08 mile southeast of Beach Road, 0.19 mile southwest of Judd Road. 2/23/47, 5.0; 12/16/47, 7.0; 2/27/48, 10.7; 11/18/48, 9.2; 3/23/49, 5.5; 11/2/49, 12.2.

12S/2E-17E1—Reference point—hole in base of pump, elevation 16.6 feet. 0.26 mile southwest of Judd Road, 0.03 mile southeast of Beach Road. 2/23/47, 4.2; 7/10/47, 25.9; 12/16/47, 6.2; 2/26/48, 10.3; 11/18/48, 8.2; 3/23/49, 4.7; 4/14/49, 17.6; 11/2/49, 11.7; 3/18/50, 12.3; 11/9/50, 10.8; 3/26/51, 9.6; 11/14/51, 9.7.

12S/2E-17G1—Reference point—hole in base of pump, elevation 22.3 feet. 0.20 mile southeast of First Street, 0.32 mile northeast of Judd Road. 2/24/47, 8.7; 12/16/47, 11.6; 2/26/48, 15.1; 11/18/48, 14.1; 3/24/49, 10.0; 11/2/49, 17.5; 11/9/50, 16.4; 11/14/51, 14.1.

12S/2E-17K1—Reference point—top of casing, elevation 22.4 feet. 0.25 mile southeast of First Street, 0.15 mile northeast of Judd Street. 2/24/47, 10.4; 12/16/47, 11.2; 2/26/48, 14.7; 11/18/48, 13.6; 3/24/49, 11.6; 11/2/49, 17.5.

12S/2E-17L1—Reference point—top of casing, elevation 17.0 feet. On north side of Pajaro River, 0.13 mile southwest of Judd Road. 3/25/49, 6.0; 11/2/49, 12.0.

12S/2E-17M2—Reference point—top of casing, elevation 16.1 feet. On north side of Pajaro River, 0.42 mile southwest of Judd Road. 2/23/47, 4.7; 7/10/47, 28.4; 12/16/47, 6.9; 2/26/48, 11.6; 11/18/48, 9.2; 3/23/49, 5.4; 11/2/49, 12.7; 11/9/50, 11.2; 3/26/51, 9.9; 11/14/51, 10.7; 4/1/52, 11.0.

12S/2E-17N1—Reference point—hole in base of pump, elevation 2.0 feet. 0.41 mile north of Trafton Road, 0.51 mile east of McGowan Road. 3/18/49, 7.1; 11/3/49, 9.2.

12S/2E-17R1—Reference point—hole in base of pump, elevation 20.2 feet. On Trafton Road, 1.00 mile west of Salinas-Watsonville Road. 2/20/47, 7.2; 5/13/47, 21.2; 12/17/47, 10.1; 2/16/48, 8.8; 3/1/48, 10.1; 11/10/48, 13.9; 1/13/49, 9.7; 2/15/49, 9.1; 3/24/49, 8.2; 5/1/49, 20.6; 5/31/49, 21.3; 6/26/49, 26.1; 7/17/49, 28.1; 8/2/49, 24.4; 8/14/49, 25.9; 9/1/49, 22.5; 11/3/49, 15.4; 11/8/50, 14.8; 3/26/51, 12.7; 11/14/51, 13.2; 4/2/52, 11.0.

12S/2E-18A1—Reference point—top of casing through slot in pump base, elevation 13.4 feet. On northwest side of Beach Road, 0.27 mile southwest of Judd Road. 2/23/47, 1.6; 7/10/47, 22.5; 12/15/47, 3.6; 2/27/48, 6.3; 11/18/48, 5.7; 3/23/49, 2.1; 6/29/49, 20.7; 7/17/49, 22.3; 8/14/49, 20.4; 11/2/49, 8.7.

12S/2E-18A2—Reference point—hole in base of pump, elevation 13.6 feet. 0.06 mile northwest of Beach Road, 0.40 mile southwest of Judd Road. 2/23/47, 1.5; 7/31/47, 19.3; 12/16/47, 3.3; 2/26/48, 7.2; 11/18/48, 5.5; 3/23/49, 2.0; 11/2/49, 8.2; 3/18/50, 8.1; 11/9/50, 7.6; 11/14/51, 6.6; 4/1/52, 2.7.

12S/2E-18A3—Reference point—hole in base of pump, elevation 14.0 feet. On northwest side of Beach Road, 0.54 mile southwest of Judd Road. 2/23/47, 2.1; 7/8/47, 16.2; 12/16/47, 4.0; 2/26/48, 8.5; 11/18/48, 6.1; 3/25/49, 2.6; 6/26/49, 19.5; 8/14/49, 18.9; 11/2/49, 9.0.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

12S/2E-18A4—Reference point—top of concrete base, elevation 14.1 feet. 0.06 mile southeast of Beach Road, 0.45 mile south of Judd Road. 7/8/47, 17.6; 12/16/47, 4.6; 2/26/48, 8.3; 11/18/48, 6.7; 3/25/49, 3.1; 11/2/49, 9.7.

12S/2E-18C1—Reference point—hole in side of pump, elevation 14.0 feet. 0.38 mile northwest of Beach Road, 0.75 mile southwest of Lee Road. 2/27/48, 1.0; 11/18/48, 1.2; 11/15/49, 2.0.

12S/2E-18E1—Reference point—hole in concrete base, elevation 10.0 feet. 0.20 mile northeast of San Andreas Road, 0.27 mile northwest of Beach Road. 7/31/47, 18.9; 12/16/47, 1.3; 2/27/48, 6.2; 11/12/48, 3.1; 11/1/49, 6.0.

12S/2E-18H1—Reference point—pipe in concrete base, elevation 13.7 feet. 0.08 mile southeast of Beach Road, 0.58 mile southwest of Judd Road. 2/23/47, 2.4; 7/8/47, 16.6; 12/16/47, 4.3; 2/26/48, 7.5; 11/18/48, 6.4; 3/25/49, 2.9; 11/1/49, 9.5.

12S/2E-18J1—Reference point, register 0.8 foot above top of casing, elevation 15.7 feet. 0.05 mile north of Pajaro River, 0.69 mile northeast of McGowan Road. 7/8/47, 19.1; 7/14/47, 25.8; 7/21/47, 20.0; 12/16/47, 5.8; 3/1/48, 8.0; 3/23/49, 5.8.

12S/2E-18L1—Reference point—plugged hole in pump base, elevation 16.4 feet. On northwest side of Beach Street, 0.47 mile northeast of San Andreas Road. 12/16/47, 1.5; 1/27/48, 1.5; 2/16/48, 0.5; 2/26/48, 7.7; 11/12/48, 3.3; 1/13/49, 1.2; 2/15/49, 0.6; 3/25/49, 0.0; 6/26/49, 22.0; 7/17/49, 20.4; 8/14/49, 18.2; 11/2/49, 7.0; 1/18/50, 8.7; 11/9/50, 6.5; 3/27/51, 3.9; 11/14/51, 4.5; 4/1/52, 4.5.

12S/2E-18N1—Reference point—hole in base of pump, elevation 9.6 feet. On southwest side of San Andreas Road, 0.10 mile northwest of Beach Road. 7/31/47, 20.0; 12/31/47, 1.9; 3/1/48, 4.2; 12/15/48, 1.8; 3/25/49, 0.1; 6/26/49, 16.6; 7/17/49, 21.4; 8/14/49, 21.9; 11/2/49, 6.5; 3/17/50, 7.9; 11/9/50, 7.0; 3/7/51, 8.9; 11/14/51, 10.2; 4/1/52, 4.1.

12S/2E-18N2—Reference point—top of casing, elevation 10 feet. 0.06 mile southeast of Beach Road, 0.36 mile southwest of McGowan Road. 2/22/47, 4.2; 7/8/47, 17.0.

12S/2E-18P1—Reference point—hole in base of pump, elevation 13.0 feet. On west side of McGowan Road, 0.27 mile south of Beach Road. 2/23/47, 1.3; 7/8/47, 18.9; 12/6/47, 3.2; 3/1/48, 6.3; 11/12/48, 7.5; 3/25/49, 3.0; 8/14/49, 20.3; 11/2/49, 10.1.

12S/2E-18P2—Reference point—top of casing, elevation 13.2 feet. On northwest corner of intersection of Pajaro River and McGowan Road. 2/23/47, 3.3; 7/8/47, 9.6; 12/16/47, 5.3; 3/1/48, 8.0; 11/23/48, 7.4; 3/25/49, 3.3; 11/2/49, 8.7.

12S/2E-19A1—Reference point—hole in side of casing, elevation 15.2 feet. 0.38 mile northeast of McGowan Road, 0.72 mile southeast of Beach Road. 2/21/47, 8.1; 12/17/47, 5.7; 1/27/48, 6.2; 2/16/48, 4.3; 3/1/48, 6.7; 11/10/48, 8.0; 1/13/49, 5.3; 2/15/49, 4.5; 3/18/49, 4.0; 5/1/49, 17.7; 7/17/49, 13.1; 9/1/49, 18.2; 11/3/49, 9.7; 3/17/50, 13.3; 11/8/50, 9.6; 3/26/51, 8.0; 4/2/52, 7.3.

12S/2E-19B1—Reference point—hole in casing under pump, elevation 13.6 feet. 0.23 mile northeast of McGowan Road, 0.38 mile northwest of Trafton Road. 2/21/47, 2.6; 7/14/47, 25.4; 12/17/47, 5.0; 1/27/48, 3.7; 2/16/48, 3.7; 3/1/48, 6.8; 11/10/48, 7.0; 1/13/49, 4.2; 2/15/49, 3.6; 3/18/49, 3.1; 6/26/49, 22.6; 9/1/49, 16.5; 11/3/49, 10.2; 3/17/50, 10.9; 3/26/51, 7.8; 11/14/51, 8.6; 4/2/52, 5.2.

12S/2E-19C2—Reference point—top of casing, elevation 12.7 feet. On Pajaro River, 0.09 mile southwest of McGowan Road. 12/23/44, 2.2; 7/8/47, 19.5; 12/16/47, 4.1; 3/1/48, 7.0; 11/12/48, 6.7; 3/25/49, 3.2; 11/2/49, 10.7.

12S/2E-19E1—Reference point—hole in base of pump, elevation 12.1 feet. 0.08 mile northwest of Pajaro River, 0.40 mile southwest of McGowan Road. 2/22/47, 2.6; 12/16/47, 4.8; 2/26/48, 11.5; 11/12/48, 6.4; 3/25/49, 3.0; 11/2/49, 12.7; 3/17/50, 12.3; 11/9/50, 7.8; 3/27/51, 7.2; 11/14/51, 8.6.

12S/2E-19E2—Reference point—hole in base of pump, elevation 11.1 feet. On west side of Pajaro River, 0.58 mile southwest of McGowan Road. 2/22/47, 1.8; 12/16/47, 4.4; 2/25/48, 12.7; 11/12/48, 5.8; 3/25/49, 3.1; 11/2/49, 11.8.

12S/2E-19E3—Reference point—top of casing, elevation 11.8 feet. On west side of Pajaro River, 0.61 mile southwest of McGowan Road. 2/22/47, 2.4; 7/18/47, 28.0; 12/16/47, 5.2; 2/26/48, 13.4; 11/12/48, 6.7; 3/25/49, 2.1; 7/17/49, 21.1; 8/14/49, 22.7; 11/2/49, 13.0.

12S/2E-19L2—Reference point—bottom of plank under pump base, elevation 12.6 feet. 0.33 mile northwest of Trafton Road, 0.27 mile southwest of McGowan Road. 2/21/47, 6.4; 7/14/47, 25.0; 12/3/47, 4.7; 2/26/48, 9.6; 11/9/48, 7.6; 3/18/49, 3.5; 5/2/49, 10.3; 5/31/49, 18.1; 6/26/49, 19.6; 7/17/49, 23.4; 8/3/49, 21.0; 8/14/49, 21.8; 9/1/49, 16.8; 11/3/49, 10.4; 3/17/50, 11.2; 11/8/50, 8.7; 3/26/51, 8.3; 11/14/51, 8.0; 4/2/52, 6.4.

12S/2E-19M1—Reference point—pipe in casing, elevation 12.3 feet. 0.03 mile southeast of Pajaro River, 0.54 mile southwest of McGowan Road. 4/11/47, 11.0; 7/31/47, 27.8; 12/17/47, 5.8; 2/16/48, 4.2; 11/9/48, 8.0; 1/13/49, 5.2; 2/15/49, 11.7; 3/18/49, 4.2; 7/17/49, 23.5; 9/1/49, 19.2; 11/3/49, 16.0; 3/17/50, 12.3; 11/8/50, 9.0; 11/14/51, 7.9; 4/2/52, 7.4.

12S/2E-20A1—Reference point—hole in casing, elevation 19.4 feet. On south side of Trafton Road, 1.40 miles east of McGowan Road. 2/20/47, 10.4; 7/14/47, 29.7; 12/17/47, 9.2; 12/16/48, 24.1.

12S/2E-20C1—Reference point—top of casing, elevation 17.2 feet. 0.23 mile north of Trafton Road, 1.05 miles northeast of McGowan Road. 2/21/47, 4.2; 5/13/47, 16.4; 7/31/47, 23.3; 12/17/47, 6.1; 1/27/48, 6.5; 2/16/48, 4.5; 3/1/48, 6.1; 11/10/48, 8.3; 1/13/49, 5.8; 2/15/49, 5.0; 3/22/49, 3.3; 5/1/49, 16.4; 5/3/49, 18.3; 6/26/49, 25.5; 7/17/49, 24.0; 8/14/49, 22.3; 9/1/49, 17.3; 11/3/49, 10.7; 3/17/50, 13.0; 11/8/50, 11.1.

12S/2E-20K1—Reference point—hole in base of pump, elevation 172.5 feet. 0.2 mile northwest of Salinas-Watsonville Road, 1.2 miles north of Trafton Road. 9/24/51, 173.5; 11/30/51, 175.1; 4/8/52, 163.6.

12S/2E-20K2—Reference point—hole in base of pump, elevation 177.7 feet. 100 feet northwest of Salinas-Watsonville Road, 1.2 miles north of Trafton Road. 10/23/51, 180.6; 11/30/51, 176.8; 4/8/52, 172.0.

12S/2E-20L1—Reference point—hole in base of pump, elevation 170.4 feet. 0.2 mile northwest of Salinas-Watsonville Road, 1.1 miles north of Trafton Road. 10/25/51, 171.9; 11/30/51, 174.1; 4/8/52, 159.5.

12S/2E-20N1—Reference point—hole in casing, elevation 169.5 feet. 0.4 mile west of Salinas-Watsonville Road, 1.1 miles north of Trafton Road. 9/18/51, 83.0; 11/30/51, 83.9; 4/8/52, 86.0.

12S/2E-29A1—Reference point—top of wood block, elevation 135.0 feet. 0.42 mile east of Salinas-Watsonville Road, 0.73 mile north of Jensen Road. 7/17/49, 50.0.

12S/2E-29B1—Reference point—top of casing, elevation 169.0 feet. 0.06 mile west of Salinas-Watsonville Road, 0.72 mile north of Jensen Road. 7/17/49, 56.3; 7/19/49, 56.5; 7/25/49, 56.5; 11/19/49, 58.5.

12S/2E-29C1—Reference point—hole in base of pump, elevation 174.6 feet. 0.10 mile west of Salinas-Watsonville Road, 0.8 mile north of Trafton Road. 9/18/51, 177.5; 4/8/52, 167.6.

12S/2E-29E—Reference point—hole in pump base, elevation 160.9 feet. 0.40 mile west of Salinas-Watsonville Road, 0.60 mile north of Trafton Road. 9/18/51, 73.0; 11/30/51, 99.4; 4/8/52, 94.0.

12S/2E-29H1—Reference point—hole in casing, elevation 176.0 feet. 0.10 mile east of Salinas-Watsonville Road, 0.30 mile north of Trafton Road. 9/12/51, 67.0.

12S/2E-29J2—Reference point—hole in casing, elevation 176.4 feet. 0.40 mile east of Salinas-Watsonville Road, 0.30 mile north of Trafton Road. 9/17/51, 142.0; 11/30/51, 155.0.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

12S/2E-29L3—Reference point—hole in casing, elevation 184.4 feet. 0.1 mile west of Salinas-Watsonville Road, 0.3 mile north of Trafton Road. 11/30/51, 124.0; 4/8/52, 177.0.

12S/2E-29M2—Reference point—top of casing, elevation 175 feet. 0.3 mile west of Salinas-Watsonville Road, 0.3 mile north of Trafton Road. 4/8/52, 135.5.

12S/2E-30C1—Reference point—bottom of base of drain pump, elevation 15.0 feet. On east side of Trafton Road, 0.20 mile north of Bluff Road. 12/19/47, 22.1; 11/9/48, 11.5; 11/14/49, 11.0.

12S/2E-30E1—Reference point—top of casing, elevation 87.4 feet. On northwest side of Bluff Road, 0.20 mile southwest of Trafton Road. 2/21/47, 80.8; 7/14/47, 90.0; 12/19/47, 82.0; 3/1/48, 82.3; 11/9/48, 93.0; 3/18/49, 81.0; 6/26/49, 88.4; 7/17/49, 88.9; 8/14/49, 89.6; 11/14/49, 83.6; 3/17/50, 83.0; 11/8/50, 82.4; 3/26/51, 82.2; 11/14/51, 83.7; 4/3/52, 81.6.

12S/2E-30E2—Reference point—hole in side of pump base, elevation 108.7 feet. On north side of Bluff Road, 0.10 mile west of Trafton Road. 5/24/47, 97.6; 7/14/47, 97.6; 7/31/47, 115.0; 12/19/47, 103.3; 2/26/48, 103.5; 12/10/48, 100.8; 3/18/49, 102.8; 11/14/49, 110.0; 3/17/50, 98.6; 11/14/51, 106.0; 4/1/52, 106.8.

12S/2E-30M1—Reference point—hole in pump base, elevation 71.0 feet. 0.29 mile south of Bluff Road, 0.10 mile west of Trafton Road. 3/24/47, 65.4; 8/12/47, 80.6; 8/14/47, 69.1; 12/19/47, 67.8; 2/26/48, 66.7; 12/10/48, 68.8; 3/18/49, 66.7; 11/14/49, 70.0.

12S/2E-30N1—Reference point—hole in side of pump base, elevation 54.2 feet. 0.29 mile northwest of Jensen Road, 0.57 mile southwest of Bluff Road. 3/24/47, 48.3; 12/19/47, 59.3; 2/25/48, 49.0; 11/9/48, 51.7; 3/18/49, 49.6; 11/14/49, 53.0.

12S/2E-30P1—Reference point—top of casing, elevation 72.5 feet. 0.23 mile northwest of Jensen Road, 0.45 mile southwest of Bluff Road. 3/24/47, 66.5; 7/15/47, 69.0; 12/19/47, 68.6; 2/25/48, 67.3; 11/9/48, 70.2; 3/18/49, 67.6; 6/26/49, 68.6; 7/17/49, 69.4; 8/14/49, 70.5; 11/14/49, 75.0.

12S/2E-30R2—Reference point—groove in wooden block under pump base, elevation 149.7 feet. On south side of Jensen Road, 0.05 mile east of Bluff Road. 3/24/47, 108.0; 8/12/47, 147.0; 12/18/47, 143.0; 2/24/48, 141.9; 12/10/48, 143.7; 3/17/49, 141.8; 6/26/49, 147.1; 7/17/49, 148.5; 8/14/49, 147.3; 11/8/49; 148.5; 3/17/50, 143.6; 11/9/50, 146.3; 3/26/51, 142.7; 11/15/51, 145.8.

12S/2E-31A1—Reference point—hole in pump base, elevation 124.1 feet. 0.18 mile south of intersection of Bluff and Jensen Roads. 7/15/47, 120.0; 12/18/47, 120.0; 2/25/48, 118.0; 11/9/48, 118.1; 3/17/49, 119.5; 11/8/49, 130.0.

12S/2E-31B1—Reference point—pipe in pump base, elevation 124.5 feet. 0.12 mile south of Jensen Road, 0.15 mile west of Bluff Road. 7/15/47, 118.7; 12/19/47, 119.0; 2/24/48, 118.0; 11/9/48, 120.3; 3/17/49, 118.2; 7/17/49, 120.7; 11/8/49, 122.0.

12S/2E-31C1—Reference point—hole in pump base, elevation 57.5 feet. 0.15 mile northwest of Jensen Road, 0.52 mile southwest of Bluff Road. 3/24/47, 51.4; 5/14/47, 53.1; 7/31/47, 55.7; 12/19/47, 53.6; 1/25/48, 53.5; 2/16/48, 52.6; 3/1/48, 52.5; 11/9/48, 59.2; 3/18/49, 52.4; 5/2/49, 52.5; 6/1/49, 55.1; 7/17/49, 55.8; 8/2/49, 55.8; 8/14/49, 55.8; 9/1/49, 62.5.

12S/2E-31C2—Reference point—top of casing, elevation 62.4 feet. 0.10 mile northwest of Jensen Road, 0.58 mile southwest of Bluff Road. 3/24/47, 56.7; 12/17/47, 58.4; 2/25/48, 58.0; 12/10/48, 58.2; 3/18/49, 56.0; 11/14/49, 61.0; 3/17/50, 60.6; 11/9/50, 62.9; 3/26/51, 58.1; 11/14/51, 61.2; 4/1/52, 54.8.

12S/2E-31E1—Reference point—groove in concrete base, elevation 28.8 feet. On south side of Jensen Road, 1.00 mile west of Bluff Road. 3/24/47, 27.2; 7/31/47, 26.0; 12/19/47, 25.6; 2/25/48, 25.3; 11/9/48, 26.2; 3/18/49, 24.0; 8/14/49, 22.6; 11/8/49, 27.0; 3/17/50, 29.8; 11/9/50, 28.9; 11/14/51, 25.9; 4/1/52, 22.2.

12S/2E-31G1—Reference point—top of casing, elevation 125 feet. 1.0 mile west of Salinas-Watsonville Road, 0.25 mile south of Jensen Road. 4/8/52, 69.4.

12S/2E-31G2—Reference point—top of casing, elevation 120 feet. 1.0 mile west of Salinas-Watsonville Road, 0.30 mile south of Jensen Road. 11/30/51, 71.2; 4/8/52, 62.5.

12S/2E-31K1—Reference point—top of casing, elevation 30.0 feet. 0.54 mile south of Jensen Road, 1.0 mile west of Salinas-Watsonville Road. 3/24/47, 24.2; 5/14/47, 28.6; 7/1/47, 27.7; 8/13/47, 30.0; 12/17/47, 25.8; 2/16/48, 25.2; 12/10/48, 26.7; 3/17/49, 24.6; 4/11/49, 24.8; 6/1/49, 28.1; 7/1/49, 31.4; 8/2/49, 40.5; 9/1/49, 45.5; 11/8/49, 29.5; 3/17/50, 25.3; 11/9/50, 29.6; 3/26/51, 25.2; 11/14/51, 27.6; 4/1/52, 23.4.

12S/2E-31L1—Reference point—top of casing, elevation 10.3 feet. 0.30 mile south of Jensen Road, 0.65 mile west of Bluff Road. 3/24/47, 4.3; 7/15/47, 8.8; 12/19/47, 6.9; 2/24/48, 6.3; 12/10/48, 7.9; 3/18/49, 5.8; 6/26/49, 8.2; 8/14/49, 9.6; 11/14/49, 9.0.

12S/2E-32B1—Reference point—top of casing, elevation 125 feet. 1,000 feet east of Springfield School, 100 feet south of Beach Road. 4/8/52, 157.0.

12S/2E-32B2—Reference point—bottom of hole in casing, elevation 172.2 feet. 500 feet east of Salinas-Watsonville Road, 0.4 mile north of Springfield School. 9/12/51, 171.4; 10/23/51, 178.2; 11/30/51, 182.0; 4/8/52, 167.0.

12S/2E-32N1—Reference point—top of casing, elevation 125 feet. 0.3 mile west of Salinas-Watsonville Road, 0.2 mile north of Beach Road. 11/30/51, 136.1; 4/8/52, 131.4.

12S/2E-32P1—Reference point—top of drum acting as casing, elevation 97.5 feet. 300 feet west of Salinas-Watsonville Road, 200 feet north of Beach Road, 300 feet west of Springfield School. 9/18/51, 3.0.

12S/3E-5D1—Reference point—hole in casing, elevation 164.3 feet. On northwest side of Silliman Road, 1.1 miles from intersection of Silliman and Chittenden Roads. 3/5/47, 130.0; 5/14/47, 134.0; 8/5/47, 153.7; 11/5/47, 144.2; 1/27/48, 142.0; 2/16/48, 140.5; 3/5/48, 140.0; 12/14/48, 143.4; 4/14/49, 141.6; 6/1/49, 143.0; 7/1/49, 147.3; 8/2/49; 160.0; 9/1/49, 148.0; 3/20/50, 143.6; 11/10/50, 150.2; 11/28/51, 144.1; 4/3/52, 141.0.

12S/3E-5E1—Reference point—hole in pump base, elevation 147.6 feet. On east side of Silliman Road, 1.0 mile from intersection of Silliman and Chittenden Roads. 3/5/47, 118.3; 8/5/47, 131.3; 11/24/47, 126.2; 3/5/48, 123.0; 12/14/48, 127.2; 4/9/49, 128.0; 11/14/49, 131.5.

12S/3E-5L1—Reference point—top of casing, elevation 65 feet. 0.12 mile north of Chittenden Road, 1.10 mile east of Silliman Road. 8/29/47, 86.5; 11/24/47, 84.0; 9/10/47, 86.8; 9/17/47, 86.9; 9/24/47, 97.0; 9/30/47, 87.0; 10/7/47, 87.1; 3/5/48, 80.5; 11/30/48, 92.6; 4/8/49, 92.8; 11/15/49, 99.3.

12S/3E-6B1—Reference point—hole in side of pump, elevation 95 feet. On north side of Silliman Road by jog, 0.45 mile north of Chittenden Road. 3/5/47, 33.5; 8/20/47, 18.0; 11/24/47, 26.7; 3/5/48, 29.0; 11/30/48, 24.6; 4/9/49, 27.3; 11/14/49, 20.2.

12S/3E-6B2—Reference point—slot in concrete base, elevation 64.9 feet. On east side of Silliman Road, 0.39 mile north of Chittenden Road. 3/5/47, 38.3; 7/24/47, 53.9; 11/24/47, 45.1; 3/5/48, 45.5; 11/30/48, 47.8; 4/9/49, 45.1; 11/14/49, 50.4.

12S/3E-6C1—Reference point—top of casing, elevation 70.0 feet. On west side of Silliman Road, 0.41 mile north of Chittenden Road. 3/5/47, 38.6; 7/24/47, 55.0; 11/24/47, 45.4; 3/5/48, 44.0; 11/30/48, 47.8; 4/9/49, 46.5; 10/14/49, 30.4; 3/20/50, 45.4; 4/3/52, 39.2.

12S/3E-6D1—Reference point—top of casing, elevation 58.0 feet. 0.10 mile north of Chittenden Road, 0.20 mile west of Silliman Road. 3/5/47, 33.9.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

12S/3E-6E1—Reference point—hole in casing, elevation 59.0 feet. On north side of Chittenden Road, 0.08 mile west of Silliman Road. 8/13/47, 52.0; 11/24/47, 41.4.

12S/3E-6E2—Reference point—slot in concrete base, elevation 62.7 feet. 0.06 mile southwest of intersection of Silliman and Chittenden Roads. 8/13/47, 52.3; 11/24/47, 41.6; 3/5/48, 38.5; 11/26/48, 44.0; 4/12/49, 46.2; 11/14/49, 46.4; 3/20/50, 42.0; 11/10/50, 47.9; 4/2/51, 48.3; 11/28/51, 42.2; 4/3/52, 38.8.

12S/3E-6J1—Reference point—hole in pump base, elevation 71.5 feet. On north side of Chittenden Road at intersection with Murphy Road. 3/5/47, 42.0; 7/24/47, 54.0; 11/24/47, 48.0; 1/27/48, 46.4; 2/6/48, 45.2; 3/5/48, 45.2; 12/14/48, 50.3; 1/14/49, 49.2; 2/17/49, 47.5; 4/8/49, 46.4.

12S/3E-6K1—Reference point—hole in side of pump, elevation 71.7 feet. On north side of Chittenden Road, 0.16 mile west of Murphy Road. 3/5/47, 42.1; 8/3/47, 56.9; 11/24/47, 49.2; 3/5/48, 46.0; 11/26/48, 51.6; 4/8/49, 57.4; 11/16/49, 54.7; 3/20/50, 48.2; 11/10/50, 56.1; 4/2/51, 46.2; 11/28/51, 50.6; 4/3/52, 41.3.

12S/3E-6K2—Reference point—hole in pump base, elevation 71.5 feet. On south side of Chittenden Road, 0.24 mile west of Murphy Road. 3/5/47, 42.2; 7/24/47, 51.0; 11/24/47, 49.0; 3/5/48, 46.1; 11/26/48, 51.4; 4/8/49, 47.7; 11/16/49, 54.4.

12S/3E-6K3—Reference point—top of casing, elevation 70.0 feet. On south side of Chittenden Road, 0.17 mile west of Murphy Road. 3/5/47, 42.2; 8/5/47, 58.0; 11/24/47, 48.0; 3/5/48, 45.0.

12S/3E-6L1—Reference point—top of casing, elevation 61.0 feet. 0.05 mile south of Chittenden Road, 0.18 mile west of Crown Road. 3/2/47, 36.9; 7/24/47, 53.7; 11/24/47, 43.4; 3/5/48, 41.0; 11/26/48, 45.7; 4/8/49, 48.0; 11/14/49, 46.6.

12S/3E-6L2—Reference point—hole in pump base, elevation 64.9 feet. On southeast corner of intersection of Chittenden and Crown Roads. 3/2/47, 37.2; 11/24/47, 43.3; 3/5/48, 40.6; 11/26/48, 45.3; 4/11/49, 44.7; 11/14/49, 48.2; 3/20/50, 43.5; 11/10/50, 49.2; 4/2/51, 40.6; 11/28/51, 44.1; 4/3/52, 37.4.

12S/3E-6L3—Reference point—1.5 feet above top of casing, elevation 65.9 feet. On north side of Chittenden Road at intersection with Crown Road. 11/24/47, 43.3; 7/21/47, 52.8; 7/30/47, 52.4; 8/6/47, 53.8; 8/13/47, 52.7; 8/20/47, 53.0; 8/27/47, 52.8; 9/3/47, 52.4; 3/5/48, 40.6; 11/26/48, 47.0; 4/8/49, 45.1; 11/14/49, 50.5.

12S/3E-6N2—Reference point—top of casing, elevation 51.0 feet. 0.09 mile west of Crown Road, 0.43 mile south of Chittenden Road. 3/2/47, 28.4; 3/24/47, 43.3; 11/24/47, 35.3; 3/5/48, 33.0; 11/26/48, 37.4; 4/8/49, 36.3; 11/16/49, 39.7.

12S/3E-6R1—Reference point—top of casing, elevation 74.5 feet. On east side of Murphy Road, 0.17 mile south of Chittenden Road. 3/2/47, 42.3; 7/24/47, 54.4; 11/24/47, 49.6; 3/5/48, 46.0; 11/26/48, 51.9; 4/8/49, 47.5; 11/15/49, 54.5.

12S/3E-7A1—Reference point—hole in pump base, elevation 65.0 feet. 0.06 mile west of Murphy Road, 0.22 mile south of Chittenden Road. 3/2/47, 25.0; 7/24/47, 42.1; 11/24/47, 41.2; 3/5/48, 33.5; 11/26/48, 39.4; 4/8/49, 35.3; 11/15/49, 42.0; 6/6/52, 29.0.

12S/3E-7B1—Reference point—hole in pump base, elevation 57.9 feet. 0.10 mile west of Murphy Road, 0.24 mile south of Chittenden Road. 3/2/47, 25.3; 7/24/47, 38.5; 11/24/47, 31.5; 3/5/48, 29.0; 11/26/48, 34.7; 4/8/49, 31.1; 11/15/49, 39.7; 3/20/50, 31.2; 11/10/50, 38.4; 4/2/51, 28.8; 11/28/51, 33.3; 4/3/52, 23.5.

12S/3E-7C1—Reference point—hole in side of casing, elevation 48.0 feet. 0.60 mile west of Murphy Road, 0.27 mile south of Chittenden Road. 5/24/47, 27.1; 7/24/47, 35.4; 4/8/49, 33.6; 11/16/49, 22.0.

12S/3E-7G1—Reference point—hole in pump base, elevation 48.0 feet. 0.31 mile west of Murphy Road, 0.49 mile south of Chittenden Road. 8/13/47, 39.8; 11/24/47, 31.8; 3/5/48, 30.5; 11/26/48, 34.6; 11/14/49, 38.0.

12S/3E-7H1—Reference point—hole in pump base, elevation 73.8 feet. On east side of Murphy Road, 0.70 mile south of Chittenden Road. 3/5/47, 40.0; 7/21/47, 63.8; 12/1/47, 48.6; 3/8/48, 49.2; 12/16/48, 52.5; 4/7/49, 51.4; 11/7/49, 57.8.

12S/3E-7J1—Reference point—hole in pump base, elevation 72.3 feet. On west side of Murphy Road, 0.30 mile north of San Juan Road. 3/5/47, 38.7; 5/14/47, 55.3; 12/1/47, 44.4; 12/24/47, 42.7; 1/27/48, 43.5; 2/16/48, 41.7; 1/4/49, 46.0; 2/15/49, 43.8; 4/7/49, 49.8; 8/2/49, 62.0; 11/7/49, 49.9; 11/3/50, 49.9; 3/29/51, 46.4; 11/29/51, 44.8; 4/4/52, 37.0.

12S/3E-7J2—Reference point—top of casing, elevation 72.1 feet. On east side of Murphy Road, 0.35 mile north of San Juan Road. 3/5/47, 38.7; 7/21/47, 58.3; 12/1/47, 44.1; 3/8/48, 44.4; 12/2/48, 47.9; 4/7/49, 49.2; 11/7/49, 52.1.

12S/3E-7K1—Reference point—top of casing, elevation 68.1 feet. 0.20 mile west of Murphy Road, 0.30 mile north of San Juan Road. 12/23/47, 40.2; 3/8/48, 42.3; 12/2/48, 44.6; 11/13/50, 49.4; 11/29/51, 42.7; 4/4/52, 40.2.

12S/3E-7K2—Reference point—top of casing, elevation 69.4 feet. 0.16 mile west of Murphy Road, 0.35 mile north of San Juan Road. 12/2/48, 46.0; 4/7/49, 49.1; 11/7/49, 49.9.

12S/3E-7M1—Reference point—top of casing, elevation 60.9 feet. 0.23 mile north of San Juan Road, 0.75 mile west of Murphy Road. 3/5/47, 25.9; 7/22/47, 28.6; 11/26/47, 30.5; 3/8/48, 28.0; 12/2/48, 32.6; 4/7/49, 27.9; 11/7/49, 42.0; 3/21/50, 40.8; 11/13/50, 42.3; 3/29/51, 41.2; 11/29/51, 38.3.

12S/3E-7Q1—Reference point—hole in side of pump, elevation 63.4 feet. On south side of San Juan Road, 0.40 mile west of Murphy Road. 3/4/47, 34.2; 7/22/47, 54.9; 11/26/47, 37.4; 12/2/48, 40.0.

12S/3E-7Q2—Reference point—hole in pump base, elevation 62.9 feet. On north side of San Juan Road, 0.29 mile west of Murphy Road. 3/5/47, 33.7; 11/26/47, 36.6; 3/8/48, 38.2; 12/2/48, 40.7; 11/7/49, 46.6.

12S/3E-8C1—Reference point—hole in side of casing, elevation 58.8 feet. 0.37 mile east of Murphy Road, 0.42 mile south of Chittenden Road. 7/21/47, 33.7; 11/26/47, 26.2; 3/8/48, 25.0; 12/2/48, 32.6; 4/7/49, 26.2; 11/7/49, 38.2; 11/13/50, 35.8; 4/2/51, 24.5; 11/29/51, 28.4; 4/4/52, 18.7.

12S/3E-8C2—Reference point—top of casing, elevation 64.1 feet. 0.38 mile west of Murphy Road, 0.47 mile south of Chittenden Road. 3/4/47, 32.8; 7/21/47, 40.5; 11/26/47, 33.2; 3/8/48, 31.0; 12/2/48, 39.4; 4/7/49, 33.6; 11/3/49, 43.0.

12S/3E-8L1—Reference point—top of casing, elevation 76.9 feet. 0.83 mile south of Chittenden Road, 0.48 mile east of Murphy Road. 3/4/47, 33.2; 7/21/47, 42.0; 11/26/47, 44.2; 3/8/48, 44.5; 12/2/48, 47.2; 4/7/49, 45.3; 11/7/49, 51.0; 3/21/50, 45.8; 11/13/50, 49.0; 4/2/51, 45.2; 11/29/51, 44.9; 4/4/52, 39.6.

12S/3E-9F1—Reference point—hole in pump base, elevation 105.0 feet. 0.13 mile south of Chittenden Road, 0.60 mile west of Carpenteria Road. 3/5/47, 50.3; 5/14/47, 51.1; 6/12/47, 51.1; 7/24/47, 51.7; 11/26/47, 51.4; 1/27/48, 50.8; 2/16/48, 51.3; 12/3/48, 53.2; 1/14/49, 51.5; 2/17/49, 51.2; 4/7/49, 50.0; 5/3/49, 53.3; 6/1/49, 51.6; 8/2/49, 51.2; 9/1/49, 55.8; 11/4/49, 57.1; 3/20/50, 50.2; 11/13/50, 59.0; 4/2/51, 51.7; 11/29/51, 51.9; 4/4/52, 48.5.

12S/3E-9P1—Reference point—hole in pump base, elevation 105.0 feet. 0.40 mile west of Carpenteria Road, 0.80 mile north of Aromas Road. 3/4/47, 57.0; 8/13/47, 75.1; 11/25/47, 59.4; 12/3/48, 61/2; 11/7/49, 68.0; 3/22/50, 64.4; 11/13/50, 69.7; 11/29/51, 60.7.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

12S/3E-9P2—Reference point—top of casing, elevation 103.0 feet. 0.38 mile west of Carpenteria Road, 0.69 mile north of Aromas Road. 3/4/47, 55.6; 8/3/47, 69.7; 11/26/47, 58.1; 12/3/48, 60.5; 11/7/49, 69.2.

12S/3E-9Q1—Reference point—hole in side of pump base, elevation 102.0 feet. 0.09 mile west of Carpenteria Road, 0.72 mile north of Aromas Road. 3/5/47, 31.2; 7/21/47, 43.0; 11/25/47, 42.3; 3/5/48, 42.0; 12/3/48, 43.2; 4/13/49, 41.4; 11/4/49, 46.5.

12S/3E-9Q2—Reference point—top of casing, elevation 102.0 feet. 0.09 mile west of Carpenteria Road, 0.81 mile north of Aromas Road. 3/5/47, 45.1; 7/21/47, 46.4; 11/26/47, 45.7; 3/5/48, 45.5; 12/3/48, 46.5; 1/14/49, 45.2; 2/17/49, 45.2; 4/7/49, 45.2; 11/4/49, 47.8; 3/22/50, 48.7; 11/13/50, 51.3; 4/2/51, 43.8; 11/29/51, 45.3; 4/4/52, 42.2.

12S/3E-10N1—Reference point—top of casing, elevation 115.0 feet. 0.48 mile east of Carpenteria Road, 0.82 mile north of Carr Road. 3/4/47, 49.2; 8/5/47, 50.9; 12/24/47, 49.1; 3/5/48, 49.5; 12/3/48, 55.9; 12/16/48, 50.9; 4/13/49, 51.1; 11/4/49, 54.0.

12S/3E-10N2—Reference point—top of casing, elevation 115.0 feet. 0.48 mile east of Carpenteria Road, 0.78 mile north of Carr Road. 3/4/47, 47.9; 7/21/47, 55.7; 12/24/47, 48.2; 3/5/48, 48.7; 12/16/48, 50.6; 4/13/49, 50.2.

12S/3E-16A1—Reference point—slot between plank base, elevation 95.0 feet. 0.32 mile east of Carpenteria Road, 0.67 mile north of Carr Road. 3/4/47, 26.5; 7/21/47, 30.0; 11/26/47, 27.6; 3/5/48, 27.0; 12/3/48, 28.5; 4/7/49, 26.6; 11/4/49, 31.5; 3/22/50, 30.1; 11/13/50, 34.2; 4/2/51, 27.5; 11/29/51, 27.7; 4/4/52, 24.9.

12S/3E-16A2—Reference point—top of casing, elevation 105.0 feet. 0.33 mile east of Carpenteria Road, 0.46 mile north of Carr Road. 3/4/47, 41.8; 7/21/47, 45.9; 11/26/47, 43.2; 12/24/47, 43.0; 3/8/48, 43.2; 12/3/48, 44.0; 4/7/49, 42.3; 11/4/49, 46.1; 3/22/50, 44.3; 11/29/51, 43.2.

12S/3E-16B1—Reference point—hole in casing, elevation 85.0 feet. On east side of Carpenteria Road, 0.53 mile north of Aromas Road. 3/5/47, 26.6; 7/21/47, 28.7; 11/26/47, 27.7; 3/5/48, 27.6; 12/2/48, 28.2; 4/7/49, 26.5; 11/4/49, 31.0.

12S/3E-16C1—Reference point—hole in pump base, elevation 105.0 feet. 0.15 mile west of Carpenteria Road, 0.42 mile north of Aromas Road. 7/21/47, 25.5; 11/25/47, 20.3; 12/3/48, 22.8; 4/7/49, 20.5; 11/7/49, 25.5.

12S/3E-16G1—Reference point—top of casing, elevation 98.0 feet. 0.12 mile west of Carpenteria Road, 0.13 mile north of Aromas Road. 3/4/47, 15.0; 7/21/47, 23.1; 11/26/47, 18.5; 3/8/48, 18.0; 12/3/48, 21.0; 4/7/49, 18.7; 11/7/49, 24.2; 3/22/50, 24.8; 4/2/51, 20.1; 11/29/51, 22.3.

12S/3E-16H1—Reference point—hole in pump base, elevation 102.0 feet. 0.26 mile east of Carpenteria Road, 0.34 mile north of Carr Road. 8/20/47, 45.8.

12S/3E-16H2—Reference point—top of casing, elevation 98.0 feet. 0.12 mile east of Carpenteria Road, 0.34 mile north of Carr Road. 8/21/47, 43.4; 12/24/47, 40.1.

12S/3E-16M2—Reference point—top of casing, elevation 105.0 feet. 0.05 mile north of Aromas Road, 0.38 mile west of Carpenteria Road. 3/4/47, 18.7; 6/12/47, 20.6; 7/21/47, 30.4; 11/25/47, 20.8; 1/27/48, 28.3; 2/16/48, 27.2; 3/8/48, 21.0; 12/3/48, 22.8; 1/14/49, 21.5; 2/17/49, 21.5; 5/3/49, 24.0; 6/1/49, 21.6; 7/1/49, 35.0; 9/1/49, 33.0; 3/22/50, 28.0; 11/13/50, 33.0; 4/2/51, 21.4; 11/29/51, 22.9; 4/4/52, 12.2.

12S/3E-17B1—Reference point—top of casing, elevation 72.0 feet. 0.80 mile east of intersection of San Juan and Murphy Roads. 3/4/47, 28.2; 7/21/47, 22.0; 11/26/47, 29.5; 3/8/48, 31.0.

12S/3E-17C1—Reference point—hole in base of pump, elevation 66.9 feet. 0.40 mile east of intersection of San Juan and Murphy Roads. 3/4/47, 40.0; 8/27/47, 45.1; 11/26/47, 37.0; 3/8/48, 38.0; 12/2/48, 37.3; 4/13/49, 43.1; 11/7/49, 42.0; 3/21/50, 46.5; 11/13/50, 41.2; 4/2/51, 34.5; 4/4/52, 30.5.

12S/3E-17D1—Reference point—hole in side of pump base, elevation 63.6 feet. On west side of San Juan Road, 0.25 mile south of Murphy Road. 3/4/47, 30.8; 11/26/47, 34.0; 3/8/48, 38.0; 12/2/48, 36.3; 3/21/50, 30.8; 11/29/51, 35.5; 4/4/52, 22.7.

12S/3E-17E1—Reference point—hole in side of pump base, elevation 64.8 feet. 0.10 mile west of San Juan Road, 0.25 mile south of Murphy Road. 3/4/47, 28.8; 11/26/47, 31.4; 3/8/48, 34.3; 12/2/48, 32.5.

12S/3E-17K1—Reference point—top of casing, elevation 74.0 feet. 0.11 mile east of San Juan Road, 0.83 mile south of Murphy Road. 3/4/47, 27.6; 8/26/47, 36.3; 11/26/47, 28.4; 1/27/48, 28.6; 2/16/48, 27.0; 12/3/48, 30.0.

12S/3E-17M1—Reference point—hole in base of pump, elevation 62.2 feet. 0.30 mile southwest of San Juan Road, 0.40 mile southeast of Murphy Road. 3/4/47, 26.4; 7/21/47, 22.4; 11/26/47, 26.6; 3/8/48, 24.7; 12/2/48, 27.8; 4/7/49, 24.8; 11/7/49, 27.1; 3/21/50, 24.6; 3/29/51, 23.5; 11/29/51, 26.8; 4/4/52, 18.3.

12S/3E-17M3—Reference point—hole in top of casing, elevation 61.9 feet. 0.21 mile southwest of San Juan Road, 0.70 mile southeast of Murphy Road. 3/4/47, 36.2; 8/15/47, 51.1; 11/26/47, 32.1; 3/8/48, 37.0; 12/2/48, 33.9; 4/7/49, 40.0; 11/7/49, 38.0; 3/21/50, 33.8; 11/13/50, 36.7; 3/29/51, 40.2; 11/29/51, 34.0; 4/4/52, 29.6.

12S/3E-18B1—Reference point—top of casing, elevation 61.8 feet. On south side of San Juan Road, 0.20 mile west of Murphy Road. 3/4/47, 30.3; 7/21/47, 43.3; 11/26/47, 33.5; 3/8/48, 33.7; 12/2/48, 34.4; 11/7/49, 39.0; 3/21/50, 35.4; 11/13/50, 35.9; 3/29/51, 32.2; 4/4/52, 28.0.

12S/3E-18C1—Reference point—hole in side of pump base, elevation 61.3 feet. On south side of Southern Pacific Railroad, 0.75 mile west of intersection of railroad and San Juan Road. 3/4/47, 31.8; 7/22/47, 49.3; 11/26/47, 36.2; 3/8/48, 37.4; 12/2/48, 38.7; 4/7/49, 45.6; 11/7/49, 43.0; 3/21/50, 40.1; 11/13/50, 45.2; 3/29/51, 42.9; 11/29/51, 38.4; 4/4/52, 37.9.

12S/3E-18D3—Reference point—top of casing, elevation 67.0 feet. On west side of San Miguel Canyon Road, 0.41 mile south of San Juan Road. 11/26/47, 31.4.

12S/3E-18D4—Reference point—top of casing under pump base, elevation 68.0 feet. 0.16 mile east of San Miguel Canyon Road, 0.35 mile south of San Juan Road. 3/4/47, 27.9; 7/2/47, 45.1; 11/26/47, 31.9; 3/8/48, 33.0; 12/2/48, 34.3; 4/7/49, 40.0; 11/7/49, 40.0.

12S/3E-18E1—Reference point—hole in base of pump, elevation 49.1 feet. On east side of San Miguel Canyon Road, 0.54 mile south of San Juan Road. 3/4/47, 29.0; 7/22/47, 38.9; 11/26/47, 32.5; 3/8/48, 32.7; 12/2/48, 34.7; 4/7/49, 34.7; 11/7/49, 36.7; 3/21/50, 35.2; 11/13/50, 36.8; 3/29/51, 34.8; 11/29/51, 34.4.

12S/3E-18E2—Reference point—slot in concrete base, elevation 69.0 feet. On east side of San Miguel Canyon Road, 0.46 mile south of San Juan Road. 3/4/47, 27.7; 11/26/47, 31.6; 3/8/48, 31.6; 4/7/49, 37.6.

12S/3E-18E3—Reference point—hole in casing, elevation 55.0 feet. On west side of San Miguel Canyon Road, 0.48 mile south of San Juan Road. 3/1/47, 27.8; 7/22/47, 46.8; 11/26/47, 31.9; 3/2/48, 32.0; 12/2/48, 33.6; 1/14/49, 32.8; 2/15/49, 31.3; 4/7/49, 37.4; 11/9/49, 35.2.

12S/3E-18P1—Reference point—pipe in concrete base, elevation 70.0 feet. On west side of San Miguel Canyon Road, 0.08 mile north of Lewis Road. 3/4/47, 28.8; 5/14/47, 29.4; 7/22/47, 29.6; 11/26/47, 30.9; 1/27/48, 30.6; 2/16/48, 30.5; 12/2/48, 32.3; 1/14/49, 32.3; 2/15/49, 37.8; 4/7/49, 31.3; 11/7/49, 33.0; 3/21/50, 31.2; 11/13/50, 33.9; 3/29/51, 31.8; 11/29/51, 32.9; 4/4/52, 29.4.

TABLE 1—Continued

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN SANTA CRUZ-MONTEREY AREA

Measurements Made by Division of Water Resources
(Depths to water in feet measured from reference point)

13S/1E-1A1—Reference point—hole in base of pump, elevation 5.3 feet. At west end of Giberson Road. 8/12/47, 4.0; 12/19/47, 1.8; 2/24/48, 1.5; 12/10/48, 1.6; 3/18/49, 0.4; 8/14/49, 4.3; 11/8/49, 4.0; 3/17/50, 0.4; 11/9/50, 3.1; 3/26/51, 1.0; 11/29/51, 2.6; 4/1/52, 0.0.

13S/2E-4E1—Reference point—top of casing, elevation 91.1 feet. 0.5 mile east of Salinas-Watsonville Road, 0.3 mile south of Springfield School. 9/17/51, 103.0; 10/23/51, 92.1; 4/8/52, 53.4.

13S/2E-4K1—Reference point—bottom of hole in casing, elevation 103.8. 1 mile east of Salinas-Watsonville Road, 0.7 mile south of Beach Road. 10/23/51, 105.4; 11/30/51, 111.2; 4/8/52, 100.7.

13S/2E-5B1—Reference point—bottom of hole in casing, elevation 141.0 feet. 0.2 mile east of Springfield School, 100 feet south of Beach Road. 9/17/51, 147.6; 11/30/51, 138.5; 4/8/52, 84.0.

13S/2E-5D2—Reference point—top of casing, elevation 100 feet. 0.3 mile west of Salinas-Watsonville Road, 0.1 mile south of Beach Road. 9/18/51, 23.0; 11/30/51, 44.0; 4/8/52, 40.9.

13S/2E-5E1—Reference point—top of casing, elevation 17.3 feet. 0.07 mile north of Struve Road, 0.33 mile west of Salinas-Watsonville Road. 8/28/47, 15.9.

13S/2E-5E3—Reference point—top of casing, elevation 25 feet. 0.3 mile west of Salinas-Watsonville Road, 0.3 mile south of Beach Road. 9/18/51, 5.0; 11/30/51, 3.8; 4/8/52, 1.9.

13S/2E-5E4—Reference point—top of pump base, elevation 25 feet. 200 feet southeast of well no. 13S/2E-5E3. 11/30/51, 4.4; 4/8/52, 2.2.

13S/2E-5G1—Reference point—top of concrete base, elevation 120.3 feet. 0.5 mile south of Beach Road, 0.2 mile east of Salinas-Watsonville Road. 9/17/51, 127.5; 10/23/51, 121.2; 11/30/51, 110.1; 4/8/52, 82.0.

13S/2E-5L1—Reference point—top of casing, elevation 15.6 feet. On west side of Salinas-Watsonville Road, 0.15 mile south of Struve Road. 7/15/47, 13.4; 12/23/47, 12.3; 2/25/48, 11.1.

13S/2E-5L2—Reference point—top of casing, elevation 15.6 feet. On east side of Salinas-Watsonville Road, 0.17 mile south of Struve Road. 7/15/47, 12.7; 10/3/47, 15.1; 11/4/47, 15.1; 12/23/47, 11.8; 2/25/48, 10.4.

13S/2E-5L3—Reference point—top of casing, elevation 13.9 feet. 0.06 mile east of Salinas-Watsonville Road, 0.20 mile south of Struve Road. 11/9/48, 8.3.

13S/2E-5M1—Reference point—top of casing in pit, elevation 10.2 feet. 0.25 mile west of Salinas-Watsonville Road, 0.15 mile south of Struve Road. 7/15/47, 10.1; 12/23/47, 6.9; 3/1/48, 6.6; 11/9/48, 19.9; 3/18/49, 15.6; 6/26/49, 22.0; 8/14/49, 24.1; 11/8/49, 22.0.

13S/2E-6B1—Reference point—hole in base of pump, elevation 14.5 feet. On northeast side of McClusky Slough, 0.88 mile south of Jensen Road. 7/15/47, 14.4; 12/19/47, 10.2; 2/25/48, 10.1; 11/9/48, 12.3; 3/18/49, 8.3; 7/17/49, 14.5; 8/14/49, 14.1; 11/8/49, 13.0.

13S/2E-6C1—Reference point—hole in base of pump, elevation 26.0 feet. On north side of Giberson Road, 1.37 miles west of Struve Road. 12/19/47, 22.3; 2/24/48, 22.3; 11/9/48, 28.0; 3/18/49, 21.2; 11/8/49, 25.0.

13S/2E-6E1—Reference point—hole in base of pump, elevation 28.6 feet. 0.18 mile west of Giberson Road, 1.23 miles west of Struve Road. 7/15/47, 27.5; 12/19/47, 25.6; 3/1/48, 25.0; 11/9/48, 26.8; 3/17/49, 24.1; 11/8/49, 27.0.

13S/2E-6E2—Reference point—top of casing, elevation 27.8 feet. 0.07 mile west of Giberson Road, 1.25 miles west of Salinas-Watsonville Highway. 7/31/47, 26.4; 12/19/47, 24.2; 2/24/48, 24.2; 12/10/48, 25.0; 3/18/49, 22.7; 11/8/49, 26.5.

13S/2E-6E3—Reference point—hole in base of pump, elevation 31.4 feet. 0.22 mile west of Giberson Road, 1.07 miles west of Struve Road. 8/21/47, 24.7; 12/19/47, 26.9; 2/24/48, 26.8; 12/10/48, 27.6; 3/18/49, 25.4; 11/8/49, 29.0.

13S/2E-6F1—Reference point—hole in base of pump, elevation 22.8 feet. 0.06 mile east of Giberson Road, 1.25 miles west of Struve Road. 8/12/47, 23.5; 12/19/47, 18.8; 2/24/48, 18.7; 11/9/48, 22.7; 3/17/49, 17.5; 6/26/49, 21.4; 7/17/49, 21.4; 8/14/49, 22.2; 11/8/49, 21.0.

13S/2E-6F2—Reference point—hole in base of pump, elevation 48.4 feet. 0.07 mile east of Giberson Road, 1.03 miles west of Struve Road. 7/31/47, 48.7; 12/19/47, 43.3; 2/24/48, 43.7; 12/10/48, 44.3; 3/18/49, 42.1; 7/17/49, 46.8; 8/14/49, 46.8; 11/8/49, 48.0; 3/17/50, 42.5; 11/9/50, 48.0; 3/26/51, 42.5; 11/27/51, 44.8; 4/1/52, 41.6.

13S/2E-6J1—Reference point—top of casing, elevation 20.4 feet. 0.15 mile west of Struve Road, 0.20 mile north of Giberson Road. 7/15/47, 19.6; 12/19/47, 16.3; 2/25/48, 17.0; 12/10/48, 17.8; 3/18/49, 14.4; 6/26/49, 19.5; 7/17/49, 20.2; 8/14/49, 21.4; 11/8/49, 21.0.

13S/2E-6J2—Reference point—top of casing, elevation 22.9 feet. On west side of Struve Road, 0.10 mile north of Giberson Road. 8/21/47, 25.3; 12/19/47, 19.3; 3/1/48, 18.8; 12/10/48, 21.6; 3/18/49, 17.4; 11/8/49, 24.0.

13S/2E-6M1—Reference point—bottom of pump base, elevation 29.4 feet. 0.21 mile west of Giberson Road, 0.95 mile west of junction of Struve Road and Salinas-Watsonville Highway. 7/15/47, 64.4; 8/31/47, 42.9; 12/19/47, 36.2; 2/24/48, 36.2; 11/9/48, 37.9; 3/18/49, 35.2; 5/2/49, 36.0; 5/31/49, 36.2; 6/26/49, 37.2; 7/17/49, 38.1; 8/2/49, 38.2; 8/14/49, 38.6; 9/1/49, 38.8; 11/8/49, 38.0; 3/17/50, 36.5; 11/9/50, 40.4; 3/26/51, 35.4; 11/27/51, 37.3; 4/1/52, 33.8.

13S/2E-6M2—Reference point—hole in base of pump, elevation 22.7 feet. 0.15 mile west of Giberson Road, 0.90 mile west of junction of Struve Road and Salinas-Watsonville Highway. 7/15/47, 20.3; 12/19/47, 19.0; 2/24/48, 19.4; 11/9/48, 21.0; 3/18/49, 18.8; 11/18/49, 22.0.

13S/2E-6R1—Reference point—hole in base of pump, elevation 26.4 feet. On southwest corner of Struve and Giberson Roads. 8/21/47, 26.5; 12/19/47, 22.3; 2/24/48, 23.7; 11/9/48, 25.8; 3/17/49, 20.4; 8/14/49, 27.1; 11/8/49, 26.0; 3/17/50, 23.8; 11/9/50, 25.9; 3/26/51, 22.4; 11/27/51, 24.6; 4/1/52, 21.0.

13S/2E-7B1—Reference point—hole in base of pump, elevation 19.0 feet. 0.20 mile west of Salinas-Watsonville Road, 0.20 mile southwest of Struve Road. 8/21/47, 20.6; 12/19/47, 15.6; 3/1/48, 15.3; 11/7/49, 19.5.

13S/2E-7B2—Reference point—hole in base of pump, elevation 12.8 feet. 0.15 mile west of Salinas-Watsonville Road, 0.21 mile southwest of Struve Road. 8/21/47, 13.5; 12/19/47, 8.4; 3/1/48, 8.5; 12/10/48, 9.5; 3/17/49, 7.5; 6/26/49, 12.0; 7/17/49, 12.5; 8/14/49, 13.1; 11/8/49, 12.0; 3/17/50, 9.9.

13S/2E-9D1—Reference point—top of inside casing, elevation 5 feet. On private road 1 mile south of Springfield School, 0.6 mile southwest of 60 degree turn in Salinas-Watsonville Road. 9/17/51, 4.6; 4/8/52, 2.5.

TABLE 2

DEPTHS TO GROUND WATER AT AUGER HOLES IN PAJARO UNIT

Measurements Made by United States Soil Conservation Service

Hole number	Date of measurement	Depth to water from ground surface, in feet	Date of measurement	Depth to water from ground surface, in feet
1	1/ 1/43	5.6	8/ 3/43	4.4
	1/16/43	5.7	8/17/43	5.7
	1/30/43	4.2	9/ 4/43	5.2
	2/13/43	5.0	9/18/43	5.6
	3/ 1/43	5.3	10/ 4/43	5.5
	3/16/43	4.3	10/19/43	5.0
	4/ 1/43	4.9	11/18/43	5.4
	4/16/43	4.6	11/18/43	5.7
	5/ 3/43	4.9	12/17/43	6.0
	5/18/43	4.6	1/ 3/44	5.9
	6/ 1/43	5.4	1/15/44	5.6
	6/19/43	5.9	2/ 7/44	4.7
	7/ 1/43	4.9	2/17/44	5.0
	7/17/43	4.9	3/ 1/44	2.3
2	1/ 1/43	7.3	8/ 3/43	6.6
	1/16/43	7.3	8/17/43	6.7
	1/30/43	6.3	9/ 4/43	7.0
	2/13/43	6.2	9/18/43	7.0
	3/ 1/43	6.3	10/ 4/43	7.2
	3/16/43	4.8	10/19/43	7.3
	4/ 1/43	4.8	11/18/43	7.5
	4/16/43	5.2	12/17/43	7.9
	5/ 3/43	5.2	1/ 3/44	7.7
	5/18/43	5.4	1/15/44	7.8
	6/ 1/43	5.8	2/ 7/44	7.3
	6/19/43	6.2	2/17/44	6.8
	7/ 1/43	6.4	3/ 1/44	3.9
	7/17/43	6.6		
3	1/ 1/43	2.8	8/ 3/43	3.8
	1/16/43	3.8	8/17/43	3.1
	1/30/43	1.7	9/ 4/43	3.4
	2/13/43	2.6	9/18/43	3.5
	3/ 1/43	2.6	10/ 4/43	3.9
	3/16/43	2.0	10/19/43	3.9
	4/ 1/43	2.6	11/18/43	4.8
	4/16/43	2.4	12/17/43	4.5
	5/ 3/43	2.6	1/ 3/44	2.9
	5/18/43	2.8	1/15/44	3.0
	6/ 1/43	3.0	2/ 7/44	2.1
	6/19/43	3.3	2/17/44	2.5
	7/ 1/43	3.6	3/ 1/44	1.0
	7/17/43	3.3		
4	1/ 1/43	1.2	7/17/43	2.5
	1/16/43	2.0	8/ 3/43	2.5
	1/30/43	0.7	8/17/43	2.5
	2/13/43	1.3	9/ 4/43	2.6
	3/ 1/43	0.9	9/18/43	2.5
	3/16/43	0.7	10/ 4/43	2.7
	4/ 1/43	1.4	10/19/43	2.9
	4/16/43	2.0	11/18/43	3.2
	5/ 3/43	1.5	12/17/43	3.5
	5/18/43	2.0	1/ 3/44	0.8
	6/ 1/43	1.7	1/15/44	1.2
	6/19/43	1.6	2/ 7/44	0.8
	3/ 1/43	2.7	3/ 1/44	0.5
5	1/ 1/43	2.9	8/ 3/43	3.0
	1/16/43	3.2	8/17/43	2.9
	1/30/43	1.5	9/ 4/43	3.4
	2/13/43	2.5	9/18/43	3.5
	3/ 1/43	2.4	10/ 4/43	1.7
	3/16/43	1.6	10/19/43	3.1
	4/ 1/43	2.2	11/18/43	3.5
	4/16/43	2.3	12/17/43	4.0
	5/ 3/43	2.6	1/ 3/44	3.0
	5/18/43	2.2	1/15/44	2.7
	6/ 1/43	2.7	2/ 7/44	1.9
	6/19/43	2.7	3/ 1/44	0.5
	7/ 1/43	2.9	7/19/46	2.9
	7/17/43	2.3		

Hole number	Date of measurement	Depth to water from ground surface, in feet	Date of measurement	Depth to water from ground surface, in feet
6	1/ 1/43	2.8	8/ 3/43	3.3
	1/16/43	4.0	8/17/43	4.0
	1/30/43	0.7	9/ 4/43	2.7
	2/13/43	3.4	9/18/43	3.7
	3/ 1/43	3.0	10/ 4/43	3.7
	3/16/43	2.1	10/19/43	4.3
	4/ 1/43	3.3	11/18/43	4.8
	4/16/43	3.9	12/17/43	4.9
	5/ 3/43	3.0	1/ 3/44	3.4
	5/18/43	3.4	1/15/44	4.2
	6/ 1/43	3.8	2/ 7/44	1.9
	6/19/43	2.8	3/ 1/44	0.3
	7/ 1/43	3.6	7/19/46	2.0
	7/17/43	3.7		
7	1/ 1/43	2.0	8/ 3/43	2.7
	1/16/43	2.5	8/17/43	2.7
	1/30/43	1.2	9/ 4/43	2.9
	2/13/43	2.2	9/18/43	3.1
	3/ 1/43	1.9	10/ 4/43	3.9
	3/16/43	1.7	10/19/43	4.2
	4/ 1/43	2.2	11/18/43	4.2
	4/16/43	2.9	12/17/43	4.3
	5/ 3/43	2.9	1/ 3/44	2.6
	5/18/43	3.4	1/15/44	3.6
	6/ 1/43	2.7	2/ 7/44	2.1
	6/19/43	2.0	7/15/46	4.7
	7/ 1/43	2.6		
	7/17/43	3.2		
8	1/ 1/43	2.4	7/17/43	3.0
	1/16/43	2.6	8 /3/43	2.4
	1/30/43	1.8	8/17/43	2.8
	2/13/43	2.3	9/11/43	3.0
	3/ 1/43	2.2	9/18/43	3.1
	3/13/43	1.9	10/ 4/43	3.1
	4/ 1/43	2.2	10/19/43	2.6
	4/16/43	2.5	11/18/43	2.9
	5/ 3/43	2.8	12/17/43	1.7
	5/18/43	3.0	1/ 3/44	1.1
	6/ 1/43	3.2	1/15/44	1.6
	6/19/43	3.3	2/ 7/44	1.1
	7/ 1/43	2.7	7/19/46	3.0
9	1/ 1/43	3.3	8/ 3/43	3.2
	1/16/43	3.4	8/17/43	3.6
	1/30/43	2.2	9/ 4/43	3.3
	2/13/43	3.2	9/18/43	3.8
	3/ 1/43	3.0	10/ 4/43	3.4
	3/16/43	3.2	10/19/43	3.3
	4/ 1/43	3.4	11/18/43	3.4
	4/16/43	3.7	12/17/43	2.4
	5/ 3/43	3.7	1/ 3/44	2.2
	5/18/43	3.9	1/15/44	2.3
	6/ 1/43	3.7	2/ 7/44	2.1
	6/19/43	3.9	7/19/46	3.5
	7/ 1/43	3.6		
	7/17/43	3.9		
10	1/ 1/43	2.9	8/ 3/43	2.0
	1/16/43	3.6	8/17/43	2.0
	1/30/43	0.6	9/11/43	2.5
	2/13/43	2.0	9/18/43	2.9
	3/ 1/43	1.6	10/ 4/43	2.9
	3/16/43	1.0	10/19/43	3.1
	4/ 1/43	1.7	11/18/43	4.6
	4/16/43	2.5	12/17/43	4.7
	5/ 3/43	2.2	1/ 3/44	3.7
	5/18/43	2.7	1/15/44	3.3
	6/ 1/43	3.3	2/ 7/44	1.7
	6/19/43	2.6	3/ 1/44	0.6
	7/ 1/43	2.4	7/19/46	3.4
	7/17/43	2.0		

TABLE 2—Continued

DEPTHS TO GROUND WATER AT AUGER HOLES IN PAJARO UNIT

Measurements Made by United States Soil Conservation Service

Hole number	Date of measurement	Depth to water from ground surface, in feet	Date of measurement	Depth to water from ground surface, in feet
11	1/ 1/43	3.1	7/17/43	4.1
	1/16/43	3.8	8/ 3/43	4.2
	1/30/43	1.5	8/17/43	4.6
	2/13/43	3.2	9/ 4/43	3.0
	3/ 1/43	3.0	9/18/43	4.6
	3/16/43	2.1	10/ 4/43	4.8
	4/ 1/43	3.2	10/19/43	4.9
	4/16/43	2.4	12/17/43	5.1
	5/ 3/43	2.1	1/ 3/44	4.7
	5/18/43	3.6	1/15/44	4.6
	6/ 1/43	3.9	2/ 7/44	2.6
	6/19/43	4.0	7/19/46	3.8
	7/ 1/43	4.7		
12	1/ 1/43	5.4	8/ 3/43	5.7
	1/16/43	5.8	8/17/43	5.2
	1/30/43	4.2	9/ 4/43	5.7
	2/13/43	5.5	9/18/43	5.8
	3/ 1/43	5.3	10/ 4/43	5.8
	3/16/43	4.6	10/19/43	5.6
	4/ 1/43	5.4	11/18/43	5.8
	4/16/43	5.6	12/17/43	5.9
	5/ 3/43	5.3	1/ 3/44	5.4
	5/18/43	5.6	1/15/44	5.6
	6/ 1/43	5.7	2/ 9/44	4.8
	6/19/43	5.5	3/ 1/44	1.6
	7/ 1/43	5.7	7/19/46	5.5
	7/17/43	5.6		
13	1/ 1/43	1.9	7/17/43	2.9
	1/16/43	3.0	8/ 3/43	3.1
	1/30/43	0.7	8/17/43	3.2
	2/13/43	1.6	9/ 4/43	2.9
	3/ 1/43	1.1	9/18/43	2.6
	3/16/43	0.6	10/ 4/43	3.0
	4/ 1/43	1.8	10/19/43	2.8
	4/16/43	2.6	11/18/43	3.2
	5/ 3/43	2.0	12/17/43	4.4
	5/18/43	2.4	1/ 3/44	2.0
	6/ 1/43	2.4	1/15/44	2.2
	6/19/43	2.2	2/ 7/44	0.6
	7/ 7/43	2.8	3/ 1/44	0.4
14	1/ 1/43	2.3	7/12/43	3.5
	1/16/43	3.7	8/ 3/43	3.7
	1/30/43	0.6	8/17/43	3.9
	2/13/43	1.8	9/ 4/43	3.5
	3/ 1/13	1.2	9/18/43	3.0
	3/16/43	0.9	10/ 4/43	3.6
	4/ 1/43	1.8	10/19/43	3.7
	4/16/43	2.8	11/18/43	4.2
	5/ 3/43	2.1	12/17/43	4.9
	5/18/43	2.1	1/ 3/44	3.0
	6/ 1/43	3.0	1/15/44	2.7
	6/19/43	2.0	2/ 7/44	1.0
	7/ 1/43	3.5	7/19/46	4.3

Hole number	Date of measurement	Depth to water from ground surface, in feet	Date of measurement	Depth to water from ground surface, in feet
15	1/ 1/43	4.7	8/ 3/43	4.0
	1/16/43	5.2	8/17/43	3.6
	1/30/43	1.4	9/ 4/43	4.4
	2/13/43	3.2	9/18/43	4.4
	3/ 1/43	3.4	10/ 4/43	4.9
	3/16/43	1.3	10/19/43	5.5
	4/ 1/43	2.1	11/18/43	6.0
	4/16/43	2.8	12/17/43	6.3
	5/ 3/43	2.5	1/ 3/44	5.9
	5/18/43	2.7	1/14/44	5.6
	6/ 1/43	3.0	2/ 7/44	4.2
	6/19/43	2.9	3/ 1/44	0.6
	7/ 1/43	3.3	7/19/46	4.5
	7/17/43	3.4		
16	1/ 1/43	7.7	5/18/43	4.8
	1/16/43	8.9	6/ 1/43	5.9
	1/30/43	3.1	6/19/43	6.5
	2/13/43	5.7	7/ 1/43	8.5
	3/ 1/43	6.2	7/17/43	7.8
	3/16/43	2.1	8/ 3/43	7.5
	4/ 1/43	3.7	8/17/43	7.7
	4/16/43	6.2	9/ 4/43	7.6
	5/ 3/43	6.6	3/ 1/44	1.3
17	1/ 1/43	7.1	5/18/43	5.7
	1/30/43	5.8	6/ 1/43	6.1
	3/16/43	4.6	6/19/43	6.6
	4/ 1/43	4.5	1/ 3/44	6.2
	4/16/43	4.9	2/ 7/44	6.6
	5/ 3/46	5.2	3/ 1/44	0.5
18	1/ 1/43	3.0	7/17/43	2.6
	1/16/43	4.0	8/ 3/43	3.8
	1/30/43	0.5	8/17/43	2.4
	2/13/43	2.3	9/ 4/43	3.7
	3/ 1/43	1.7	9/18/43	3.9
	3/16/43	1.0	10/ 4/43	5.1
	4/ 1/43	1.7	10/19/43	4.7
	4/16/43	2.3	11/18/43	5.8
	5/ 3/43	1.7	12/17/43	6.5
	5/18/43	2.1	1/ 3/44	5.5
	6/ 1/43	2.7	1/15/44	5.9
	6/19/43	2.8	2/ 7/44	1.4
	7/ 1/43	2.8	7/19/46	3.8
19	1/30/43	4.2	2/ 7/44	4.9
	3/16/43	5.1	3/ 1/44	4.1
	4/ 1/43	5.1	7/19/46	4.0
	5/ 3/43	4.6		
	5/18/43	5.4		
20	1/ 1/43	8.3	6/ 1/43	5.0
	1/16/43	8.1	6/19/43	5.3
	1/30/43	4.7	7/ 1/43	5.7
	2/13/43	5.7	7/16/43	6.3
	3/ 1/43	5.2	8/ 3/43	6.8
	3/16/43	1.8	8/17/43	6.8
	4/ 1/43	2.9	9/ 4/43	7.5
	4/16/43	4.1	9/18/43	7.6
	5/ 3/43	4.3	10/ 4/43	7.9
	5/18/43	4.8	2/ 7/44	7.3
			3/ 1/44	0.9
			7/19/46	6.0

APPENDIX F

RECORDS OF PARTIAL MINERAL ANALYSES OF GROUND WATER IN SANTA CRUZ-MONTEREY AREA

RECORDS OF PARTIAL MINERAL ANALYSES OF GROUND WATER IN SANTA CRUZ-MONTEREY AREA

Well number	Date sampled	Chlorides, in ppm	Total solids, in ppm	Well number	Date sampled	Chlorides, in ppm	Total solids, in ppm
11S/1E-13A1	5/23/49	10	290	12S/2E-11C1	7/ 8/49	50	650
11S/1E-13H1	7/ 7/49	30	370	12S/2E-11C1	9/13/49	60	600
11S/1E-13J1	7/ 5/49	30	300	12S/2E-11H1	7/ 8/49	70	830
11S/1E-24F1	9/14/49	30	280	12S/2E-11H1	9/14/49	40	520
11S/1E-24J1	7/ 5/49	30	265	12S/2E-11H2	5/24/49	60	740
11S/1E-25R1	7/ 5/49	20	330	12S/2E-12J1	9/13/49	70	680
11S/2E- 8F2	5/23/49	20	142	12S/2E-13A1	7/ 8/49	50	650
11S/2E- 8L1	7/ 7/49	30	230	12S/2E-14E1	9/13/49	40	400
11S/2E-15M1	7/ 5/49	30	485	12S/2E-15A2	7/16/49	40	680
11S/2E-15M1	9/14/49	20	390	12S/2E-15D3	7/ 8/49	60	650
11S/2E-17R1	5/25/49	20	300	12S/2E-16A1	7/ 8/49	30	455
11S/2E-17R1	7/ 5/49	20	350	12S/2E-16L1	5/23/49	30	520
11S/2E-19D1	7/ 5/49	20	350	12S/2E-16J1	9/12/49	40	460
11S/2E-19R1	5/23/49	20	300	12S/2E-16P2	7/ 7/49	50	630
11S/2E-19R1	7/ 5/49	30	330	12S/2E-16R1	9/13/49	40	420
11S/2E-20E1	9/14/49	10	280	12S/2E-17A1	5/29/49	30	520
11S/2E-21N1	7/ 5/49	20	370	12S/2E-17D1	7/ 7/49	30	440
11S/2E-21Q1	9/14/49	10	290	12S/2E-17D1	9/13/49	40	370
11S/2E-22L1	7/ 6/49	40	430	12S/2E-17K1	7/ 6/49	40	540
11S/2E-23G2	7/ 8/49	40	330	12S/2E-17N1	7/ 7/49	40	440
11S/2E-23N1	7/19/49	10	320	12S/2E-17N1	9/12/49	20	370
11S/2E-25F1	7/ 7/49	30	325	12S/2E-18A3	5/23/49	10	300
11S/2E-26G1	5/24/49	40	520	12S/2E-18D1	9/13/49	10	230
11S/2E-26G1	7/ 5/49	40	540	12S/2E-18L1	5/23/49	20	300
11S/2E-26R1	9/14/49	30	240	12S/2E-18L1	7/ 6/49	20	335
11S/2E-28N1	7/ 6/49	30	430	12S/2E-18N1	9/13/49	30	290
11S/2E-30K1	7/ 5/49	20	330	12S/2E-19A1	5/23/49	20	450
11S/2E-31Q1	7/ 7/49	50	390	12S/2E-19C1	5/25/49	20	360
11S/2E-33R1	7/ 6/49	30	375	12S/2E-19C1	7/ 6/49	30	370
11S/2E-33R1	9/14/49	20	310	12S/2E-19E1	7/ 6/49	30	395
11S/2E-34D2	7/ 5/49	50	485	12S/2E-19L1	5/25/49	30	440
11S/2E-35B1	7/ 7/49	50	370	12S/2E-19L1	9/12/49	20	380
11S/2E-36B2	5/24/49	20	380	12S/2E-19M1	7/ 6/49	30	455
11S/2E-36C1	7/ 8/49	30	480	12S/2E-20A1	7/ 8/49	60	630
11S/2E-36C1	9/14/49	20	420	12S/2E-25Q1	7/ 7/49	60	455
11S/2E-36J1	5/24/49	30	420	12S/2E-29B2	7/ 8/49	30	455
11S/2E-36J1	7/ 6/49	40	485	12S/2E-30E2	9/12/49	50	330
11S/2E-36M2	5/24/49	30	630	12S/2E-30F1	7/ 7/49	40	390
11S/3E-31R1	7/ 7/49	50	630	12S/2E-30F2	7/ 7/49	2,190	5,700
12S/1E-1R1	5/23/49	20	300	12S/2E-30M1	5/25/49	20	300
12S/1E-1R1	7/ 6/49	20	330	12S/2E-30P1	5/24/49	40	230
12S/1E-12Q1	7/ 6/49	30	280	12S/2E-31B1	7/ 8/49	50	220
12S/1E-24G1	7/ 6/49	30	375	12S/2E-31C2	9/12/49	30	270
12S/1E-25B1	9/13/49	740	1,500	12S/2E-31K1	7/ 8/49	60	425
12S/1E-25Q1	7/ 7/49	60	455	12S/3E- 6E2	7/ 7/49	50	630
12S/1E-25Q1	9/12/49	40	350	12S/3E- 7C1	5/24/49	70	720
12S/1E-36A1	5/24/49	40	420	12S/3E- 7C1	7/ 8/49	70	750
12S/1E-36A1	7/ 7/49	60	420	12S/3E- 7C1	9/13/49	70	650
12S/1E-36A1	9/12/49	70	350	12S/3E- 7H1	7/ 8/49	80	780
12S/2E- 2H1	5/24/49	30	840	12S/3E- 9P1	5/24/49	80	800
12S/2E- 2H1	7/ 6/49	50	990	12S/3E- 9P1	7/ 8/49	100	830
12S/2E- 2H1	9/14/49	60	680	12S/3E-10N1	9/13/49	100	460
12S/2E- 3K1	5/24/49	30	520	12S/3E-16A2	5/24/49	50	630
12S/2E- 3K3	7/ 8/49	30	535	12S/3E-16A2	7/ 8/49	60	670
12S/2E- 6L1	9/13/49	10	330	12S/3E-16M2	7/ 8/49	100	710
12S/2E- 6P1	7/ 6/49	30	340	12S/3E-17C1	9/13/49	70	580
12S/2E- 7E1	9/14/49	20	300	12S/3E-17K2	7/ 8/49	60	430
12S/2E- 8G2	7/ 6/49	30	425	12S/3E-18B1	5/24/49	50	740
12S/2E- 8H1	9/13/49	10	330	12S/3E-18B1	7/ 8/49	50	750
12S/2E- 8L1	5/23/49	20	350	13S/1E- 1A1	7/ 8/49	250	970
12S/2E- 8L3	7/ 6/49	30	460	13S/1E- 1A1	9/12/49	270	780
12S/2E- 8M1	9/13/49	20	300	13S/2E- 6B1	5/24/49	70	480
12S/2E-10F1	9/13/49	50	430	13S/2E- 6F1	9/12/49	130	500
12S/2E-10K1	7/ 8/49	50	650	13S/2E- 6J2	9/12/49	60	370
12S/2E-10N3	5/24/49	40	480	13S/2E- 7B1	7/ 8/49	330	1,130
12S/2E-11A1	9/13/49	60	580	13S/2E- 7B1	9/12/49	370	880

APPENDIX G

APPLICATIONS TO APPROPRIATE WATER IN SANTA CRUZ-MONTEREY AREA

(Filed with Division of Water Resources, Department of Public Works, under provisions of Water Code, State of California)

APPLICATIONS TO APPROPRIATE WATER IN SANTA CRUZ-MONTEREY AREA

(Filed With Division of Water Resources, Department of Public Works, Under Provisions of Water Code, State of California)

Application number	Date filed	Name of applicant	Source of water supply	Location of diversion point, referenced to Mt. Diablo base and meridian	Diversion in second-feet	Diversion in gallons per day	Storage, in acre-feet	Period of diversion	Purpose	Status
1744	3/31/20	C. E. Schmitt	Laurel Creek	NW¼ SE¼ Sec. 27, T.9S., R.1W.	0.067			Jan. 1 to Dec. 31	Irrigation and domestic	License
2714	1/4/22	Paul J. and Francis E. Sikora, Caroline Drews, and Helen A. Kelley	Mill Creek	SE¼ SE¼ Sec. 23, T.10S., R.3W.	0.23			May 1 to Oct. 1	Irrigation and domestic	License
2867	6/6/22	(See Application No. 2714)	Mill Creek	SE¼ SE¼ Sec. 23, T.10S., R.3W.	1.6			May 1 to Oct. 1	Hydro-mech. power	License
2897	6/22/22	L. Poletti and T. A. Morelli	Scott Creek	NE¼ NE¼ Sec.19, T.10S., R.3W.	1.67			May 1 to Dec. 1	Irrigation and domestic	License
2898	6/22/22	L. Poletti and T. A. Morelli	Scott Creek	NE¼ SE¼ Sec. 9, T.10S., R.3W.	0.33			May 1 to Dec. 1	Irrigation and domestic	License
2899	6/22/22	L. Poletti and T. A. Morelli	Scott Creek	SE¼ NE¼ Sec.19, T.10S., R.3W.	0.28			May 1 to Dec. 1	Irrigation and domestic	License
3003	8/24/22	Mr. and Mrs. Daniel Halsted Staffer	Unnamed spring	SW¼ NW¼ Sec.25, T.10S., R.3W.	0.043			Mar. 1 to Dec. 1	Irrigation and domestic	License
3286	3/9/23	Mary de Fremery Atkins, Elizabeth Steele	New Years Creek	NW¼ SE¼ Sec.28, T.9S., R.4W.	9			Jan. 1 to Dec. 31	Irrigation	Permit
		Kent, Trustee, and Flora Steele					155.5	Oct. 1 to May 31		
3693	10/25/23	Division of Beaches and Parks	Craig Spring	NE¼ NE¼ Sec.18, T.8S., R.2W.	0.068			Jan. 1 to Dec. 31	Highway maintenance and domestic	License
4017	6/9/24	City of Santa Cruz	San Lorenzo River	SE¼ NW¼ Sec.12, T.11S., R.2W.						
			Well No. 1	SE¼ NW¼ Sec.12, T.11S., R.2W.						
			Well No. 2	NE¼ NW¼ Sec.12, T.11S., R.2W.	6.2			Jan. 1 to Dec. 31	Municipal and domestic	License
			Well No. 3	NE¼ NW¼ Sec.12, T.11S., R.2W.						
			Well No. 4	NE¼ NW¼ Sec.12, T.11S., R.2W.						
4667	7/1/25	Lompico Cooperative Water Association	Lompico Creek	NW¼ NE¼ Sec.35, T.9S., R.2W.		24,000		Jan. 1 to Dec. 31	Domestic	License
4842	11/24/25	Forest Lakes Mutual Water Company	Gold Gulch	SE¼ NE¼ Sec.29, T.10S., R.2W.	0.6			Jan. 1 to Dec. 31	Domestic	Permit
				SE¼ NE¼ Sec.29, T.10S., R.2W.						
				SW¼ NW¼ Sec.28, T.10S., R.2W.						
			2 unnamed streams	SE¼ NW¼ Sec.28, T.10S., R.2W.						
				SE¼ NW¼ Sec.28, T.10S., R.2W.			100	Nov. 1 to May 31		
				NW¼ NE¼ Sec.28, T.10S., R.2W.						
				NE¼ NE¼ Sec.28, T.10S., R.2W.						
5055	6/14/26	Zayante Water Company	Zayante Creek	NE¼ NE¼ Sec.2, T.10S., R.2W.	0.2			Jan. 1 to Dec. 31	Domestic	Permit
5215	9/20/26	City of Santa Cruz	San Lorenzo River	SE¼ NW¼ Sec.12, T.11S., R.2W.						
			Well No. 1	SE¼ NW¼ Sec.12, T.11S., R.2W.						
			Well No. 2	NE¼ NW¼ Sec.12, T.11S., R.2W.	25			Jan. 1 to Dec. 31	Municipal and domestic	Permit
			Well No. 3	NE¼ NW¼ Sec.12, T.11S., R.2W.						
			Well No. 4	NE¼ NW¼ Sec.12, T.11S., R.2W.						
5297	12/6/26	Felton Water Company	Bennett Creek	NW¼ NW¼ Sec.21, T.10S., R.2W.	0.232			Jan. 1 to Dec. 31	Domestic	Permit
			Shingle Mill Creek	SW¼ SW¼ Sec.21, T.10S., R.2W.						
5298	12/6/26	Felton Water Company	Bennett Creek	NW¼ NW¼ Sec.21, T.10S., R.2W.	0.232			Jan. 1 to Dec. 31	Irrigation	Permit
			Shingle Mill Creek	SW¼ SW¼ Sec.21, T.10S., R.2W.						
5299	12/6/26	Felton Water Company	Bennett Creek	NW¼ NW¼ Sec.21, T.10S., R.2W.	0.232			Jan. 1 to Dec. 31	Municipal	Permit
			Shingle Mill Creek	SW¼ SW¼ Sec.21, T.10S., R.2W.						
5689	9/14/27	Bracken Brae Country Club	West Fork of Sand Creek	NE¼ NW¼ Sec.24, T.9S., R.3W.		8,825		Jan. 1 to Dec. 31	Domestic	License
5784	12/31/27	Paradise Park Masonic Club	Eagle Creek	SE¼ SE¼ Sec.35, T.10S., R.2W.	0.12			May 1 to Nov. 15	Irrigation and domestic	License
5990	7/20/28	Margaret Ann Werner	Bean Creek	NE¼ SW¼ Sec.13, T.10S., R.2W.		1,500		Jan. 1 to Dec. 31	Irrigation and domestic	License
6813	10/1/30	Theodore J. Hoover	Waddell Creek	NW¼ SW¼ Sec.35, T.9S., R.4W.	1.8			May 1 to Oct. 31	Irrigation	License
7942	5/21/34	Theodore J. Hoover	Waddell Creek	NW¼ SW¼ Sec.35, T.9S., R.4W.	1			May 1 to Nov. 1	Irrigation	License
8843	12/5/36	Felton Water Company	Bennett Creek	NW¼ NW¼ Sec.21, T.10S., R.2W.	0.50			Jan. 1 to Dec. 31	Domestic	Permit
8844	12/5/36	Felton Water Company	Bulls Creek	SE¼ NW¼ Sec.21, T.10S., R.2W.	1			Jan. 1 to Dec. 31	Domestic	Permit
8845	12/5/36	Felton Water Company	Fall Creek	SE¼ SE¼ Sec.16, T.10S., R.2W.	0.75			Jan. 1 to Dec. 31	Domestic and irrigation	Permit
8999	6/14/37	Riverside Grove Water Company	San Lorenzo River	NW¼ SE¼ Sec.1, T.9S., R.3W.	0.1			Nov. 1 to June 1	Domestic	Permit
9604	6/2/39	San Lorenzo Valley County Water District	Newell Creek	NW¼ NW¼ Sec.3, T.10S., R.2W.			5,000	Nov. 1 to May 31	Domestic, recreational, fire protection	Application filed
9629	6/20/39	San Lorenzo Valley County Water District	Fall Creek No. 1	NW¼ NE¼ Sec.21, T.10S., R.2W.	2		55	Nov. 1 to May 31	Domestic, recreational, fire protection	Application filed
			Fall Creek No. 2	SW¼ NW¼ Sec.16, T.10S., R.2W.	2		83	Nov. 1 to May 31		
			Bear Creek	SW¼ NW¼ Sec.21, T.9S., R.2W.	5		7,350	Nov. 1 to May 31		
			Newell Creek	NW¼ NW¼ Sec.3, T.10S., R.2W.	5		2,000	Nov. 1 to May 31		
10346	12/26/41	San Lorenzo Valley County Water District	San Lorenzo River	NE¼ SW¼ Sec.25, T.8S., R.3W.	3		2,000	Nov. 1 to May 31	Domestic, recreational, fire protection	Application filed
			Boulder Creek	NE¼ NE¼ Sec.23, T.9S., R.3W.	2		113			
			Boulder Creek	SW¼ SW¼ Sec.2, T.9S., R.3W.	2		795			
10409	3/19/42	San Lorenzo Valley County Water District	San Lorenzo River	NE¼ SW¼ Sec.25, T.8S., R.3W.			1,596	Nov. 1 to May 31	Domestic, recreational, fire protection	Application filed

APPLICATIONS TO APPROPRIATE WATER IN SANTA CRUZ-MONTEREY AREA—Continued

(Filed With Division of Water Resources, Department of Public Works, Under Provisions of Water Code, State of California)

Application number	Date filed	Name of applicant	Source of water supply	Location of diversion point, referenced to Mt. Diablo base and meridian	Diversion in second-feet	Diversion in gallons per day	Storage, in acre-feet	Period of diversion	Purpose	Status
11750	2/28/47	Monte Vista Christian School, Inc.	3 unnamed streams (tributary to Green Valley Creek)	SE¼ SE¼ Sec.8, T.11S., R.2E. NE¼ SE¼ Sec.8, T.11S., R.2E. SW¼ SW¼ Sec.9, T.11S., R.2E.			8 2 2	Nov. 1 to Apr. 1	Irrigation	Permit
11922	6/ 9/47	Aida K. Roy	Bonanza Spring	SW¼ NE¼ Sec.6, T.10S., R.2W.		1,700		Jan. 1 to Dec. 31	Domestic	License
11923	6/ 9/47	Preston L. and Ruth Prescott	Bonanza Spring	SW¼ NE¼ Sec.6, T.10S., R.2W.		2,500		Jan. 1 to Dec. 31	Domestic	Permit
12381	3/ 3/48	Mae L. Hughes	Unnamed stream (tributary to Moore Creek)	SW¼ NE¼ Sec.27, T.10S., R.1W.	0.12			Mar. 1 to Nov. 30	Irrigation and domestic	Permit
12406	3/16/48	City of Santa Cruz	Kings, Bear, Boulder, Newell, Zayante, Fall Creeks, and Upper San Lorenzo River	SW¼ NE¼ Sec.12, T.11S., R.2W. (Point of diversion is from San Lorenzo River)			31,400	Oct. 1 to May 1	Municipal, domestic, and irrigation	Application filed
12407	3/16/48	City of Santa Cruz	Soquel Creek	SW¼, Sec.23, T.10S., R.1W.	16.5		 12,000	Jan. 1 to Dec. 31 Oct. 1 to May 1	Municipal, domestic, and irrigation	Application filed
12474	4/14/48	Mary de Fremery Atkins	Finney Creek	SW¼ SW¼ Sec.27, T.9S., R.4W. NW¼ NW¼ Sec.34, T.9S., R.4W.	 1		45	Oct. 1 to May 31 Jan. 1 to Dec. 31	Domestic and irrigation	Permit
12640	8/11/48	Northern California and Nevada District Council of the Assemblies of God, Inc.	Carbonero Creek	NE¼ SW¼ Sec.8, T.10S., R.1W.	0.05 0.25			Oct. 1 to June 1 June 1 to Oct. 1	Domestic	Permit
12763	10/26/48	Division of Beaches and Parks	Sempervirens Creek	SE¼ SE¼ Sec.32, T.8S., R.3W.			46.2	Nov. 30 to Apr. 30	Domestic and recreational	Permit
12777	11/ 4/48	San Lorenzo Valley County Water District	Kings Creek	SW¼ NE¼ Sec.31, T.8S., R.2W.			55	Oct. 1 to May 31	Fire protection, domestic, and recreational	Application filed
12886	12/30/48	J. B. Coykendall	Unnamed creek (tributary to Moore Creek)	NE¼ SE¼ Sec.27, T.10S., R.1W.	0.15			Jan. 1 to Dec. 31	Domestic and irrigation	Permit
13147	6/10/49	P. H. Rowe	Unnamed creek (tributary to Casserly Creek)	SW¼ SE¼ Sec.15, T.11S., R.2E.			22	Dec. 1 to May 31	Irrigation	Permit
13396	10/13/49	Soquel Union Elementary School	Soquel Creek	NW¼ SE¼ Sec.10, T.11S., R.1W.	0.029			Mar. 15 to Nov. 1	Irrigation	Permit
13562	2/ 3/50	Charles W. Clark	Doyle Gulch	SW¼ NE¼ Sec.4, T.11S., R.1W.			3.1	Nov. 1 to Apr. 1	Irrigation	Permit
13760	5/26/50	D. C. and A. J. Bequette	Unnamed stream (tributary to Green Valley Creek)	SE¼ NE¼ Sec.8, T.11S., R.2E.			2.92	Oct. 1 to May 1	Irrigation	Permit
13799	6/19/50	Teresa Hihn	East Branch Valencia Creek	SW¼ SW¼ Sec.34, T.10S., R.1E.	0.33			Jan. 1 to Dec. 31	Irrigation and domestic	Permit
13977	10/ 3/50	D. McCulloch	Unnamed stream (tributary to Green Valley Creek)	NE¼ SE¼ Sec.8, T.11S., R.2E.			5	Sept. 15 to June 15	Domestic and irrigation	Permit
14317	5/22/51	Margaret Bennett	Bonanza Spring	SW¼ NE¼ Sec.6, T.10S., R.2W.		2,500		Jan. 1 to Dec. 31	Domestic	Permit
14323	5/24/51	Mary and Joe Correia	Bonanza Spring	SW¼ NE¼ Sec.6, T.10S., R.2W.		2,500		Jan. 1 to Dec. 31	Domestic	Permit
14383	7/ 9/51	M. G. and Irene E. Emminger	Bonanza Spring	SW¼ NE¼ Sec.6, T.10S., R.2W.		2,500		Jan. 1 to Dec. 31	Domestic	Permit
14403	7/23/51	Warren L. Harrison	Unnamed creek (within City of Santa Cruz)	NE¼ SE¼ Sec.14, T.11S., R.2W.		900		Mar. 1 to Nov. 30	Domestic	Permit
14411	7/31/51	Harry F. and Diana B. Salyer	Bonanza Spring	SW¼ NE¼ Sec.6, T.10S., R.2W.		2,500		Jan. 1 to Dec. 31	Domestic	Permit
14449	8/28/51	Bruce Rider	Jesus Creek	SE¼ NW¼ Sec.30, T.11S., R.2E.	 0.28		9	Dec. 1 to Sept. 30 May 15 to June 20	Irrigation	Permit
14573	11/ 8/51	Teresa Hihn	East Branch Valencia Creek	SW¼ SW¼ Sec.34, T.10S., R.1E.			6	Oct. 1 to June 30	Irrigation	Permit
14847	6/10/52	Clarence King	Bean Creek	SW¼ SE¼ Sec.13, T.10S., R.2W.	0.33			Apr. 15 to Nov. 15	Irrigation	Application filed
15076	11/ 5/52	Robert A. Houghton, et al	Stream tributary to Carbonero Creek	SW¼ SE¼ Sec.24, T.10S., R.2W.	0.111			Mar. 15 to Oct. 15	Irrigation	Permit

APPENDIX H

RECORDS OF APPLICATION OF GROUND WATER TO REPRESENTATIVE CROPS IN SANTA CRUZ-MONTEREY AREA

(Plot studies conducted by the Division of Water Resources in cooperation with the Soil Conservation Service of the United States Department of Agriculture)

APPLICATION OF GROUND WATER TO REPRESENTATIVE CROPS IN SANTA CRUZ-MONTEREY AREA IN 1947 AND 1949

(In inches of depth)

Crop	Season	Plot No., Plate 18	Well number	Method of irrigation	Acres irrigated	Jan.-March	April	May	June	July	August	Sept.	Oct.	Nov.-Dec.	Total
Alfalfa	1947	1	11S/2E-21G1	Check	15		1.4	3.4	3.4	3.9	4.6	2.3	0.3		19.3
	1947	2	11S/2E-17R1	Border check	3.5			5.3		9.3	8.0				22.6
	1947	3	11S/2E-15M1	Border check	5			6.9		8.9		4.7			20.5
	1949	3	11S/2E-15M1	Border check	15				5.96	6.49	3.96		7.0		23.4
	1949	3	11S/2E-15M1	Border check	5			11.8		7.26	10.9				29.9
	1949	2	11S/2E-17R1	Border check	3		5.18	10.85	16.10	8.07	11.18	12.94	4.85		69.2
									Weighted mean depths:						
									1947 19.8 inches (1.65 feet)						
									1949 30.8 inches (2.57 feet)						
									1947 and 1949 25.2 inches (2.10 feet)						
Artichokes	1947	4	12S/2E-31K1	Sprinkler	25		3.5	0.6			2.7	2.5			9.3
	1947	5	12S/1E-25B1	Basin furrow	115			1.1	4.1	3.7	3.7	3.6	0.2		16.4
	1947	5	12S/1E-25B1		23		3.1								3.1
	1949	5	12S/1E-25B1	Border check	95		1.46	1.55	3.36	3.52	2.20	3.88	3.39		19.4
									Weighted mean depths:						
									1947 13.4 inches (1.12 feet)						
									1949 19.4 inches (1.62 feet)						
									1947 and 1949 15.7 inches (1.31 feet)						
Beans	1947	6	12S/3E-5D1	Furrow	37.2				4.0	7.0					11.0
	1947	7	11S/2E-33F2	Furrow	18				7.7						7.7
	1947	8	12S/3E-9F1	Furrow	13.5				5.2						5.2
	1947	9	11S/2E-23N1	Furrow	8				1.2						1.2
	1947	2	11S/2E-17R1	Row and furrow	8			4.6	4.0	4.4					13.0
	1947	10	11S/2E-21C1	Row and furrow	32			0.8	5.6	13.0	2.5				21.9
	1947	3	11S/2E-15M1	Furrow	37				6.9	2.8					9.7
	1947	3	11S/2E-15M1	Furrow	12			6.0							6.0
	1947	11	11S/2E-15Q2	Furrow	5.5				13.4	8.9					22.3
	1947	12	11S/2E-8D1	Furrow	17					9.9	3.8				13.7
	1949	3	11S/2E-15M1	Furrow	5			8.05	8.11	12.74	8.18				37.1
	1949	3	11S/2E-15M1	Furrow	8				5.15		5.80				10.9
	1949	9	11S/3E-23N1	Furrow	7.5				2.10		0.87	0.54			3.5
	1949	10	11S/2E-21C1	Furrow	20		2.94		2.55	2.94					8.4
	1949	6	12S/3E-5D1	Furrow	35				4.00	7.00					11.0
	1949	8	12S/3E-9F1	Furrow	18				5.20						5.2
									Weighted mean depths:						
									1947 11.8 inches (0.99 foot)						
									1949 10.1 inches (0.84 foot)						
									1947 and 1949 11.2 inches (0.93 foot)						
Berries (bush)	1947	13	12S/1E-1C1	Contour furrow	15.0			1.6	2.0	0.9	0.5	0.8			5.8
	1947	14	11S/1E-24J1	Furrow	8.4			3.6	2.3	1.5					7.4
	1947	2	11S/2E-17R1	Row and furrow	9			6.0			0.6				6.6
	1947	10	11S/2E-21C1	Furrow	10		6.5	11.4	12.9	1.8		6.9	0.1		39.6
	1947	15	11S/2E-19R1	Furrow	30			11.5	2.1						13.6
	1947	16	11S/2E-20E1	Furrow	18			2.7	5.6	2.9					11.2
	1947	17	11S/2E-8L1	Furrow	5				7.7						7.7
	1949	2	11S/2E-17R1	Furrow	6		6.60		4.50		6.46				17.6
	1949	15	11S/3E-19R1	Furrow	10			29.40	25.06	13.18					67.6
	1949	16	11S/2E-20E1	Furrow	18				2.26	1.56	1.76				5.6
	1949	16	11S/2E-20E1	Furrow	4			5.91	5.71	5.86		3.10			20.6
	1949	14	11S/1E-24J1	Furrow	8		4.73		8.80	3.80					17.3
	1949	10	11S/2E-21C1	Furrow	6				12.90	12.50					25.4
									Weighted mean depths:						
									1947 13.1 inches (1.09 feet)						
									1949 24.0 inches (2.00 feet)						
									1947 and 1949 15.0 inches (1.42 feet)						
Lettuce (1-crop)	1947	18	12S/2E-11E3	Furrow	20	3.7	3.7								7.4
	1947	19	12S/2E-1R1	Furrow	14	3.1	2.6								5.7
	1947	6	12S/3E-5D1	Cross slope furrow	37.2		1.7	0.4							2.1
	1947	20	11S/2E-26F1	Furrow	28.0		10.6	3.4	7.5						21.5
	1947	7	11S/2E-33F2	Furrow	20		4.6	5.1	0.9						10.6
	1947	9	11S/3E-23N1	Furrow	8.0		1.3	0.9							2.2
	1947	3	11S/2E-15M1	Furrow	13.0			2.1							2.1
	1947	3	11S/2E-15M1	Furrow	10.0			4.1							4.1
	1949	20	11S/2E-26F1	Furrow	51.7		4.15	3.46	3.06						10.7
	1949	20	11S/2E-26F1	Furrow	26.0				6.74						6.7
	1949	3	11S/2E-15M1	Furrow	20		3.70	1.73							5.4
	1949	3	11S/2F-15M1	Furrow	8		7.1	2.9							10.0
	1949	3	11S/2E-15M1	Furrow	7		7.1								7.1
	1949	9	11S/3E-23N1	Furrow	12		1.52	0.84							2.4

APPLICATION OF GROUND WATER TO REPRESENTATIVE CROPS IN SANTA CRUZ-MONTEREY AREA IN 1947 AND 1949—Continued

(In inches of depth)

Crop	Season	Plot No., Plate 18	Well number	Method of irrigation	Acres irrigated	Jan.-March	April	May	June	July	August	Sept.	Oct.	Nov.-Dec.	Total
Lettuce (1-crop)—Continued	1949	6	12S/3E-5D1	Furrow	37.2		2.63	1.30							3.9
	1949	21	11S/2E-28P1	Furrow	10.0	4.63	2.70	2.90							10.2
									Weighted mean depths:						
									1947 8.0 inches (0.67 foot)						
									1949 7.0 inches (0.58 foot)						
									1947 and 1949 7.4 inches (0.62 foot)						
Lettuce (2-crop)	1947	22	12S/2E-16L1	Furrow	40.0		3.6		3.5	4.8	2.9	1.8			16.6
	1947	22	12S/2E-16L1	Furrow	30.0		3.5	3.6		11.4	2.2	2.5			23.2
	1947	22	12S/2E-16L1	Furrow	30.0			3.6	3.6	4.9	2.8	2.6			17.5
	1947	23	12S/2E-17R1	Furrow	14			2.0	2.3	3.1	10.1				17.5
	1947	23	12S/2E-17R1	Furrow	40		0.8	0.9	1.9	2.6	0.5	0.7			7.4
	1947	23	12S/2E-17R1	Furrow	9			1.7	1.8	5.0	6.2				14.7
	1947	23	12S/2E-17R1	Furrow	18			1.7	1.1	6.0	3.3	3.5			15.6
	1947	24	12S/2E-20C1	Furrow	20		2.8	2.8	6.6	5.0	1.4	2.8			21.4
	1947	24	12S/2E-20C1	Furrow	13.5		2.8	2.0	2.1	5.7	5.8				18.4
	1947	24	12S/2E-20C1	Furrow	14		2.8	2.8			9.7	3.8			19.1
	1947	24	12S/2E-20C1	Furrow	15		2.8		6.7	2.4	4.8				16.7
	1947	24	12S/2E-20C1	Furrow	22		2.8	2.1	4.6	3.0	3.2				15.7
	1947	25	12S/2E-19M1	Furrow	16		3.8	4.3	4.0	2.6	11.6	5.5			31.8
	1947	25	12S/2E-19M1	Furrow	26		4.0	6.7	2.6	10.1	5.5				28.9
	1947	25	12S/2E-19M1	Furrow	4		8.6	3.6	3.3	8.0	6.6	6.8			36.9
	1947	25	12S/2E-19M1	Furrow	20		3.8	3.6		7.7	5.0	3.0			23.1
	1947	25	12S/2E-19M1	Furrow	22		4.7	3.6	8.3	4.3					20.9
	1947	25	12S/2E-19M1	Furrow	13			14.9	13.9	4.9	5.5				39.2
	1947	26	12S/3E-18K1	Furrow	21			5.2	4.3	10.7	3.9				24.1
	1947	26	12S/3E-18K1	Furrow	26		2.2	1.3	10.6	4.1	4.5				22.7
	1947	27	12S/2E-8K2	Furrow	28		4.2	1.2	2.7	1.4	3.5				13.0
	1947	27	12S/2E-8K2	Furrow	18		4.0	2.8	4.1	7.7	2.3				20.9
	1947	28	12S/2E-8K1	Furrow	16			1.3	5.3	9.6	2.7				18.9
	1947	29	12S/2E-15M1	Furrow	34		2.8	1.5	7.8	3.1	3.3				18.5
	1947	29	12S/2E-15M1	Furrow	40		2.8	1.5		9.2	2.4	0.9			16.8
	1947	29	12S/2E-15M1	Furrow	10		2.7	3.1	9.2	6.4	2.6				24.0
	1947	30	12S/2E-16R1	Furrow	18		6.7	5.0	7.1	7.6	5.0	4.5	1.7		37.6
	1947	31	12S/2E-15D3	Furrow	26		3.8	0.9	5.9	4.8	2.2				17.6
	1947	31	12S/2E-15D3	Furrow	36		3.8	0.9	6.7		3.9				15.3
	1947	32	12S/2E-2K1	Furrow	86		5.4	3.2	5.8	8.9	5.4	0.9			29.6
	1947	33	12S/2E-1B1	Furrow	30		3.1		8.3	4.4	2.5				18.3
	1947	33	12S/2E-1B1	Furrow	22		3.1	1.9	5.7	7.0	2.5				20.2
	1947	33	12S/2E-1B1	Furrow	16		3.1	2.6	8.5	4.4	2.5				21.1
	1947	20	11S/2E-26F1	Furrow	12.5		2.2	3.5	2.7	2.3	5.0	0.4			16.1
	1947	20	11S/2E-26F1	Furrow	12.0		2.2		13.6	10.1					25.9
	1947	34	12S/3E-18P1	Furrow	6			5.1	5.2	1.9	5.9	2.7			20.8
	1947	35	12S/3E-7J1	Furrow	22.5		5.8	13.1	4.5	18.4	3.7	2.8			48.3
	1949	36	12S/2E-9N1	Furrow	28		5.4	2.70		5.98	0.58				14.7
	1949	36	12S/2E-9N1	Furrow	18		1.74	2.10		3.07					6.9
	1949	36	12S/2E-9N1	Furrow	13		5.80	1.78	9.90	3.17					20.6
	1949	27	12S/2E-8K2	Furrow	14		1.77	2.50			2.95	3.63			10.8
	1949	27	12S/2E-8K2	Furrow	10			5.28	4.60	1.82					11.7
	1949	27	12S/2E-8K2	Furrow	17				7.70	2.42	6.30	0.75			17.2
	1949	18	12S/2E-11E3	Furrow	43		4.96	6.63	7.70	4.50	8.34	2.33			34.5
									Weighted mean depths:						
									1947 21.4 inches (1.78 feet)						
									1949 19.9 inches (1.66 feet)						
									1947 and 1949 21.2 inches (1.77 feet)						
Lettuce (3-crop)	1947	22	12S/2E-16L1	Furrow	23		2.6	1.6	5.2		5.6	4.7			19.7
	1947	25	12S/2E-19M1	Furrow	16	3.2		9.3	4.2		12.4	6.8	6.1		42.0
	1947	25	12S/2E-19M1	Furrow	20		6.2	6.9	8.6		8.5		3.3		33.5
	1947	26	12S/3E-18K1	Furrow	15		4.1	7.5	3.8	10.5	9.3	3.4			38.6
	1947	26	12S/3E-18K1	Furrow	15		3.8	7.7	3.8	2.5	11.5	3.5			32.8
	1947	27	12S/2E-8K2	Furrow	13		1.9	7.6	2.0	4.1	11.2	4.1	1.6		32.5
	1947	37	12S/3E-16M2	Furrow	15.5	7.4	4.9	10.2	6.2	6.6	7.5	6.0	0.8		49.8
	1947	37	12S/3E-16M2	Furrow	17	2.3	3.1	8.4	6.2	8.0	7.5	6.0	0.8		42.3
	1947	35	12S/3E-7J1	Furrow	15	9.6	3.5	8.5	10.5	4.2	10.1	3.5			49.9
									Weighted mean depth:						
									1947 37.0 inches (3.08 feet)						
Orchard															
Apple	1947	38	12S/3E-6J1	Furrow	55				1.4	11.3					12.7
Young apples and bush berries	1947	38	12S/3E-6J1	Furrow	5			10.6							10.6
Young apples and beans	1947	14	11S/1E-24J1	Furrow	11				3.0	2.6					5.6
	1947	14	11S/1E-24J1	Furrow	13				4.3						4.3

APPLICATION OF GROUND WATER TO REPRESENTATIVE CROPS IN SANTA CRUZ-MONTEREY AREA IN 1947 AND 1949—Continued

(In inches of depth)

Crop	Season	Plot No., Plate 18	Well number	Method of irrigation	Acres irrigated	Jan.-March	April	May	June	July	August	Sept.	Oct.	Nov.-Dec.	Total
Orchard—Continued															
Young apples with cover crop	1947	21	11S/2E-28P1	Basin check	45				5.4						5.4
	1947	38	11S/2E-8F2	Furrow	24			4.0	4.0	4.6	0.8				13.4
	1947	17	11S/2E-8L1	Furrow	7			6.2							6.2
	1947	17	11S/2E-8L1	Furrow	40				4.1						4.1
	1947	17	11S/2E-8L1	Furrow	24				4.2			1.1			5.3
	1947	17	11S/2E-8L1	Furrow	12					18.4					18.4
	1947	39	11S/2E-17K1	Furrow	30					9.4					9.4
Apples and pears with cover crop	1947	40	11S/2E-30N1	Cross slope furrow	10				2.9	3.3					6.2
	1949	38	11S/2E-8F2	Furrow	17			6.7	6.7						13.4
	1949	21	11S/2E-28P1	Basin check	75					2.46					2.5
	1949	17	11S/2E-8L1	Furrow	17				5.10						5.1
	1949	17	11S/2E-8L1	Furrow	30					7.40					7.4
	1949	15	11S/3E-19R1	Furrow and basin check	10				9.46						9.5
	1949	14	11S/1E-24J1	Furrow	8				5.09						5.1
Apples and pears	1949	14	11S/1E-24J1	Furrow	23.5				4.9						4.9
	1949	40	11S/2E-30N1	Furrow	5					1.73					1.7
Young apples, interplanted with beans	1949	12	11S/2E-8D1	Furrow	17			2.9	2.17	1.66	2.10				9.8
	1949	12	11S/2E-8D1	Furrow	5				3.06						3.1
									Weighted mean depths: 1947 8.4 inches (0.70 foot) 1949 6.7 inches (0.56 foot) 1947 and 1949 7.7 inches (0.64 foot)						
Apricots	1947	38	12S/3E-6J1	Furrow	9			9.5							9.5
	1947	8	12S/3E-9F1	Furrow	19			5.6							5.6
	1949	8	12S/3E-9F1	Furrow	7			7.4							7.4
									Weighted mean depths: 1947 6.8 inches (0.57 foot) 1949 7.4 inches (0.62 foot) 1947 and 1949 6.9 inches (0.57 foot)						
Total Orchard									Weighted mean depths: 1947 8.2 inches (0.68 foot) 1949 6.7 inches (0.56 foot) 1947 and 1949 7.6 inches (0.63 foot)						
Pasture															
Ladino	1947	41	12S/2E-7E1	Free flooding	49		3.3	3.0	1.4	4.6	6.2	3.6	0.7		22.8
	1947	32	12S/2E-2K1	Border check	9		5.4	3.2	5.8		5.4				19.8
Sudan	1947	2	11S/2E-17R1	Row and furrow	8					2.2	0.4				2.6
	1949	2	11S/2E-17R1	Flooding and sprinkler	8			2.85			7.70				10.5
									Weighted mean depths: 1947 19.2 inches (1.60 feet) 1949 10.6 inches (0.88 foot) 1947 and 1949 18.3 inches (1.52 feet)						
Strawberries	1947	42	12S/1E-36A1	Contour furrow	11		5.9	3.8	2.4	3.7	8.1	3.5			27.4
	1947	1	11S/2E-21G1	Level furrow	45		1.4	3.4	3.4	3.9	4.6	2.3	0.3		19.3
	1947	10	11S/2E-21C1	Furrow	10		7.7	7.7	4.8	2.4	4.0		0.9		27.5
	1947	16	11S/2E-20E1	Furrow	2		8.7	7.2	7.9	9.9	14.9	6.9			55.5
	1949	10	11S/2E-21C1	Furrow	15		8.92	7.90	8.21	6.40					31.4
	1949	42	12S/1E-36A1	Furrow	15		2.22	1.42	3.40	1.94	3.52	2.20	1.60		16.3
									Weighted mean depths: 1947 22.9 inches (1.91 feet) 1949 23.9 inches (1.99 feet) 1947 and 1949 23.2 inches (1.93 feet)						
Sugar Beets	1947	43	12S/1E-24G1	Furrow	80		1.7	1.5	3.7	3.0					9.9
	1947	26	12S/3E-18K1	Furrow	26			3.7	4.4						8.1
	1947	26	12S/3E-18K1	Furrow	17			2.4	3.4						5.8
	1947	27	12S/2E-8K2	Furrow	26		0.8	4.8	6.8						12.4
	1947	18	12S/2E-11E3	Furrow	20			5.80	4.51	4.08		2.35			16.7
	1947	18	12S/2E-11E3	Furrow	30			2.47	4.51			2.35			9.3

APPLICATION OF GROUND WATER TO REPRESENTATIVE CROPS IN SANTA CRUZ-MONTEREY AREA IN 1947 AND 1949—Continued

(In inches of depth)

Crop	Season	Plot No., Plate 18	Well number	Method of irrigation	Acres irrigated	Jan.-March	April	May	June	July	August	Sept.	Oct.	Nov.-Dec.	Total
Sugar Beets—Continued	1947	32	12S/2E-2K1	Furrow	47		5.4	3.2	5.8		5.4				19.8
	1947	33	12S/2E-1B1	Furrow	18		3.1	9.3		6.8	7.1				26.3
	1949	3	11S/2E-15M1	Furrow	13			6.75	5.30	4.60					16.6
	1949	2	11S/2E-17R1	Furrow	5		4.84		5.44						10.3
	1949	{ 2 10	11S/2E-17R1 11S/2E-21C1	Furrow	12		4.66	10.20	7.55		7.38				29.8
									Weighted mean depths: 1947 13.0 inches (1.08 feet) 1949 20.8 inches (1.73 feet) 1947 and 1949 13.8 inches (1.15 feet)						
Tomatoes	1947	20	11S/2E-26F1	Furrow	6						2.1	0.9			3.0
	1947	37	12S/3E-16M2	Cross slope furrow	10				10.8	12.6	7.5	6.0	0.8		37.7
	1947	9	11S/3E-23N1	Furrow	8				2.1	2.2	0.7	0.7			5.7
	1947	3	11S/2E-15M1	Furrow	10				4.1	10.6		2.0			16.7
	1947	39	11S/2E-17K1	Furrow	20				3.3						3.3
	1949	8	12S/3E-9F1	Furrow	12				2.12						2.1
	1949	8	12S/3E-9F1	Furrow	18				2.37						2.4
	1949	9	11S/3E-23N1	Furrow	6				1.54	2.30		0.85			4.7
	1949	17	11S/2E-8L1	Furrow	6			2.42	7.30	4.10	3.00	1.85	1.57		20.2
									Weighted mean depths: 1947 12.4 inches (1.03 feet) 1949 5.1 inches (0.42 foot) 1947 and 1949 9.2 inches (0.77 foot)						
Truck															
Cauliflower	1947	20	11S/2E-26F1	Furrow	28					9.3	4.5	3.3			17.1
	1947	7	11S/2E-33F2	Furrow	7				3.0	6.6	5.5				15.1
	1947	7	11S/2E-33F2	Furrow	30					2.2	2.7	0.6			5.5
	1947	7	11S/2E-33F2	Furrow	53					2.2	2.7	0.6			5.5
Brussels sprouts	1947	44	12S/2E-31C1	Sprinkler	12			0.9	7.4	3.2	3.5	2.5	1.0	1.3	19.8
	1947	42	12S/2E-36A1	Sprinkler	17				2.2	2.8	3.2	2.9	1.5		12.6
	1947	4	12S/2E-31K1	Sprinkler	25				3.9	3.4	4.7	4.9	1.8	0.6	19.3
Celery	1947	33	12S/2E-1B1	Furrow	14				9.1	5.4	3.0	14.4			31.9
Zucchini squash	1947	13	12S/1E-1C1	Furrow	3					8.5	4.2	4.0	0.7		17.4
Corn and string beans	1947	13	12S/1E-1C1	Furrow	1				5.0	34.4		9.7	3.0		52.1
Corn and tomatoes	1947	3	11S/2E-15M1	Furrow	5					4.76					4.8
Brussels sprouts	1949	44	12S/2E-31C1	Sprinkler	12			1.63	6.11	2.20			1.60		11.5
	1949	42	12S/2E-36A1	Sprinkler	20			0.73	3.69	2.70	6.00	4.34	4.56		22.0
	1949	5	12S/1E-25B1	Furrow	15			7.00	5.62	6.53	5.70	6.14	2.78		33.8
	1949	4	12S/2E-31K1		30			2.05	4.84	5.81	4.24	6.66	3.83		27.4
Cauliflower	1949	3	11S/2E-15M1		5						3.38	2.26			5.6
Broccoli	1949	20	11S/2E-26F1	Furrow	3						12.60				12.6
	1949	20	11S/2E-26F1	Furrow	51.6							3.32	2.72		6.0
	1949	4	12S/2E-31K1		3						2.04	2.16	1.93		6.1
Cabbage	1949	4	12S/2E-31K1		3			2.37							2.4
	1949	14	11S/1E-24J1		5					13.34					13.3
									Weighted mean depths: 1947 12.8 inches (1.07 feet) 1949 16.1 inches (1.34 feet) 1947 and 1949 14.2 inches (1.18 feet)						
Hops	1949	3	11S/2E-15M1		11				2.90						2.9
Vetch	1947	22	12S/2E-16L1	Furrow	15							1.3	6.5		7.8
	1947	23	12S/2E-17R1	Furrow	14							2.3	2.5		4.8
	1947	23	12S/2E-17R1	Furrow	18							5.3			5.3
	1947	23	12S/2E-17R1	Furrow	40							1.0			1.0
									Weighted mean depth: 1947 3.7 inches (0.31 foot)						

APPENDIX I

UNITED STATES DEPARTMENT OF AGRICULTURE

IRRIGATION PRACTICES AND CONSUMPTIVE USE OF WATER IN PAJARO VALLEY, CALIFORNIA

By Harry F. Blaney, Senior Irrigation Engineer, and
Paul A. Ewing, Senior Irrigation Economist

Under the Direction of
GEORGE D. CLYDE, Chief
Division of Irrigation and Water Conservation

(A report based on data gathered under cooperative agreement between the Division of Water Resources, Department of Public Works, State of California and the Soil Conservation Service, United States Department of Agriculture)

A Contribution from
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief
M. L. Nichols, Chief of Research

December, 1949

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INTRODUCTION

This progress report is a contribution to an investigation initiated by the Division of Water Resources, California State Department of Public Works, involving the whole subject of the utilization of the water supply of lower Pajaro Valley.

Because of experience accumulated by the Division of Irrigation and Water Conservation (of the U. S. Soil Conservation Service), in similar circumstances, especially those encountered in neighboring Salinas Valley, its entry into the investigation was brought about under the provisions of a formal agreement of long standing between the two agencies. By this arrangement, the Division of Irrigation and Water Conservation undertook to ascertain the amounts of water artificially applied to irrigated crops in Pajaro Valley under current practices and to calculate the amounts consumptively used by those crops and by the native or natural vegetation.

In the study of irrigation practices and in an associated examination of the soils of the valley, the Division of Irrigation and Water Conservation had the assistance of field personnel of the Operations Division, Soil Conservation Service, through a party headed by Clyde M. Seibert, District Conservationist,* and operating under the general direction of John Barnes, State Conservationist for California. This party, already familiar with general farming methods in the Valley, obtained water information from operators of 44 farms, selection of which was intended to reflect the different soil conditions as well as the irrigation practices applying to the principal crops. The interviews thus produced data indicative of the growing season, the number of irrigations and the irrigation season, amounts of water applied (measured or estimated) and other pertinent information.

Since the surveyed area included portions of two Soil Conservation Districts, Pajaro and Elkhorn (figures 1 and 2), to which Mr. Seibert and his staff provide technical assistance, the support of the boards of directors was requested and freely given, to the effect of suggesting those farmers best capable of supplying the needed information and informing the farmers generally as to the objectives of the work. This assistance proved to be helpful in expediting the field work, and was greatly appreciated by those heading the investigation. Also valued was information obtained from Santa Cruz County Farm Advisor Henry Washburn, Monterey County Farm Advisor A. A. Tavernetti, and the Division of Irrigation Investigations and Practice of the College of Agriculture, University of California.

Responsibility for the irrigation-practice study was assigned to Paul A. Ewing, Senior Irrigation Economist, while Harry F. Blaney, Senior Irrigation Engineer, was placed in charge of the consumptive-use determinations.

* Assisting Mr. Seibert were Irving F. Pearce, Lew Hanks, George Watt, Everett Richards and A. E. Bode, Soil Conservation Service technicians working with the Pajaro and Elkhorn Soil Conservation districts. Gordon E. Shipman, Soil Scientist, prepared the chapter on Soils.

THE LOCALE DEFINED

Pajaro River and its tributaries drain approximately 1300 square miles of land on the west side of the Coast Range, the area itself lying east of Monterey Bay into which the river flows. That portion of the watershed west of Pajaro Gap embraces about 110 square miles. Pajaro Gap, on the San Andreas Fault, is at the eastern edge of the alluvial fill of Pajaro Valley, which is separated from South Santa Clara Valley and San Benito Valley respectively by the Santa Cruz Mountains and the Gabilan Range. The principal tributary of Pajaro River within Pajaro Valley is Corralitos Creek, which enters it from the North. The valley floor comprises about 59 square miles, of which about 81 percent is irrigable. The major portion of the area with which the investigation was concerned lies in Santa Cruz County. A smaller portion is in Monterey County, while a fragmentary portion of San Benito County is also included.

The important urban center of Pajaro Valley is the City of Watsonville, which has a (1950) population of 11,516. Several agricultural processing industries are located along the railroad at Watsonville Junction.

General Geology

The Santa Cruz Mountains are characterized by marine sediments and metamorphic-rock formations, including sandstones, limestones, cherts and serpentines. There are granitic rocks, including granite, quartz and diorite in the Gabilan Range. Granite outcropping appears at the northerly toe of the Gabilan Range near Pajaro Gap.

The San Andreas Fault runs parallel to the crest of the Santa Cruz Mountains along a line a short distance west of the crest. The basement on the eastern side of the fault in this area is of the Franciscan type and that on the bay side is granitic. The heavy vertical displacement along the fault line makes it probable that Pajaro Valley watershed west of the fault is a definite sub-basin.

Well logs collected in this area indicate that ground water in the pumping zone within almost the whole valley floor is confined in a pressure or semi-pressure area; the area in which wells flow a portion of the year is small.

Valley Fill

A limited number of logs of wells fairly well scattered over the valley floor, obtained from the Pajaro Soil Conservation District, show water-bearing sands and gravels as deep as 400 feet below ground surface. Most of the wells between Watsonville and the bay shore have been drilled to depths of 180 to 190 feet. The existence of a wide range in specific capacities of wells, some of which will not support irrigation draft in the pressure area, indicates that the water-bearing gravels occur in tongues rather than broad strata.

U S DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
H H BENNETT, Chief

PACIFIC REGION
J H CHRIST, Director

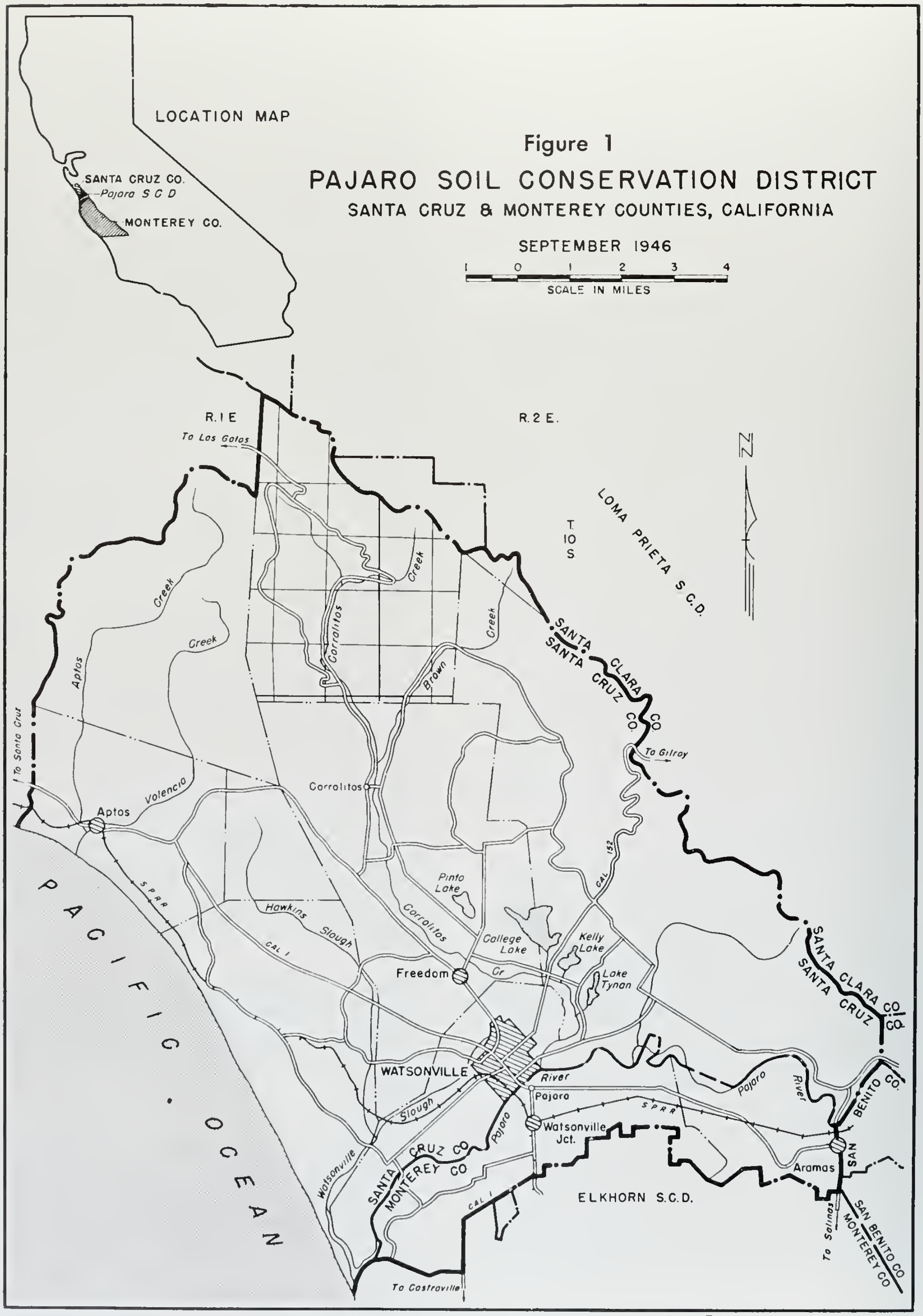


Figure 1

PAJARO SOIL CONSERVATION DISTRICT

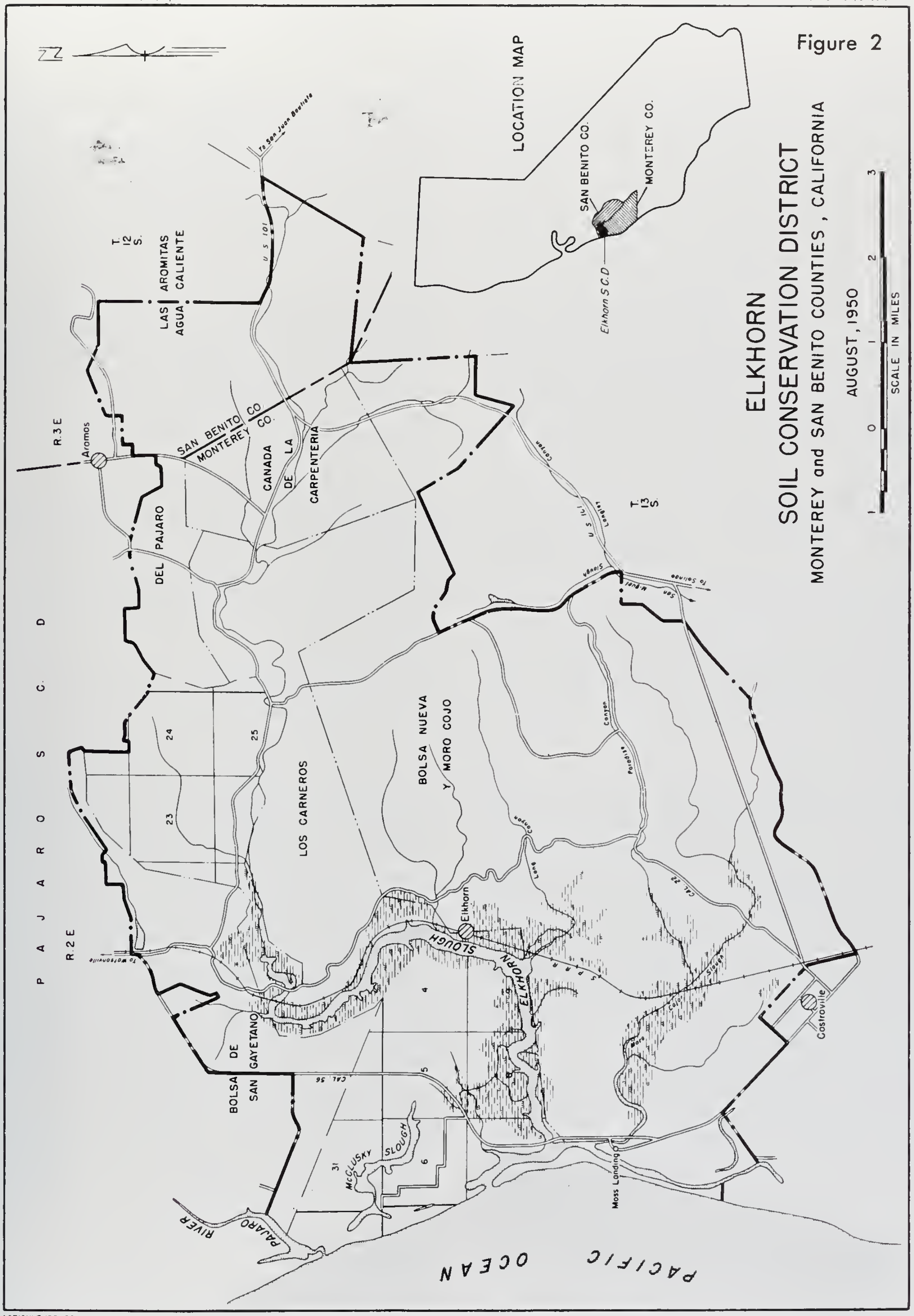
SANTA CRUZ & MONTEREY COUNTIES, CALIFORNIA

AGRICULTURE - PORTLAND, OREGON

PAJARO S.C.D. CAL. 7- L-10511

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
H. H. BENNETT, Chief

PACIFIC REGION
J. H. CHRIST, Director



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ELKHORN S.C.D., CAL. 7-L-13068

AGRICULTURAL HISTORY

In November 1851 the first settlers entered Pajaro Valley for the purpose of farming. Although several houses were already in the valley, they were used only by herdsmen on the cattle ranchos. The soil of the Valley was exceedingly fertile, so that in 1853, when the exodus from the mining communities to the so-called "cow counties" began, difficulty arose with squatters on the rancho grants in the Valley.

The coming of the railroad into the Pajaro Valley in 1870 stimulated agriculture because of the increased market it made available. Commercial fruit growing became important about 1880, most of the previous plantings having been for home use. A beet-sugar factory built near Watsonville in 1886 was later abandoned, and sugar beets from Pajaro Valley were shipped to Salinas on a narrow-gage railroad.

In recent years a gradual change to the more intensive types of agriculture has taken place. During the early period agriculture consisted of growing grain, grain hay, and potatoes, but apples and sugar beets soon replaced grain on the valley soils. The acreage of most of the field crops, such as corn and oats, has diminshed since 1900, chiefly because of the increased production of lettuce and other vegetables. The type of farming in the mountain districts has changed very little, except that possibly the acreage of tree fruits has been slightly reduced as the trees deteriorated from age.

Present Development

About half (48 percent) of the irrigable land is irrigated. There is a series of five lakes on the valley floor between Corralitos Creek and the Western base of the Santa Cruz Mountains. Some water is pumped from Pinto Lake for irrigation and a portion of the municipal water supply for Watsonville is obtained from Corralitos and Brown Creeks. A few pumps lift water from the creeks, but all other irrigation requirements are supplied from the ground. The principal irrigated crops are lettuce, sugar beets, artichokes, tomatoes, beans, peas, berries, and young orchards. Many of the old orchards receive no irrigation.

Pressure on developed water supplies which gave rise to the investigation now reported has been greatly increased in recent years. While no previous survey has been made along the present lines, an analysis of statistics resulting from the 1940 Federal Irrigation Census indicates that the area irrigated in 1939 in lower Pajaro Valley (that is, the portion mainly in Santa Cruz and Monterey Counties, was some 5,000 acres less than the acreage irrigated in 1947.

Statistics obtained in 1940 were tabulated in the Census reports by drainage basins and by counties. The drainage basin groupings did not segregate San Benito River from Pajaro River, so that the published figures are inclusive of both. However, by subtracting the Salinas Basin figures from those for Monterey County, and adding the Santa Cruz County figures, approximate totals are obtained.* Table 1 shows the results of the breakdown.

TABLE 1

APPROXIMATE AREA, COST AND EQUIPMENT OF IRRIGATION ENTERPRISES IN LOWER PAJARO VALLEY, CALIFORNIA, AS REPORTED IN FEDERAL IRRIGATION CENSUS OF 1940

Irrigation enterprises, 1940, number	369
Area irrigated in 1939, acres	12,394
Area works were capable of supplying with water in 1940, acres	15,052
Capital invested in irrigation enterprises, 1940, dollars	781,955
Per acre irrigated in 1939, dollars	63.09
Per acre suppliable in 1940, dollars	51.95
Average reported cost of operation and maintenance in 1939, per acre (not including capital costs), dollars	6.25
Average reported delivery of water to irrigators in 1939, acre-feet per acre	1.57
Average cost of operation and maintenance per acre-foot of water delivered in 1939 (not including capital costs), dollars	3.98
Main canals and laterals—Total length, miles	24.6
Pipelines—Total length, miles	140.3
Pumped wells, number	340
Average yield, g.p.m.	419.9
Pumping plants, number	434
Average capacity of pumps, g.p.m.	345.6
Area served per pump, 1939, acres	28.3
Area served per pumped well, 1939, acres	36.5

Pump capacities in Pajaro Valley average only about one-third those of neighboring Salinas Valley and acreage served per pump is in even smaller proportion (28 acres, Pajaro; 80 acres, Salinas). However, the preferred practice in both basins is to irrigate only during daytime, except at the height of the season, when night irrigation is also resorted to; hence the average pump capacity of a little less than 14 g.p.m. per irrigated acre in Pajaro Basin corresponds to the Salinas Valley average (13 g.p.m.), so that substantially larger acreages could be served by many of the pumps, even with present rates of application, if longer day schedules were adopted, provided the wells could stand the consequent increase in draft. (Somewhat amplifying the significance of the foregoing statistical description is the fact that an undetermined but considerable number of Pajaro Valley pumping plants, notably some installed in orchards, receive little use because of the ability of the apple trees to produce without irrigation when rainfall is normal.)

* This manipulation necessarily ignores the fact that a small portion of San Benito County is in Lower Pajaro Basin, while some irrigation is practiced in several unidentified areas of Santa Cruz County not in or tributary to Lower Pajaro Basin.

CLIMATE

The climate of Pajaro Valley is characterized by two seasons: the dry or summer season which extends from May to October, and the wet or winter season comprising the other months. More than half the rain falls during December, January, and February. The amount varies widely from place to place, being lowest along the coast and increasing toward the mountains. (For further discussion see chapter on Consumptive Use of Water.)

During the rainy season the prevailing winds blow from either north or south, causing alternate rainy and clear weather; but during the summer they generally blow from the west or northwest, rising in the forenoon and subsiding in the evening. The moisture they gather from the ocean forms fogs at night in Pajaro Valley that usually disappear about next midday but frequently continue longer. They are of great benefit to farmers, as they retard evaporation of soil moisture and transpiration of such plants as lettuce, artichokes and brussels sprouts. During the rainy winter season the fogs are infrequent.

Killing frosts may occur from November to March, but have occurred as late as May 26 and as early as September 25 at Watsonville, where the average frost-free season is 237 days. Temperatures are too severe for the commercial growing of subtropical or the more sensitive fruits, but in a few well-protected spots in the mountains a few lemons are grown for home use.

Table 2 shows the normal monthly, seasonal, and annual temperature and precipitation at Watsonville.

TABLE 2

MONTHLY, SEASONAL, AND ANNUAL TEMPERATURE AND PRECIPITATION AT WATSONVILLE, SANTA CRUZ COUNTY, CALIFORNIA, FROM 1880-81 THROUGH 1945

(Elevation, 23 feet)

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1917)	Total amount for the wettest year (1909)
	°F.	°F.	°F.	Inches	Inches	Inches
December	50.2	82	15	4.49	0.32	10.41
January	49.9	82	20	4.18	1.65	14.10
February	51.8	84	23	3.74	5.22	7.39
Winter	50.6	84	15	12.41	7.19	31.90
March	53.9	95	24	3.35	.87	4.12
April	55.9	90	22	1.30	.28	.00
May	58.6	99	26	0.62	.10	.00
Spring	56.1	99	22	5.27	1.25	4.12
June	60.9	110	31	0.12	.00	.10
July	61.5	105	32	0.01	.00	.00
August	61.6	95	30	0.02	.00	.00
Summer	61.3	110	30	0.15	.00	.10
September	60.9	105	32	0.27	.00	.44
October	58.4	104	22	0 93	.00	.79
November	54.3	90	23	1.94	.84	1.80
Fall	57.9	105	22	3.14	84	3.03
Year	56.5	110	15	20.97	9.28	39.15

SOILS *

The soils in the irrigated section of the Pajaro Valley occur in three general areas; i.e., first, the well-drained bottom land alluvial soils; second, the bottom land soils with restricted drainage; and third, the bench and low rolling hill soils.** The largest of these areas is the bottom land alluvial soils that were formed by the fans of the Pajaro River and the Corralitos Creek. They are deep soils and generally very fertile. These soils are used mainly for orchard and vegetable production. Near the mouth of the Pajaro River, the soils are heavy-textured and drainage is restricted. This area is second in size and is used mainly for vegetable production. The remaining irrigated lands are located above the bottom lands in scattered sections of the valley. There are two general types of land in this section. One is the fairly flat bench or terrace land which has soils with restricted subsoils. Shallow-rooted crops are the best to use on this type of land. The other irrigated upland areas are located on sandy, rolling hills. They are used mainly for winter-vegetable production.

The suitability of other soils for irrigation and their adaptability for crops are dependent upon several factors. Some of these are soil texture, soil type and depth, root feeding zone, drainage condition, slope of the land, past erosion, and the erodibility of the soil. Detailed information on these factors may be found in the Soil Conservation Service report on the "Physical Land Conditions in the Pajaro Soil Conservation District" and the "Physical Land Conditions in the Elkhorn Soil Conservation District." Combinations of these factors as found in the field have been covered in a Land Class in the above publications. Most of the irrigated land is in Class I, II, or III. Class I land is the best land, with little or no limitations in its use. Classes II and III have one or more of the above factors that are detrimental and limit their use in some way. The land classes are explained in detail in the above-mentioned reports.

The bottom land soils of the Pajaro River and Corralitos Creek fans are deep and have good textures.† They are mainly Class I lands, with some Class II lands along the stream channels. The soils along the Pajaro River have heavier textures than those along the Corralitos Creek. This gives them a better water-holding capacity and greater fertility. These bottom lands are at present about 40 percent orchard, with the rest in irrigated vegetables. They are highly valued and have a wide range of use. There is little chance for deterioration from erosion. With good farming methods such as crop rotation, growing of green-manure crops, crop-residue utilization, manuring and fertilization, and proper use of irrigation water, they should continue to produce high yields. The principal soil series in these bottom lands are the Soquel, Corralitos, Metz, Pajaro, Bottela and Salinas. The textures vary from sandy loams to silty clays, depending on the location. This area covers about 65 percent of the irrigated area of the valley.

The areas of imperfectly drained soils are located near the mouth of the Pajaro River. They cover most of the bottom land area from Watsonville to the coast, and make up about 20 percent of the irrigated lands. These soils were poorly drained in their natural state. Drainage ditches were installed and it is necessary to maintain them to continue crop production. Proper application of water is highly important in this area, as over-irrigation intensifies the drainage problem. Other practices necessary are crop rotations, growing of green-manure crops, crop-residue utilization and use of soil amendments to maintain these soils in good production.

These areas are heavy-textured and are mainly Class II and III because of the drainage problem. They are used entirely for vegetable production and are highly valued for that use. They are not suited for orchard use, owing to restricted drainage.

The irrigated land above the bottom lands is in two main forms. The largest and most scattered of these upland areas are to the north, east and west of Watsonville along the fringes of the Corralitos Creek and Pajaro River. These soils are restricted in depth and therefore are used primarily for irrigated vegetable crops. Their fertility and production from them are lower than is the case with the bottom land soils. Irrigation problems are much greater, owing to unevenness of slope, and limited soil depth. The soils occurring on these benches are mainly Pinto, Pinto (compact subsoil phase), Watsonville, and McClusky series. Textures are mostly medium (loams). The other irrigated sections in the upland areas are the sand hills in the Springfield area. These soils are on gently rolling hills and are very sandy, a combination which results in irrigation by sprinklers. The crops are mainly winter vegetables, such as brussels sprouts, cabbage, cauliflower, etc. Use of sprinklers helps control erosion that would occur with the furrow type of irrigation. This upland irrigated area occupies about 15 percent of the irrigated lands in the valley, which are mainly Classes II and III owing to slope, soil depth or coarse textures. On sloping land in these upland areas, certain conservation practices are necessary to maintain the soil. Some of these practices involve crop rotations, winter cover crops, crop-residue utilization, fertilization, contour or cross-slope operations, and proper irrigation. These practices become more important as slopes increase.

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* This discussion was prepared by Gordon E. Shipman, Soil Scientist, Soil Conservation Service.

** Land division areas are further broken down and defined in "Natural Land Divisions of Santa Cruz County, California: Their Utilization and Adaptation," by R. Earl Storie. *(12)*

† Series names and textures were taken from the "Soil Survey of the Santa Cruz Area" by R. Earl Storie and others. *(13)*

WATER-CONSUMING CROPS

Alfalfa

This crop is unimportant in the present agricultural set-up of Pajaro Valley, its acreage being limited to a few small fields. Because its use is mainly for pasture and much of it is grown in areas of high water table, irrigation requirements are low as compared with those of many other areas.

Artichokes

Commercial plantings of artichokes are limited to areas that are nearly if not entirely frost-free in the winter and cool and foggy in the summer.

The globe artichoke is adaptable to a fairly wide range of soil conditions. The plant is deep-rooted and does best on the deeper soils, although considerable acreages devoted to this crop in neighboring environments have soils with claypan subsoils at depths of 18 to 30 inches. In many places it is necessary to sacrifice the best soil conditions to obtain the right climatic circumstances. Both brussels sprouts and artichokes appear to do well on Watsonville sandy loam, Watsonville loam, and Lockwood loam. The yield of artichokes ranges from 100 to 150 boxes an acre on the soils of the terraces. Soquel loam produces somewhat better yields, but the crop must be harvested before December, as the danger of frost is great in the bottom lands after that time. At any rate, the Pajaro Valley crop is concentrated in the bottom areas south and west of Watsonville.

Fertilizer applications ranging from 5 to 10 tons of manure per acre every other year have given good results. The leaves and stems of the plant are usually returned to the soil after harvest. Some growers apply from 300 to 400 pounds of nitrogenous inorganic fertilizer to the acre before the buds begin to form, this usually being nitrate of soda or ammonium sulfate.

In Pajaro Valley, irrigation is done by a method somewhat peculiar to this crop, involving considerable labor. A single furrow is opened down each row of plants. Short runs are made from rather frequent cross ditches. A head is turned in and permitted to reach the lower end of one run. When it has reached the lower end of the run, an irrigator begins cutting in the sides of the furrow so that water is flooded from the ditch to the plants on either side. This flooding and filling in of the ditch are carried on up the row to the entrance of the water from the cross ditch, where it is then cut into the furrows in the next row. After an irrigation, the entire surface is wet. This method is thorough but not efficient because of the labor expended in applying the water. Estimates made by the University of California as to time required to irrigate artichokes by this method were about 8 man-hours per acre.

Beans

Pajaro Valley beans are mostly small whites (some snap beans for seed), grown on sites of restricted possibilities; that is, while the acreage of beans on top-grade lettuce land is not large, it would probably be advantageous for them to appear more prominently in the areas of better land because of their soil-drying effect. In fact, the crop represents a possibility for reduced use of water, although facing the hazard of early rains if planted following a lettuce harvest. Desirable maximum seasonal application is about 10 to 12 inches.

Beans are planted in 26-inch rows or even closer (two 24-inch and a 28-inch), and are so cultivated that two rows are on either side of one bed. Thus irrigation is by furrows.

Bush Berries

Although the acreage in bush berries, such as Boysenberries, Young dewberries (Youngberries), Logan blackberries (Logan berries), other blackberries, and raspberries, has varied widely, this enterprise is important. The plantings of bush berries are scattered principally in the Freedom district, where local conditions seem well suited to their culture. They do well on a wide range of soils. The soils of the terraces give good results, owing to the air drainage and the smooth surface, which is easily irrigated. Some plantings are grown without irrigation, but the common practice is to irrigate. Irrigation of both bushberries and strawberries is liberal and more or less continuous during the irrigation season. However, Loganberries are grown on the deep sandy soils of the San Andreas section without irrigation.

Lettuce

As measured by income, lettuce is now the most important crop. Usually two crops are grown on the same land each season, in various combinations—spring and summer, summer and fall, or late spring and early fall. Sometimes three crops are raised—spring, summer and fall. Lettuce can be successfully matured during any time of the year except the rainy season, maturity being attained in from 75 to 150 days, depending on the season.

Lettuce acreage has apparently experienced a marked expansion in recent years. For the portion of Pajaro Valley lying in Monterey County no comparison is possible, but the Agricultural Commissioner of Santa Cruz County is authority for the following figures, which may be understood to apply almost entirely to the Santa Cruz County portion of the Pajaro area, as insignificant acreages of lettuce are grown elsewhere in the county.

	1940	*1946* *
Spring lettuce, acres	1350	2700
Summer lettuce, acres	1846	2400
Fall lettuce, acres	1458	2770

The Federal Census of 1940 reported 1808 acres of lettuce in Santa Cruz County in 1939.

Thus, although much if not most of the acreage now in lettuce had previously supported other irrigated crops,** the use of water has been greatly increased, since lettuce is irrigated more liberally than any other major crop.

Lettuce is grown on the soils of the bottom lands, ranging from fine sandy loams to silty clays of the Salinas, Botella, Metz, and Soquel series. The heavier textured soils produce liberally, but they cannot be managed so easily as the lighter soils during rainy weather. The medium-textured soils of the bottom lands that are high in organic matter produce the largest yields as well as the best quality of lettuce. Large quantities of barnyard manure are used for lettuce, and application of 8 to 12 tons an acre have materially increased or maintained the yields. Green-manure crops, preferably legumes (usually purple vetch) are used by some growers to maintain the organic content of the soil. Readily available nitrogen, in the form of sodium nitrate, ammonium sulfate, calcium nitrate, or ammonia, is often added to produce a good growth and color before the heading period. Since two or three crops of lettuce are produced on the same land in a year, it becomes necessary to maintain the soil fertility by the use of crop rotation, manures, cover crops, and inorganic fertilizers.

Lettuce requires moisture throughout the growing season, and this is supplied by the furrow type of irrigation. The frequency of irrigation depends on soil conditions and the season. Although over-irrigation is common practice, it is not so extreme as in some other lettuce-growing sections. Since the lettuce plant is shallow-rooted, the presence of a water table as near the ground surface as five feet in much of the lettuce area has little effect on irrigation practice. Irrigation applications to first-crop lettuce average only two, however, and the amount applied totals only eight inches, as this crop is given a good start by the rainfall. Second crop irrigations average four, and the total amount about 15 inches; while third crop irrigations are around three and the amount about 12 inches.

Lettuce yields between 150 and 250 crates an acre for each crop. Much of the lettuce is grown by large operators who lease the land for that purpose. Labor for producing and harvesting the crop is contracted for.

While irrigation practice in the growing of lettuce differs from that of Salinas Valley in the amounts of water applied, the following descriptions abstracted from a recent publication (*8*) are generally in point:

> Unpublished reports of experiments on lettuce irrigation requirements, conducted in Salinas Valley by the College of Agriculture of the University of California, note that while the measurements of water applied to commercial lettuce fields are not extensive, the experimenters believe that 4 to 6 inches is usually applied to germinate the seed.† It is noted also, however, that
>
> Excessive amount of water to germinate seed in most instances is due to use of high beds—those 6 inches or more. High beds are necessary on land not properly leveled, as water must be kept in furrows until soil around the seed is moistened and the greater the distance the longer the time required to wet the soil. In a few tests where low beds were used, about one-half as much water was used in flooding as for the high beds. A bed need not be any higher than necessary to compensate for unevenness of the land and prevent the beds from being flooded. While lettuce can be raised by flooding the entire surface, crusting of the soil surface may interfere with seed emergence and leaching may occur.
>
> Commercial plantings in Salinas Valley are made on raised beds in which two rows of lettuce are grown. Beds are commonly about 6 to 8 inches high and spaced 42 inches apart from center to center, the rows on each bed being 14 inches apart. Irrigation is accomplished by running water down each furrow between the beds. A small stream running many hours is the general practice. When water is applied to germinate the seed, it is held in the furrow until it soaks into the beds. Irrigation runs may vary from a few hundred feet to more than 1000 feet, depending on slope, soil type and individual preferences. In general, irrigations are more frequent on light sandy soils than on heavy soils, and the sandy soils are given more water than on the heavier soils. As many as 6 to 8 irrigations have been made on one crop. In other cases, as few as 2 or 3 irrigations have been made on crops not receiving moisture from rainfall. A fairly common practice is to irrigate a crop lightly after a first cutting has been made and when two to three more cuttings are anticipated.
>
> Usual tillage practices previous to planting are plowing, disking, and listing. Sled-type implements with planters attached are then used to shape the beds. Cultivation often begins shortly after the plants have two true leaves. A more common prac-

* The 1946 acreages are in reasonable harmony with the results of the 1947 survey of lower Pajaro Valley, which show 3556 acres in 1-crop lettuce, 3296 acres in 2-crop lettuce, but only 200 acres in 3-crop lettuce. See table 4.

** As evidenced by beans, acreage of which in Santa Cruz County declined from 1804 to 700 acres, and sugar beets, which declined from 1834 to 245 acres. Sugar beets are now grown to some extent in rotation with lettuce.

† Access to these reports and permission to quote from them were given by Dr. F. J. Veihmeyer, Professor of Irrigation, College of Agriculture, University of California, who directed the experiments. Full details of the study and conclusions drawn from it have been published in a bulletin of the California Agricultural Experiment Station. (*18*)

tice is to make the first cultivation shortly before the plants are thinned. The first cultivation is generally shallow and is done with side and top knives together with shovels. The blades of the knives are set so they will cut weeds between the two rows and on the sides of each bed. Two- and four-bed tractor-powered cultivators are most common. Following this cultivation the beds frequently are chiseled; that is, two chisel-like blades are drawn through the soil to a depth of four to 6 inches between the two rows of each bed. After thinning, when the plants become larger, 2 to 6 cultivations are often made. These later practices may stir the soil from one to 3 inches deep. The primary purpose of cultivation is to destroy weeds, but other reasons are often given for tillage.

Recent experiments (*18*) show that the primary purpose of cultivation after the crop is planted is to control weeds, and cultivation of lettuce in the absence of weeds is wasted effort.

Crusting of the soil before the seedling emerges is believed to be detrimental to good plants. Some growers irrigate before thinning because this practice seems to be facilitated when the soil is moist; others irrigate after thinning because they believe that irrigation helps the plants to recover from the disturbance of the soil caused by thinning. The lettuce growers thus are not in complete agreement in their reasons for irrigation or cultivation practices, even when climates and soil conditions are comparable. Many growers believe that water applied to the soil when the heads are maturing is apt to make them soft and loose; they also think that when the moisture supply is plentiful the leaves are crisp and a lighter green than when the soil is dry. Premature production of seed stalks is believed to be due to unfavorable soil moisture conditions.

Veihmeyer and Holland (*18*) make the following comments based on their lettuce experiments in the Monterey Bay area:

> The results indicate that there are no marked differences which can be attributed to the differences in irrigation treatments.
>
> Tests of quality were made by tasting in all experiments. This failed to show any marked differences.
>
> The belief that lettuce requires an irrigation close to harvest time to produce firm heads is without foundation since our experiments do not show any difference in moisture content of the heads from the various treatments, nor in firmness, as measured by hand pressure, visual condition, and packing house inspection.
>
> * * * irrigation is not the causal factor for bolting and tipburn (under the climatic and soil conditions prevalent in the Monterey Bay region).

Comments by Monterey County Agent A. A. Tavernetti in a mimeographed "Guide to Irrigation of Lettuce in the Salinas Valley" (*14*) are, by inference, disclosive of current irrigation practice affecting this crop. Paragraphs from this guide that appear to be especially pertinent are quoted below:

> The first use of irrigation water in the production of crops was solely for the purpose of replenishing moisture in the root zone. Irrigation systems as well as most practices in the use of irrigation water are based on this use alone. While this purpose of water is still the most important, yet as more and more information has been learned in the production of crops, the use of water for other purposes than merely replenishing moisture has become a general practice. It is estimated that almost one-half of the water applied to lettuce is for purposes incidental to supplying moisture to the plant.
>
> These extra water applications can seldom be timed with the need for moisture replenishment. As a result, soils on which lettuce is grown are subjected to amounts of water far in excess of that needed for plant growth. * * * The duty of water has little relation to its efficiency of water use. It merely represents the amount used in general practices regardless of whether such practices be good or bad.

Mr. Tavernetti considers that lettuce irrigation is more efficient in Pajaro Valley than in Salinas Valley by perhaps 20 percent, an opinion that is supported in other pages of this report. At no place in the Pajaro study were the exceptionally high applications noted that were cited by the College of Agriculture and Mr. Tavernetti in their Salinas Valley investigations. One reason for the difference, as mentioned by Mr. Tavernetti, is the use of lower hills by Pajaro growers. Other contributing reasons are (1) less wind effect, (2) generally shorter runs, (3) smaller pump deliveries.

While other truck crops are rotated with lettuce in Pajaro Valley, the preferred plan of the lettuce growers calls for lettuce following lettuce, two crops of lettuce being harvested annually, or, infrequently, three. As in other lettuce-growing areas, the heaviest irrigation is that given for germination of the second crop, the spring crop usually being germinated without irrigation. On the other hand, the growing period of spring lettuce is longer than that of the summer crop. A variation of usual practice, encouraged by high prices, is to give an extra irrigation after completion of nominally final picking, to induce enough extra production to justify a repicking.

A new variety, Great Lakes, appears to take longer to mature than the Iceberg, and is assumed to require another irrigation. One grower reported applications to Great Lakes no greater than to other lettuce; another applied two more irrigations.

Land best adapted to lettuce is now all in lettuce, and variations in the rotation away from lettuce are typically on land above the bottoms. Where other crops are rotated with lettuce, sugar beets are favored, but there are also small patches of celery, carrots, and cauliflower; and on land best suited to a spring crop of lettuce some beans or tomatoes are grown. Some of this tomato-bean land is fairly steep and hard to irrigate, but the water demands of both tomatoes and beans are not exorbitant.

The acreage growing truck independently of lettuce is limited, but there are occasional fields of cabbage and brussels sprouts in sandy land not suited to lettuce.

Strawberries

Strawberries and bush berries constitute another important crop. In the early days the acreage in strawberries was confined chiefly to the alluvial soils of the Salinas, Botella, Soquel, and Pajaro series in Pajaro Valley. Within recent years the search for new strawberry land has led to the use of Watsonville loam and Pinto loam on the terraces in the Freedom district. Strawberries are produced for three to four years, after which the plants die. In setting out strawberry plants, care must be used to select them from beds free of wilt and to select land not previously cropped with wilt-affected plants. Tomatoes are known to be responsible for the spread of the wilt fungus, and strawberries must not be planted on land previously cropped to tomatoes.

Medium-textured soils are the easiest to manage for strawberries, owing to the frequency of irrigation during the summer. Claypan soils, such as Pinto loam, seem to be well adapted to strawberries, although they have to be fertilized more heavily than the alluvial soils of more recent deposition. Strawberries seem to do better on acid soils than on neutral or alkaline soils. Where the claypan is close to the surface, these soils are not so desirable, because the surface soil becomes saturated after an irrigation. Soils of the Pinto and Watsonville series that are developed on the older terraces need to be fertilized with barnyard manure, chicken manure, and green manures along with a top dressing of commercial fertilizer carrying a high content of available nitrogen. An acre of berries in full bearing produces from 75 to 125 crates per season.

Sugar Beets

The growing of sugar beets was an important enterprise on the alluvial soils while the beet-sugar factory in Watsonville was in operation. Until lettuce was introduced, a considerable acreage was planted annually to sugar beets in the Salinas soils in the lower part of the Valley, which was too near the coast for the successful culture of apples. At present, beets are grown in a few fields of the Salinas, Metz, and Botella soils. The beets are shipped to the sugar factory in Salinas Valley. Yields range from 10 to 30 tons an acre. The soils of the terraces and uplands are not adapted to the culture of sugar beets.

Partly because of the long-continued position of this crop in the agriculture of Pajaro Valley, most of the land on which beets are grown has been properly graded, permitting even distribution of irrigation water without flooding. The land is usually prepared by plowing in the fall or when the soil is dry, in order to condition it. Subsoiling frequently follows the plowing, and land planes are used to remove irregularities of the surface. Deep chiseling in two directions further conditions the soil. The chisels are followed by harrows or ring rollers to break clods and compact the surface soil in the interest of soil moisture control.

The beets are grown on beds formed by ridges thrown up by lister shovels, rows in the beds being 12 to 14 inches apart, with 26 to 28 inches separating the beds. Distribution of water is by furrows, flow to them from the lateral ditches being controlled by portable metal dams with gates adjustable to permit maintenance of uniform heads accurately gaged. In early-season irrigation, tubes, pipes and flues through the ditch banks, siphons over them, or surface pipe with adjustable gates are useful. Sometimes the seed is planted on dry soil, immediately after which the field is irrigated to supply the moisture for germination. Following cultivation, thinning and hoeing, the sides of the beds are reshaped, and the irrigation furrows are reformed. After the first irrigation they are again reformed to permit adequate subsequent irrigation. Commercial fertilizer is applied following thinning, and water is applied as soon as possible after fertilization and hoeing.

Beets grown in the lettuce rotation are irrigated liberally, but if grown independently they get only about three applications totaling, say, 12 inches, as such plantings get the benefit of the soil moisture resulting from winter rains.

Truck (including tomatoes)

Miscellaneous vegetables, in wide variety including tomatoes, peas, potatoes, beans, sweet corn, sugar beets, spinach, celery, onions, garlic, cauliflower, carrots, and squash, are grown on both irrigated and nonirrigated land. Green peas are occasionally used in crop rotations on the bottom lands. In fact, nearly all the commercial plantings of these crops are on the alluvial soils of the bottoms. Muck and peat soils are especially adapted to the production of vegetables. There is a considerable acreage of cauliflower, sprouts, broccoli, etc., on coastal sandy soils in the Springfield area (south of the valley proper). Irrigation in the Springfield area is by sprinkling.

Since much of the area with which this report is concerned can produce more than one crop a year, several other crops are grown on the lettuce land, either independently of or in rotation with lettuce. As stated by Knott and Tavernetti (*9*),

> The grower can work out a rotation with lettuce planted for harvesting in spring, summer or fall.

To counteract the combined effect of irrigation and cultural and harvesting operations on the compaction of the soil during the growth of lettuce, it is well to rotate this crop with one that receives less working of the soil while wet.

One can grow the following crops for spring harvest and still allow sufficient time to mature a crop of lettuce during the summer and fall: Lettuce, garden peas, carrots, spinach, sugar beets, garlic, vetch seed, and certain other seed crops. Possibilities for fall harvest after lettuce include lettuce, green peas, tomatoes, potatoes, carrots, cauliflower, spinach, celery, broccoli, and cabbage.

Green-manure crops are almost indispensable if lettuce is to be grown on the same soil over a period of years. More than two crops of lettuce should not be grown without at least one of green manure intervening, particularly if animal manure is not available. . . . An August seeding of vetch for plowing under in November or December fits well into planting operations.

Purple vetch, when seeded alone, is usually at the rate of 40 to 60 or more pounds per acre. First the seed is either drilled into the soil or broadcast, then ridges and furrows are made that cover the seed. The soil is irrigated to aid germination. Many growers prepare the soil and beds and drill the vetch in close-spaced rows and in the furrows.

The data so far collected suggest a relatively liberal irrigation for cauliflower and celery raised after a spring crop of lettuce, but applications to the other truck crops do not appear to be exorbitant.

Deciduous Orchards

Up to the time that farmers in Pajaro Valley began to grow lettuce, production of apples was the largest enterprise, and the Valley still ranks as the largest apple-growing section in the State. Probably about 50 acres were devoted to apple trees in 1860, about 250 acres in 1870, and about 500 acres in 1880; and there was a rapid increase in acreage between 1880 and 1890. The peak acreage of apple trees was reached about 1910, after which the figure remained fairly constant until about 1928. Since then the acreage has been reduced by the expansion of lettuce on the alluvial soils.

Apple yields of 600 to 1,600 boxes an acre are obtained on the soils of the bottom lands. The largest yields are obtained on the loams, fine sandy loams, silt loams, clay loams, and silty clay loams of these series. Apples on the soils of the terraces and uplands do not produce so heavily. The soils of the Watsonville series are not well adapted to the production of apples, and although apples have been planted on these soils, yields are low and the loss of trees has been considerable. The Yellow Newton seems to do better on the shallower soils than the Yellow Bellflower. In general, the Yellow Newton is considered to have more promise than other varieties, partly because of its good shipping and keeping qualities.

Only within recent years has orchard irrigation been practiced, and most of the trees are still not irrigated. Investigations by the University of California have shown that the need for irrigation on the deeper alluvial soils is slight, although possibly in years of low rainfall irrigations will materially increase the yield as well as make the trees hardier. Field tests show that the largest increases in yield after an irrigation are from the shallower soils and those of heavy textures. During the early years of the apple industry many orchards were interplanted with strawberries or sugar beets, and as such crops require irrigation, the trees shared in the water application.

Cultural practices in general consist of fairly shallow cultivation on the shallow soils and deeper cultivation on the deeper soils. Many of the orchardists grow a cover crop of purple vetch or grain.* While the growers on the recent and young alluvial soils have not used fertilizers in their orchards to a great extent, the application of nitrates has increased the size of apples and, in some orchards, the yields. Probably fertilization would give greater increases in yields on the soils of the terraces and the sandier soils of the uplands. Some growers in the valley apply barnyard manure.

Apricots do not do well close to the coast; they are therefore planted on the more sheltered, better-drained soils on the eastern side of Pajaro Valley. Most of the apricot orchards are not irrigated. Cultural practices are the same as those followed in other sections of California, and very little fertilizer is used.

Districts close to the coast are not well suited to plums and prunes because of the fogs and high humidity, but some plantings have been made east of Watsonville in the same districts that produce apricots.

Pears also are grown chiefly in the mountainous districts and in small valleys away from the influence of coastal fogs. Other deciduous orchards are of restricted commercial importance in Pajaro Valley. Cultural methods are about the same as for apples.

Pasture

Although some of the alfalfa fields are pastured, most of the pasture acreage in Pajaro Valley is ladino clover grown on dairy farms. These are typically hill-land lay-outs, and irrigation is by flooding controlled with portable pipe, or by sprinklers. While irrigation is frequent, total applications run only about 24 inches per annum, an amount substantially less than that typifying ladino irrigations in most other sections of California where it is grown. A clay pan at 18-inch

* A recent study by the Giannini Foundation, involving 42 unirrigated apple orchards, showed that 21 had seeded cover crops, as follows: vetch alone, 9; vetch and oats, 4; barley alone, 2; oats alone, peas alone, vetch-wheat, vetch-barley, vetch-peas, and vetch-barley-oats, 1 each. Volunteer cover was found in 17 orchards; volunteer-seeded in 4.

depth is perhaps a partial explanation of this low total use; climatic conditions are also contributing factors. However, it is possible that more liberal irrigation, say at 2-week intervals through a 6-month season, would be profitable. The ladino acreage is being expanded on slopes where no other crop can be raised, and ladino will eventually represent an increased irrigation use whether unit applications are increased or not.

Grain

Hay and oats are grown in scattered areas on a wide variety of soils in the uplands and on the terraces. The soils of the bottom lands are too valuable for other crops to be used for grain. Very little barley is grown. Oats are sown in the fall. At present a mixture of vetch and grain—oats, wheat, or barley—is used as a cover crop in orchards (see "Deciduous Orchards"), but crops raised for grain are not irrigated. The acreage of grain and hay is gradually diminishing. As a general rule, barley is produced on the heavy-textured soils, and oats on the sandy soils near the coast, but some oats and vetch are grown for grain and seed or for hay in the Springfield and San Andreas sections.

Summary

Irrigation practices for the different crops have been discussed in the preceding paragraphs. On the basis of this discussion and the canvass conducted by the Soil Conservation Service, table 3 has been set up to summarize the normal practice in Pajaro Valley. Tables 4 and 5 show the results of the cultural survey made by the California State Division of Water Resources.

TABLE 3

SUMMARY OF AVAILABLE INFORMATION ON IRRIGATION OF VARIOUS CROPS IN PAJARO VALLEY, USED TO ESTIMATE CONSUMPTIVE USE OF WATER UNDER NORMAL CONDITIONS

Crop	Growing season	Irrigation			
		First	Last	Number	Total depth applied (season)
	Dates	Dates	Dates		Inches
Alfalfa	1/ 1–12/31	5/ 1	9/30	4	24
Artichokes	5/20–10/15	5/21	10/ 8	4	17
Beans	5/15– 9/ 1	6/ 4	8/ 1	2	12
Beans[1]	6/18–10/ 1	6/18	8/ 1	2	10
Berries (bush)	4/ 1–10/31	--	--	3	11
Lettuce (1st)	2/ 1– 5/15	4/13	5/18	2	8
Lettuce (2d)	6/ 1– 9/ 1	6/15	8/20	4	15
Lettuce (3d)	9/15–10/31	8/ 5	10/24	3	12
Strawberries	-- --	5/ 1	10/ 1	3	24
Sugar beets	4/15–10/ 1	4/15	7/20	3	12
Sugar beets[1]	5/31–10/31	5/20	9/30	4	24
Tomatoes	5/15– 9/15	5/13	8/13	4	15
Truck	6/15–10/31	6/ 1	9/ 1	4	16
Cauliflower	8/ 1–12/31	7/17	9/17	2	8
Cauliflower[1]	7/15–10/31	7/15	9/10	3	15
Celery[1]	6/15–10/31	6/19	9/30	5	25
Orchard (old)	4/ 1–10/31	6/15	8/15	2	8
Orchard (young)	4/ 1–10/31	6/15	8/15	2	6
Pasture	1/ 1–12/31	6/ 1	10/15	5	24
Miscellaneous	-- --	6/ 1	10/ 1	4	12

[1] Grown after crop of spring lettuce.

RESULTS OF CULTURAL SURVEY, PAJARO VALLEY, CALIFORNIA

(Revised May 16, 1950)

Symbol	Land Use	Area of High Water Table, Valley Floor (acres) — Zone of Average Annual Rainfall (inches)				Area Other Than That of High Water Table, Valley Floor (acres) — Zone of Average Annual Rainfall (inches)					Total Valley Floor (acres) — Zone of Average Annual Rainfall (inches)					Foothill Belt (acres) — Zone of Average Annual Rainfall (inches)						Tributary Watershed (acres) — Zone of Average Annual Rainfall (inches)						
		0-20	20-24	24-28	Sub-total	0-20	20-24	24-28	28-32	Sub-total	0-20	20-24	24-28	28-32	Total	0-20	20-24	24-28	28-32	32-36	Total	24-28	28-32	32-36	36-40	40-44	44-48	Total
	Irrigated Crops																											
a	Alfalfa	8	59	36	103	--	--	73	--	73	8	59	109	--	176	--	--	--	--	--	--	--	--				--	
A	Artichokes	353	--	--	353	200	--	8	--	208	553	--	8	--	561	--	--	--	--	--	--	--	--	--	--	--	--	
B	Beans	32	50	32	114	29	54	638	--	721	61	104	670	--	835	--	7	5	--	--	12	--	--	--	--	--	--	--
bb	Berries	--	29	14	43	43	81	208	6	338	43	110	222	6	381	79	197	49	1	--	326	--	--	--	--	--	--	
G	Guayule	--	--	--	--	--	--	3	--	3	--	--	3	--	3	--	--	--	--	--	--	6	--	--	--	--	--	6
1	Lettuce, 1 crop	1,242	1,596	297	3,135	139	17	262	1	419	1,381	1,613	559	1	3,554	2	--	--	--	--	2	--	--	--	--	--	--	
1₂	Lettuce, 2 crops	1,484	565	792	2,841	49	61	345	--	455	1,533	626	1,137	--	3,296	--	--	--	--	--	--	--	--	--	--	--	--	--
1₃	Lettuce, 3 crops	106	46	26	178	--	--	18	2	20	106	46	44	2	198	--	--	1	1	--	2	--	--	--	--	--	--	--
1b	Lettuce and beans	--	14	22	36	--	--	51	--	51	--	14	73	--	87	--	--	--	--	--	--	--	--	--	--	--	--	
1t	Lettuce and truck	48	96	125	269	--	17	27	--	44	48	113	152	--	313	--	--	--	--	--	--	--	--	--	--	--	--	--
M	Miscellaneous	21	13	17	51	37	116	328	16	497	58	129	345	16	548	--	11	25	23	--	59	23	--	--	--	--	--	23
ooi	Orchard (old)	--	472	469	941	--	15	936	52	1,003	--	487	1,405	52	1,944	--	--	5	24	--	29	--	--	--	--	--	--	
To	Tomatoes and orchard	--	--	--	--	--	--	173	--	173	--	--	173	--	173	--	--	--	--	--	--	--	--	--	--	--	--	--
yoi	Orchard (young)	--	273	182	455	--	3	445	101	549	--	276	627	101	1,004	--	--	3	41	--	44	5	--	--	--	--	--	5
P	Pasture	1	34	--	35	336	208	61	--	605	337	242	61	--	640	5	3	16	--	--	24	--	--	--	--	--	--	--
st	Strawberries	13	--	19	32	24	--	82	--	106	37	--	101	--	138	--	6	--	--	--	6	--	--	--	--	--	--	--
Sb	Sugar beets	484	606	159	1,249	--	28	170	--	198	484	634	329	--	1,447	--	--	--	--	--	--	--	--	--	--	--	--	--
T	Tomatoes	100	121	21	242	69	247	670	4	990	169	368	691	4	1,232	23	22	25	8	--	78	6	--	--	--	--	--	6
t	Truck	130	50	9	189	484	50	95	7	636	614	100	104	7	825	--	6	34	3	--	43	--	--	--	--	--	--	--
	Subtotal	4,022	4,024	2,200	10,266	1,410	897	4,593	189	7,089	5,432	4,921	6,813	189	17,355	109	252	163	101	--	625	40	--	--	--	--	--	40
	Irrigable Dry-Farmed*																											
DF	Dry-farmed	93	12	29	134	1,885	638	948	7	3,478	1,978	650	977	7	3,612	345	664	303	603	74	1,989	562	65	468	391	182	33	1,701
f	Fallow	20	8	13	41	105	68	137	1	311	125	76	150	1	352	17	14	8	--	--	39	7	--	--	--	--	--	7
Hd	Holly trees	--	--	--	--	1	--	--	--	1	1	--	--	--	1	113	--	--	--	--	113	--	--	--	--	--	--	--
Ng	Grassland pasture	8	29	48	85	1,059	779	1,332	2	3,172	1,067	808	1,380	2	3,257	395	1,500	756	997	49	3,697	--	--	--	--	--	--	--
oo	Orchard (old)	--	639	329	968	--	176	1,320	485	1,981	--	815	1,649	485	2,949	--	121	771	2,566	556	4,014	438	5	21	--	--	--	464
Td	Tomatoes	--	12	--	12	--	--	--	--	--	--	12	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	--
yo	Orchard (young)	--	52	53	105	--	13	250	51	314	--	65	303	51	419	--	--	--	52	--	52	--	--	--	--	--	--	
	Subtotal	121	752	472	1,345	3,050	1,674	3,987	546	9,257	3,171	2,426	4,459	546	10,602	870	2,299	1,838	4,218	679	9,904	1,007	70	489	391	182	33	2,172
	Native Vegetation																											
ng	Native grass	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3,474	872	446	247	--	--	5,039
BS	Sparse brush	--	--	--	--	1	--	--	--	1	1	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--
BM	Medium brush	104	291	46	441	28	7	402	36	473	132	298	448	36	914	5	115	396	702	50	1,268	69	19	--	--	--	--	88
FH	Forest	--	--	--	--	--	--	17	--	17	--	--	17	--	17	--	25	--	--	--	25	312	1,077	1,927	2,487	2,275	1,238	9,316
FM	Chaparral, etc.	85	2	4	91	5	--	27	57	89	90	2	31	57	180	15	816	789	262	116	1,998	591	1,036	722	464	565	1,177	4,555
FS	Woodland, grass	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15	--	--	--	15	--	--	--	--	--		
S	Swamp, tules	93	--	--	93	--	--	--	--	--	93	--	--	--	93	23	--	--	--	--	23	--	--	--	--	--		
	Subtotal	282	293	50	625	34	7	446	93	580	316	300	496	93	1,205	43	971	1,185	964	166	3,329	4,446	3,004	3,095	3,198	2,840	2,415	18,998
	Miscellaneous																											
Airport	Airport	--	--	--	--	--	233	--	--	233	--	233	--	--	233	--	--	--	--	--	--	--	--	--	--			
R	Roads and railroads	21	140	--	161	--	--	50	--	50	21	140	50	--	211	--	5	--	--	--	5	--	--	--	--			
TL	Town and farm lots	9	642	77	728	80	741	204	36	1,061	89	1,383	281	36	1,789	6	18	23	25	--	72	--	--	--	--	--	--	--
WL	Wasteland	698	83	64	845	--	--	43	--	43	698	83	107	--	888	--	--	--	--	--	--	--	--	--	--			
WS	Water surface	99	84	135	318	--	--	302	--	302	99	84	437	--	620	6	--	4	--	--	10	--	--	--	--			
-	County and farm roads, etc.	143	211	121	475	146	90	369	41	646	289	301	490	41	1,124	32	85	83	206	36	442	150	29	29	20	6	1	235
	Subtotal	970	1,160	397	2,527	226	1,064	968	77	2,335	1,196	2,224	1,365	77	4,862	44	108	110	231	36	529	150	29	29	20	6	1	235
	TOTAL	5,395	6,229	3,139	14,763	4,720	3,642	9,994	905	19,261	10,115	9,871	13,133	905	34,024	1,066	3,630	3,296	5,514	881	14,387	5,643	3,103	3,613	3,609	3,028	2,449	21,445

* Irrigable dry-farmed for valley floor and foothill areas; dry-farmed for tributary watershed.

TABLE 5

SUMMARY, LAND-USE SHOWN IN SURVEY OF LOWER PAJARO VALLEY, ADJACENT FOOTHILL AND TRIBUTARY WATERSHED AREAS

Land use	Acreage within zones of average rainfall per year*								Total acreage
	0-20	20-24	24-28	28-32	32-36	36-40	40-44	44-48	
Valley Floor									
Irrigated crops	5,432	4,921	6,813	189	----	----	----	----	17,355
Irrigable dry farmed	3,171	2,426	4,459	546	----	----		----	10,602
Native vegetation	316	300	496	93	----	----		----	1,205
Miscellaneous	1,196	2,224	1,365	77	----	----	----	----	4,862
Subtotal	10,115	9,871	13,133	905	----	----	----	----	34,024
Foothill Belt									
Irrigated crops	109	252	163	101	----	----	----	----	625
Irrigable dry farmed	870	2,299	1,838	4,218	679	----	----	----	3,904
Native vegetation	43	971	1,185	964	166	----	----	----	3,329
Miscellaneous	44	108	110	231	36	----	----	----	529
Subtotal	1,066	3,630	3,296	5,514	881	----	----	----	14,387
Tributary Watershed									
Irrigated crops	----	----	40	----	----	----	----	----	40
Dry farmed	----	----	1,007	70	489	391	182	33	2,172
Mountain watershed	----	----	4,446	3,004	3,095	3,198	2,840	2,415	18,998
Miscellaneous	----	----	150	29	29	20	6	1	235
Subtotal	----	----	5,643	3,103	3,613	3,609	3,028	2,449	21,445
Summary									
Irrigated crops	5,282	5,173	7,016	290	----	----		----	18,020
Irrigable dry farmed	4,041	4,725	6,297	4,747	679	----	182	33	20,506
Dry farmed	----	----	1,007	70	489	391	----	----	2,172
Native vegetation	359	1,271	6,127	4,061	3,261	3,198	2,840	2,415	23,532
Miscellaneous	1,499	2,332	1,625	337	65	20	6	1	5,626
Grand total	11,181	13,501	22,072	9,522	4,494	3,609	3,028	2,449	69,856

* Rainfall zones are bounded by annual precipitation indicated, in inches.

CONSUMPTIVE USE OF WATER *

In water-utilization investigations of areas such as Pajaro Valley, consumptive use of water is one of the important factors to be considered. From a valley-wide standpoint, consumptive use includes all transpiration and evaporation losses from lands on which there is growth of vegetation of any kind, whether agricultural crops or native vegetation, plus evaporation from bare land and from water surfaces *(1)* *(2)*. The term "consumptive use" in this report is considered synonymous with the term "evapo-transpiration" and is defined *(2)* as: The sum of the volumes of water used by the vegetative growth of a given area in transpiration or building of plant tissue and that evaporated from adjacent soil, snow, or intercepted precipitation on the area in any specified time. If the unit of time is small, such as a week or a month, the consumptive use is expressed in acre-inches per acre or depth in inches; whereas, if the unit of time is large, such as a crop growing-season or a 12-month period, the consumptive use is usually expressed as acre-feet per acre or depth in feet. The total consumptive use for a given period and area is expressed in acre-feet.

The processes of evaporation from a free water surface and plant transpiration are similar in that each is influenced by climatic conditions. Both evaporation and consumptive use (evapo-transpiration) are influenced by temperature, humidity, wind movement and precipitation. The quantity of water transpired by plants depends upon the amount of water at their disposal as well as on temperature and dryness of the air, the intensity of sunlight, the wind movement, the length of growing season, the stage of the development of the plant, the amount of its foliage, and the nature of its leaf.

GENERAL PROCEDURE

Various methods have been used to determine the amount of water consumed by native vegetation and agricultural crops. Regardless of the method, the problems encountered are numerous and considerable time is required to make satisfactory measurement of consumptive use *(6)*. The source of water used by plant life, whether from precipitation alone, irrigation plus rainfall, ground water plus precipitation, or irrigation plus ground water plus rainfall, is a factor influencing the selection of a method. Unit values of consumptive use may be determined for different kinds of native vegetation and agricultural crops by soil moisture studies, lysimeter or tank measurements, analysis of irrigation data, analysis of climatological data, and other methods *(2)*. Unit values observed in one area may be used to estimate consumptive use in other areas having somewhat similar climatic conditions, provided temperature and precipitation records are available for both areas *(7)*. For irrigated crops, data on depth of irrigation water applied, number of irrigations per year, irrigation efficiency, water-holding capacity (field capacity) of soil and length of growing season may be used in estimating unit values of consumptive use *(2)*.

The results of unit consumptive use determinations by the methods described above may be applied to large valley areas such as Pajaro Valley by the "integration method" *(1)* to compute the total amount of water consumed for a given area in acre-feet. Briefly stated, consumptive use for a specified time, as determined by the integration method, is the summation of the products of consumptive use for each crop times its area, plus the consumptive use of native vegetation times its area, plus water surface evaporation times water surface area, plus evaporation from land times its area. Before this method can be used it is necessary to know the areas of agricultural crops, native vegetation, water surfaces and other classifications, as well as the unit consumptive use for each classification.

The results of a survey of water-consuming areas in Pajaro Valley by the Division of Water Resources, California State Department of Public Works, are summarized in tables 4 and 5.

Since no measurements have been made of consumptive use of water in Pajaro Valley, estimates of unit values in this report will be made by analyses of temperature, precipitation and irrigation data for Pajaro Valley in comparison with similar data for Salinas Valley, San Luis Rey Valley and other areas of California, where measurements of consumptive use have been made.

For some agricultural crops sufficient data are available on irrigation practices, such as length of growing season, number of irrigations, depth of water applied and water application efficiency, to estimate unit consumptive use. For other crops, such as alfalfa and native vegetation, and for evaporation from free water surface, estimates of rates of use are based largely on studies in other areas transposed to the Pajaro Valley by the method suggested by Blaney and Criddle *(7)*. Briefly, the procedure is to correlate existing consumptive use data with monthly temperature, percent of daytime hours, precipitation and growing (or irrigation) season. Coefficients are developed by dividing the unit consumptive use by the corresponding consumptive use factor, or $K = \frac{U}{F}$. The coefficients so developed

* Prepared by Harry F. Blaney, Senior Irrigation Engineer, Division of Irrigation and Water Conservation, Soil Conservation Service, Research, U. S. Dept. of Agriculture.

are used to transfer consumptive use data from other areas in California to Pajaro Valley.

Disregarding the unmeasured factors, consumptive use varies with the temperature, the daytime hours and available moisture (precipitation and/or irrigation). By multiplying the mean monthly temperature (t) by the monthly percent of daytime hours of the year (p), there is obtained a monthly consumptive use factor (f). Then it is assumed that the consumptive use varies directly as this factor, when an ample water supply is available. Expressed mathematically, $U = KF =$ sum of kf where:

- U = Consumptive use of crop (or evaporation from water surface) in inches for any period.
- F = Sum of the monthly consumptive use factors for the period (sum of the products of mean monthly temperature and monthly percent of annual daylight hours) $(t \times p)$.
- K = Annual empirical coefficient.
- k = Monthly empirical coefficient.
- t = Mean monthly temperature in degrees Fahrenheit.
- p = Monthly percent of daytime hours of the year.
- $f = \frac{t \times p}{100}$ = monthly consumptive use factor.
- $u = kf$ = monthly use in inches.

This method is used for estimating unit values for evaporation, native vegetation, and alfalfa. Unit values for other crops are estimated by analyzing irrigation data as described later in this chapter.

The normal irrigation season in Pajaro Valley usually extends from April 1 to October 31. Therefore, consumptive use is determined for winter period, November 1 to March 31; irrigation season (summer period), April 1 to October 31; and for the entire year.

Climatological and irrigation data now available do not provide an adequate basis for estimates of consumptive use in the "Foothill Belt" and the "Tributary Watershed" of the Pajaro Basin; therefore only rates of consumptive use for the main valley floor are estimated in this provisional report.

CLIMATOLOGICAL RECORDS

Precipitation and temperature records have been kept at Watsonville in the Pajaro Valley for 68 years. A summary of these records is shown in table 2.

Table 6 shows the normal monthly temperature and precipitation, percent of daytime hours, and calculated consumptive use factor at Watsonville. These data are used to estimate evaporation and consumptive use in the floor of the Valley.

TABLE 6

NORMAL MONTHLY TEMPERATURE AND PRECIPITATION, PERCENT OF DAYTIME HOURS AND CALCULATED CONSUMPTIVE USE FACTOR, WATSONVILLE, PAJARO VALLEY, CALIFORNIA

Month	Mean temperature (t)	Daytime hours (p)	Consumptive use factor (f)	Normal precipitation
	°F.	Percent		Inches
January	49.9	6.93	3.46	4.18
February	51.8	6.82	3.53	3.74
March	53.9	8.35	4.50	3.35
April	55.9	8.87	4.96	1.30
May	58.6	9.87	5.78	0.62
June	60.9	9.89	6.02	0.12
July	61.5	10.05	6.18	0.01
August	61.6	9.44	5.82	0.02
September	60.9	8.37	5.10	0.27
October	58.4	7.82	4.57	0.93
November	54.3	6.87	3.73	1.94
December	50.2	6.72	3.37	4.49
Annual	56.5	100.00	----------	20.97

t = Mean monthly temperature.
p = Percent of daytime hours of year for month.
$f = \frac{t \times p}{100}$ = monthly consumptive use factor.

Miscellaneous precipitation records for areas above Watsonville are shown in table 7.

EVAPORATION FROM WATER SURFACE

No evaporation measurements have been made in Pajaro Valley. Monthly evaporation and temperature measurements made for six years at Newark in the San Francisco Bay area northeast of Watsonville are available. Climatic conditions in this area are somewhat similar to those in Pajaro Valley. The average annual temperature at Newark is 56.5 degrees Fahrenheit for the period of record as compared with a normal annual temperature at Watsonville of 56.5 degrees Fahrenheit; hence the observations at Newark are used to compute the evaporation in Pajaro Valley. Table 8 shows the observed monthly evaporation and table 9 the temperatures at Newark.

Table 10 shows the estimated normal monthly evaporation for Pajaro Valley, based on evaporation and temperature observations at Newark. The coefficients were determined by dividing the monthly evaporation at Newark by the consumptive use factor. Evaporation in Pajaro Valley was computed by multiplying the consumptive use factors for Watsonville by these coefficients, as indicated in the tabulation.

TABLE 7

MISCELLANEOUS PRECIPITATION RECORDS AT SEVERAL STATIONS IN PAJARO BASIN

Season	Station number and location					
	No. 2 Brown's Valley	No. 6 Cusack Ranch	No. 8 Evans Ranch	No. 12 Oakdale School	No. 17 Enos Ranch	Watsonville
	Inches	Inches	Inches	Inches	Inches	Inches
1925-26	28.81					18.37
1926-27	29.32	34.13				24.28
1927-28	25.56	27.22				14.92
1928-29	16.79	20.00				14.46
1929-30	23.24	28.75	26.92			16.45
1930-31	16.43	16.23	23.03			11.02
1931-32	38.85	39.13	35.59			24.50
1932-33	21.12	22.64	23.97			15.12
1933-34	18.16	21.66	23.20			12.46
1934-35	30.14	33.84	37.39			19.87
1935-36	29.95	38.48	46.77	33.31	30.47	21.04
1936-37	38.91	34.71	44.53	33.81	33.17	26.38
1937-38	47.65	44.74	60.22	38.55	38.35	25.97
1938-39	21.43	21.37	25.98	19.81	18.40	14.71
1939-40	43.56	41.27	55.87	38.46	35.72	24.14
1940-41	59.70	56.07	68.70	54.68	53.53	36.59
1941-42	42.39	-----	54.19	37.93	36.05	24.80
1942-43	-----	-----	-----	32.65	-----	20.82
1943-44	29.40	-----	-----	27.29	-----	18.55
1944-45	28.64	-----	-----	30.24	-----	21.63
1945-46	29.49	-----	-----	24.28	-----	18.66
1946-47	24.10	-----	-----	-----	-----	13.28
1947-48	28.75	-----	-----	-----	-----	16.02
1948-49	25.28	-----	-----	23.52	-----	15.12

TABLE 8

OBSERVED MONTHLY EVAPORATION FROM WEATHER BUREAU PAN, 1942 TO 1947, INCLUSIVE, NEWARK, CALIFORNIA

Month	Evaporation, inches						
	1942	1943	1944	1945	1946	1947	Average
January	1.27	1.44	1.29	0.88	1.64	0.99	1.25
February	2.28	1.88	2.24	2.06	1.46	1.42	1.89
March	3.91	2.62	4.34	2.94	3.37	3.14	3.39
April	4.10	4.44	4.75	6.07	5.16	5.45	5.00
May	6.82	8.35	7.65	6.50	6.75	8.06	7.36
June	9.00	8.22	7.08	8.69	8.51	8.58	8.35
July	9.33	8.77	8.38	8.80	8.63	8.99	8.82
August	7.78	8.05	7.85	7.44	7.76	8.04	7.82
September	5.88	6.76	6.24	6.93	7.19	7.08	6.68
October	4.22	4.43	3.81	3.66	5.33	4.46	4.32
November	2.07	2.16	2.23	1.65	2.52	2.50	2.19
December	1.09	1.85	0.80	1.24	1.01	1.51	1.25
Annual	57.75	58.97	56.66	56.86	59.33	60.22	58.32

TABLE 9

MEAN MONTHLY TEMPERATURES, 1942 TO 1947, INCLUSIVE, NEWARK, CALIFORNIA

Month	Temperature, degrees Fahrenheit						
	1942	1943	1944	1945	1946	1947	Average
January	50.5	47.8	48.0	44.9	46.0	42.8	46.7
February	51.0	52.2	48.4	50.2	46.2	50.8	49.8
March	53.1	54.2	52.4	48.6	50.2	54.6	52.2
April	54.2	56.0	52.7	53.8	54.0	57.2	54.6
May	57.2	61.2	59.7	57.3	57.8	61.1	59.0
June	61.4	62.0	61.5	63.8	61.4	65.2	62.6
July	64.6	65.1	63.6	65.2	64.8	63.7	64.5
August	64.3	64.8	63.4	62.9	63.8	64.0	63.9
September	62.2	66.0	64.6	64.6	63.9	63.4	64.1
October	59.8	60.4	60.4	60.7	57.9	61.4	60.1
November	52.2	54.7	51.6	52.9	51.0	49.6	52.0
December	48.1	49.8	49.4	49.4	48.1	47.2	48.6
Annual	56.6	57.8	56.3	56.2	55.4	56.8	56.5

TABLE 10

ESTIMATED NORMAL EVAPORATION FOR PAJARO VALLEY, BASED ON EVAPORATION AND TEMPERATURE OBSERVATIONS AT NEWARK, CALIFORNIA

Month	Newark, California			Watsonville, California			
	Evaporation W. B. pan (e)[1]	Consumptive use factor (f)	Coefficient (k)[2]	Consumptive use factor (f)[3]	Computed evaporation		
					W. B. pan[4]	Lake surface[5]	
	Inches				Inches	Inches	Feet
November	2.19	3.56	0.62	3.73	2.31	1.92	0.160
December	1.25	3.25	0.38	3.37	1.28	1.06	0.088
January	1.25	3.22	0.39	3.46	1.35	1.12	0.093
February	1.89	3.39	0.56	3.53	1.98	1.64	0.137
March	3.39	4.35	0.80	4.50	3.60	2.99	0.249
Subtotal	9.97	17.77	0.56	18.59	10.52	8.73	0.727
April	5.00	4.85	1.03	4.96	5.11	3.83	0.319
May	7.36	5.84	1.26	5.78	7.28	5.46	0.455
June	8.35	6.21	1.34	6.02	8.07	6.05	0.504
July	8.82	6.90	1.28	6.18	7.91	5.93	0.494
August	7.82	6.04	1.29	5.82	7.51	5.63	0.469
September	6.68	5.37	1.24	5.10	6.32	4.74	0.395
October	4.32	4.69	0.92	4.57	4.20	3.15	0.262
Subtotal	48.35	39.90	1.21	38.43	46.40	34.79	2.898
Annual	58.32	57.67	1.01	57.02	56.92	43.52	3.625

[1] Average of observed evaporation, 1942 to 1947, inclusive.

[2] $k = \frac{e}{f}$ = coefficient.

[3] From table 6.

[4] Computed evaporation e = kf.

[5] Lake surface evaporation = pan evaporation × 0.83 for winter months and = pan evaporation × 0.75 for summer months.

NATIVE VEGETATION ON THE VALLEY FLOOR

For some 20 years the Division of Irrigation, in cooperation with the California Division of Water Resources, has investigated the consumptive use of water by native vegetation (*3*) (*4*) (*10*) (*17*). Some of the results for California and other western states have been summarized in one report (*17*), according to which, the relation of plant communities to moisture supply is one of the outstanding characteristics of the growth of natural vegetation. While individual species are largely restricted to favorable physical environments, the principal condition that governs the distribution of vegetative groups is the amount of available moisture. Each species responds to individual water conditions for its most favorable growth and its widest distribution.

Natural vegetation grows under moisture conditions that are always changing. Plants that do not subsist on ground water but depend upon moisture held by the soil particles may have an abundant supply at one time and suffer a scarcity at another. Ground water fluctuates and roots in contact with it are alternately wet and dry. Soil moisture is dependent upon precipitation, but evaporation, transpiration, percolation, and runoff cause its uneven distribution in the soil.

In arid areas moisture is retained in the upper soil horizon, and the vegetation is confined to those species which are adapted to extreme economy of water. In areas of greater precipitation, deeper penetration results in plant roots drawing upon a greater volume of soil moisture. In low places a concentration of moisture takes place and ground-water areas support those plants which use more water than dry-land plants. Finally the water-loving plants, living with their roots in water, are large consumers of it.

No measurements have been made of evapo-transpiration by native vegetation in Pajaro Valley. However, climatic conditions in the lower San Luis Rey Valley near Oceanside, California, are somewhat similar to those in Pajaro Valley. Therefore, the results of evapo-transpiration studies in San Luis Rey Valley (*10*) made by the Division of Irrigation and Water Conservation in cooperation with the Division of Water Resources are used to estimate consumptive use of water in Pajaro Valley by the method previously described.

Native vegetation on the floor of Pajaro Valley was mapped by the Division of Water Resources as sparse brush-grass, medium brush-trees-grass, dense trees-brush-grass, chaparral, and swamp. (See table 4.)

Swamp Areas

The results of observations in San Luis Rey Valley on consumptive use of water by tules growing in a tank (six feet in diameter and six feet deep, located in a swamp) are shown in table 11, together with computed monthly consumptive-use factors and coefficients. By applying these coefficients to the consumptive-use factors at Watsonville, estimates have been made of monthly consumptive use of water by swamp vegetation, as shown in table 11.

TABLE 11

ESTIMATED NORMAL CONSUMPTIVE USE OF WATER BY SWAMP AREAS IN PAJARO VALLEY, BASED ON OBSERVED CONSUMPTIVE USE BY TULES IN SAN LUIS REY VALLEY, CALIFORNIA

Month	San Luis Rey Valley (observed)			Pajaro Valley (computed)		
	Consumptive use (u)[1]	Consumptive use factor (f)	Coefficient (k)[2]	Consumptive use factor (f)	Consumptive use (u)[3]	
	Inches			Inches	Inches	Feet
November	3.18	4.02	0.79	3.73	2.95	0.25
December	1.92	3.74	.51	3.37	1.72	.14
January	1.82	3.91	.47	3.46	1.63	.41
February	1.90	3.81	.50	3.53	1.76	.15
March	3.09	4.79	.65	4.50	2.93	.24
Subtotal	11.91	20.27	0.59	18.59	10.99	0.92
April	4.56	5.12	0.89	4.96	4.41	0.37
May	7.07	6.22	1.14	5.78	6.59	.55
June	7.46	6.44	1.16	6.02	6.98	.58
July	8.70	6.89	1.26	6.18	7.79	.65
August	7.76	6.68	1.16	5.82	6.75	.56
September	6.41	5.51	1.16	5.10	5.92	.49
October	5.07	5.03	1.01	4.57	4.62	.39
Subtotal	47.03	41.89	1.12	38.43	43.06	3.59
Annual	58.94	62.16	0.95	57.02	54.05	4.51

[1] Average observed consumptive use by tules, San Luis Rey Valley, 1940, 1941 and 1943.

[2] $k = \frac{u}{f} = \frac{\text{observed consumptive use}}{\text{consumptive use factor}}$ = monthly coefficient.

[3] u = kf = computed consumptive use at Watsonville.

Trees-Brush-Grass With High Water Table

Some areas in Pajaro Valley are covered with growths consisting of native trees intermingled with grasses and brush of varying density, the variation being governed by the available water supply. In those areas underlain by a high water table the growths are dense, and as the terrain rises toward the hills and distance to the water table increases, vegetation becomes less dense and changes to a species having roots developed for obtaining water from greater depths. This arrangement results in zones of vegetation that are irregular according to the ability of the roots to obtain moisture. Exceptions occur in some places as a result of soil types. In the valley, there are areas where ground water is near enough to the ground surface to support luxuriant growths of vegetation, but, owing to lack of fertility in the soil, the vegetation is sparse. These areas consist in general of sandy or gravelly soils which have been deposited by recent flood flows.

In mapping areas of trees intermingled with grasses and underbrush the growths were classified as dense, medium, or sparse. In some cases there was no distinct dividing line between the classifications, and one graded more or less gradually into another. In places where there was abrupt change in topography, soils, or other features, the dividing line was rather definite.

Willows, cottonwoods, and baccharis were the predominating type of tree, and although they drop their leaves and become dormant for about three months during the winter, consumptive use continues in the areas they occupy, owing to growths of grasses, weeds, and underbrush. The lands may be considered as having a double crop with the trees using water during the summer periods and the grasses and underbrush using it during the winter. There was, of course, much overlapping of the two crops.

To estimate the consumptive use of intermingled native trees, brush and grass, data obtained from studies in Bonsall Basin, San Luis Rey Valley, were employed.

In San Luis Rey Valley an intermingled growth of cottonwood, willow trees and grasses (similar to growth in Pajaro Valley) was grown in a tank located in natural environment (*10*). The water table in the tank was held for two years at three feet below the ground surface and for another two years at four feet below the ground surface. On the basis of the information presented, the annual use of water by native vegetation with water table at three and four feet averages 92.7 and 62.5 inches, respectively.

Plotting the observed data results in two points designated "A" and "B" on figure 3. In order to complete the curve it was necessary to estimate a third point. This third point, "C," was determined on the assumption that valley vegetation draws little if any water from the ground water when the water-table is at a depth of 12 feet or more. Where the water-table depth is more than 12 feet, the vegetation depends wholly or very largely on rainfall which has been stored in the soil. Previous investigations in Santa Ana Valley (*3*) indicated that in soil consisting of sand of variable texture to a depth of 12 feet or more, the major root activity of native vegetation existed in the zone from ground surface to a depth of 11 feet. The consumptive use consisted entirely of rainfall and amounted to as much as 14 inches in one year without penetration below the root zone. Point "C" on figure 3 was therefore set at 14 inches of consumptive use with a water-table at 12 feet. The consumptive use for areas with water-tables at greater depths than 12 feet would be the same and consist entirely of rainfall. In years of excessive precipitation there would be contribution to the ground water, and in years of low precipitation the consumptive use could not exceed the rainfall. The curve does not necessarily apply where the water-table depth is less than three feet, for the reason that the type of vegetation changes to swampy growths and there is more or less direct evaporation from the soil by capillary action.

Another point on the curve may be obtained from the data secured at the abandoned well in Bonsall Basin where a water level recorder was maintained and the consumptive use computed from the diurnal fluctuations of the water-table. The use of water as determined by this method was 45.40 inches depth per year with an average distance to ground-water table of 4.7 feet. This point is shown on figure 3 as "D."

Table 12 shows the results of observed monthly consumptive use of water by intermingled growth of trees and grasses in a tank with the water table at four feet below the ground surface in natural environment in San Luis Rey Valley, and computed monthly coefficients. These data are considered applicable to areas in Pajaro Valley where dense growth occurs along the streams and the depth to water table ranges from three to five feet with an average depth of four feet. An estimate of monthly consumptive use of water by dense growth of trees-brush-grass in the Pajaro Valley, based on the San Luis Rey Valley studies (*10*) and temperature records, is also shown in table 12.

From the curve (figure 3), the annual use of water in San Luis Rey Valley by medium brush-trees-grass (in areas with depth to water-table ranging from four to seven feet) is taken as 36 inches, and use by sparse brush-grass (in areas with depth to water-table ranging from six to 10 feet) is shown as 21 inches.

These values for medium and sparse vegetation are transposed to Pajaro Valley by means of the ratio of the consumptive use factors at Watsonville to those at San Luis Rey. In estimating the seasonal consumptive use for sparse vegetation, consideration was given to the amount of moisture available from precipitation during the winter and summer periods.

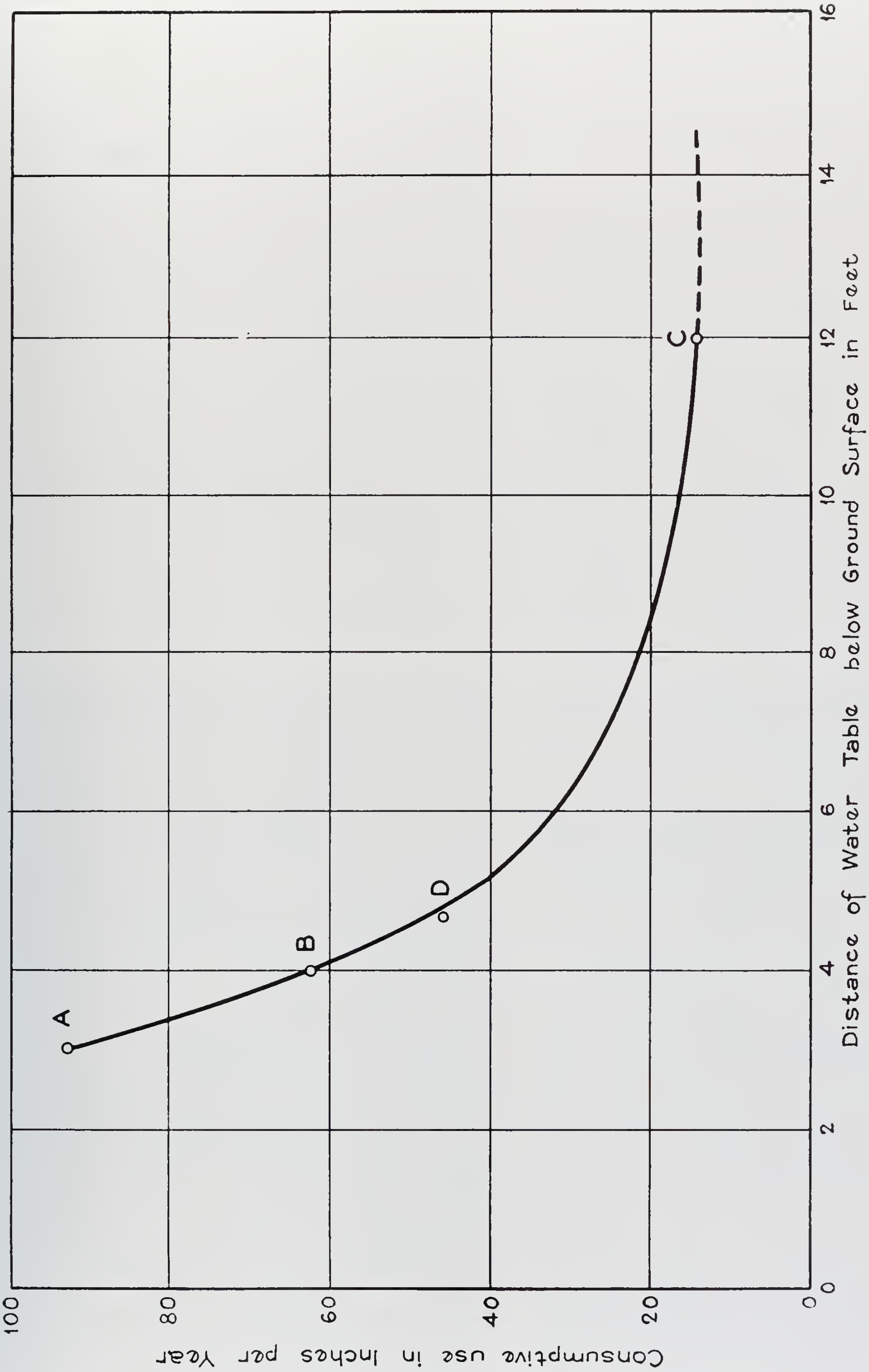

Figure 3

CONSUMPTIVE USE BY NATIVE VEGETATION
SAN LUIS REY VALLEY, CALIFORNIA

TABLE 12

ESTIMATED NORMAL CONSUMPTIVE USE OF WATER BY DENSE NATIVE VEGETATION IN PAJARO VALLEY, BASED ON OBSERVED CONSUMPTIVE USE IN SAN LUIS REY VALLEY, CALIFORNIA

Month	San Luis Rey Valley			Pajaro Valley	
	Consumptive use (u)[1]	Consumptive use factor (f)	Coefficient (k)[2]	Consumptive use factor (f)	Consumptive use (u)[3]
	Inches				Inches
November	2.00	4.01	0.50	3.73	1.86
December	1.24	3.66	.34	3.37	1.15
January	1.53	3.91	.39	3.46	1.37
February	1.89	3.80	.50	3.53	1.76
March	3.21	4.72	.68	4.50	3.06
Subtotal	9.87	20.10	.49	18.59	9.20
April	5.49	4.93	1.11	4.96	5.51
May	7.58	6.10	1.24	5.78	7.17
June	8.09	6.36	1.27	6.02	7.65
July	10.27	6.90	1.49	6.18	9.21
August	9.65	6.52	1.48	5.82	8.61
September	7.91	5.46	1.45	5.10	7.40
October	3.65	5.01	.73	4.57	3.34
Subtotal	52.64	41.28	1.28	38.43	48.89
Annual	62.51	61.38	1.02	57.02	58.09

[1] Average observed consumptive use, San Luis Rey Valley, 1941-42 and 1942-43.

[2] $k = \frac{u}{f} = \frac{\text{observed consumptive use}}{\text{consumptive use factor}}$ = monthly coefficient.

[3] u = kf = computed consumptive use.

Estimates of normal annual consumptive use of water by trees-brush-grass growing in Pajaro Valley based on the San Luis Rey Valley data, in areas with the water-table at various depths, are given in table 13.

TABLE 13

ESTIMATED NORMAL ANNUAL CONSUMPTIVE USE OF WATER BY TREES-BRUSH-GRASS IN PAJARO VALLEY WITH WATER TABLE AT VARIOUS DEPTHS, BASED ON OBSERVED CONSUMPTIVE USE IN SAN LUIS REY VALLEY, CALIFORNIA

Type of vegetation	Depth to water-table		Consumptive use		
	Range	Average	San Luis Rey	Pajaro	
	Feet	Feet	Inches	Inches	Feet
Dense: Trees-brush-grass	3 to 5	4.0	62.5	58.1	4.84
Medium: Brush-trees-grass	4 to 7	5.5	36.0	33.5	2.79
Sparse: Brush-grass	6 to 10	8.0	21.0	19.5	1.63

Chaparral and Brush Without a High Water Table

The results of three years of study near San Bernardino, California, indicated that a seasonal rainfall of less than 19 inches under normal conditions is consumed by brush cover in areas without a high water table (*3*). With a seasonal rainfall varying from about 13 to 32 inches, the evapo-transpiration by chaparral-brush on the valley floor ranged from 13 to 27 inches with an average use of about 19 inches. Practically all this use occurred prior to July 1. The consumptive use factor (F) for the growing season (of brush) at Watsonville is about 90 percent of that of San Bernardino. On this basis it is estimated that the annual consumptive use by chaparral-brush growing in areas without a high water table in Pajaro Valley at Watsonville is 17 inches, or 1.42 feet. In the "Foothill Belt" and "Tributary Watershed" where the precipitation ranges from 24 to 48 inches, consumptive use will be greater than 17 inches.

NATIVE VEGETATION IN TRIBUTARY WATERSHED

Surveys by the United States Forest Service indicate that the vegetative cover of the Pajaro Watershed consists of grassland, sagebrush, chamise, chaparral, woodland-grass, woodland, oak, miscellaneous conifers and giant sequoia.

The results of a four-year study of woodland chaparral by Rowe (*11*) of the California Forest and Range Experiment Station, during 1934-38 at North Fork in central California may be indicative of consumptive use by woodland chaparral in the Pajaro watershed. The total annual consumptive use (including interception loss) ranged from 16.89 to 21.37 inches with an average of 19.06 inches. About 85 percent of the use occurred from January 1 to July 1. The consumptive-use factor (F) for this six-month period at North Fork was about the same as at Watsonville.

A study by Troxell and Stafford (*16*) of natural water losses in the mountain drainage areas of the southern California coastal plain shows mean seasonal natural water losses (consumptive use) ranging from 14.1 inches at Murrieta Creek (Elev. 1,700 ft.) width a mean annual precipitation of 14.9 inches, to 27.5 inches at Lytle Creek (Elev. 5,400 ft.) with a mean seasonal precipitation of 39.2 inches. This study indicates that in some areas of high precipitation, ground water from winter precipitation is available throughout the summer months for use by chaparral and trees.

The California State Division of Water Resources has requested an estimate of consumptive use by chaparral and forest areas in the Pajaro watershed for the purpose of estimating rainfall penetration below the root zone. Therefore, it is estimated that the mean annual consumptive use by chaparral in the Pajaro watershed ranges from 18 inches to 24 inches while the use in the denser forest areas may be as much as 30 inches, depending upon the availability of ground water to supply moisture to the trees during the summer months.

SUMMARY: UNIT CONSUMPTIVE USE BY NATIVE VEGETATION

Estimated normal unit consumptive use values for winter, summer and annual periods for native vegetation growing on "Valley Floor," "Foothill," and "Tributary Watershed" are summarized in table 14.

TABLE 14

ESTIMATED NORMAL UNIT CONSUMPTIVE USE BY NATIVE VEGETATION, ON VALLEY FLOOR, PAJARO AREA, CALIFORNIA

Classification	Normal consumptive use		
	Nov. 1 to Mar. 31	April 1 to Oct. 31	Annual
	Feet	Feet	Feet
With high water table			
Grass	0.70	0.80	1.50
Sparse brush-grass	.75	.90	1.65
Medium brush-grass	.80	2.00	2.80
Dense trees[1]-grass	.80	4.00	4.80
Swamp (tules)	.90	3.60	4.50
Without high water table			
Grass	0.70	0.60	1.30
Sparse brush-grass	.70	.60	1.30
Medium brush	.70	.70	1.40[2]
Chaparral	.80	.70[3]	1.50

[1] Cotton, willows and other water-loving trees with water table 3 to 5 feet below ground surface.

[2] In areas of higher rainfall, where soil moisture is available during the summer months as result of slow seepage from winter rainfall, the normal water consumption may reach 1.7 feet per year.

[3] For rainfall zone of 20-24 inches. In "Foothill Belt" and "Tributary Watershed" areas, where moisture is available in the root zone during summer months from slow movement of ground water from previous rainfall, it is estimated that the rate of consumptive use will increase 0.1 foot per four inches of increase in precipitation. In areas of denser forest and higher precipitation the use of water will probably reach 30 inches, provided ground water stored during the rainy season is available to the trees during the summer months.

IRRIGATED CROPS

Investigations of use of water by irrigated crops have been conducted in California for many years by the Division of Irrigation and Water Conservation in cooperation with the State Division of Water Resources or the California Agricultural Experiment Station. The experimental work has not been limited to use-yield investigations and the ascertainment of the amounts of water applied, but has included determination of evapo-transpiration by soil moisture or tank studies in some areas. However, there are no specific data available as to the consumptive use of water by agricultural crops in Pajaro Valley.

As heretofore indicated, unit consumptive use may be estimated by analyses of irrigation data, climatological records, or a combination of both. Careful consideration should be given to temperature, length of growing season, distribution and amount of precipitation, kind of crop, number of irrigations, depth of water applied, efficiency of irrigation, and evaporation after rainfall and irrigation. In areas of high water table, deep rooted crops such as alfalfa may secure moisture from ground water. Irrigation and other data in Pajaro Valley have been collected and tabulated by the Soil Conservation Service, as previously described. The irrigated areas have been mapped by staff members of the State Division of Water Resources and the acreages determined under the following classifications: alfalfa, artichokes, beans, berries, lettuce, miscellaneous, orchard, pasture, strawberries, sugar beets, tomatoes and truck.

The annual consumptive use has been divided into two periods: "winter," November 1 to March 31, the season when most of the precipitation occurs; and "summer," April 1 to October 31, which is the usual irrigation season.

Precipitation is a large factor in winter consumptive use. Studies in southern California (*3*) indicate that during the winter months evaporation after each rainstorm is about 0.5 inch and evapo-transpiration by grass, grain, or cover crops is approximately 2 inches per month with normal distribution of precipitation. At Watsonville normal precipitation for the winter period (November 1 to March 31) is 17.70 inches and for the year 20.97 inches.

On most of the irrigated lands, crops or cover crops grow throughout the year. Some moisture from fall irrigation may be carried over for winter use, and some precipitation during the winter months which is not used by winter crops may be available for use during the summer period. Measurements in southern

California (*3*) indicate that evaporation after each irrigation usually ranges from 0.5 to 1.0 inch, depending upon soil, percentage of surface soil that is wet, length of time of irrigation, and temperature.

If all the water delivered to a farm could be absorbed by the roots of the crop and transpired by the foliage, an efficiency of irrigation of 100 percent would be reached, but in actual practice some is lost by evaporation and some may be wasted by deep percolation below the root zone or by surface runoff. Studies in California (*6*) indicate that with the best equipment for distributing water and its most skilful application in moistening the soil, it is seldom practicable to utilize more than 75 percent. With poor equipment and less skilful irrigators, the efficiency may drop to 30 percent.

Irrigation practices for different crops in Pajaro Valley, which may influence the amount of consumptive use, have been previously discussed. (See table 3.) The following preliminary estimates of unit values of consumptive use are based on normal conditions.

Alfalfa and Pasture

Under the present agricultural program of Pajaro Valley, alfalfa acreage is limited to a few fields. Few irrigation data are available for this crop as grown in the Valley. Sufficient rainfall occurs during the winter period to satisfy its transpiration requirements. During the irrigation season alfalfa receives some moisture from rainfall and ground water as well as from irrigation. Therefore, estimates of consumptive use of water for alfalfa will be computed from consumptive use factors for Pajaro Valley (f) and coefficients (k) determined by experiments in other areas (*6*). As heretofore indicated, there is a definite relationship between monthly consumptive use factor (f) and monthly consumptive use of water (u), and this is expressed mathematically by the formula $u = kf$. From data now available, it is estimated that the monthly coefficient (k) for alfalfa in Pajaro Valley ranges from 0.40 in January to 0.80 in July. Table 15 shows the computed normal unit monthly consumptive use of water by alfalfa for Pajaro Valley.

Although some of the alfalfa fields are pastured, most of the pasture acreage in Pajaro Valley is ladino clover. These pastures are located on hill lands where there is no high water table. The fields are irrigated by portable pipe with controlled flooding or by sprinkling. While irrigation is frequent, total applications usually do not exceed 24 inches per year. This amount is substantially less than that applied in the San Joaquin Valley and some other areas of California. The normal unit consumptive use for pasture during the winter period (November 1 to March 31) is estimated to be about the same as for alfalfa, or 9 inches. During the irrigation season (April 1 to October 31) the normal consumptive use is estimated to be 24 inches, based on the assumption that three inches of moisture is stored in the soil from winter rains and 75 percent of the irrigation water applied to the pasture is consumed. Then the normal annual unit consumptive use would be 33 inches, or 2.75 feet.

TABLE 15

COMPUTED NORMAL UNIT CONSUMPTIVE USE OF WATER BY ALFALFA, PAJARO VALLEY, CALIFORNIA

Month	Mean monthly temperature (t)	Percent daytime hours (p)	Consumptive use factor (f)	Coefficient[1] (k)	Consumptive use (u)	
	°F.	Percent			Inches	Feet
November	54.3	6.87	3.73	0.6	2.24	0.19
December	50.2	6.72	3.37	.4	1.35	.11
January	49.9	6.93	3.46	.4	1.38	.11
February	51.8	6.82	3.53	.5	1.77	.15
March	53.9	8.35	4.50	.5	2.25	.19
Subtotal	52.0	35.69	18.59	--	8.99	0.75
April	55.9	8.87	4.96	0.6	2.98	0.24
May	58.6	9.87	5.78	.7	4.05	.34
June	60.9	9.89	6.02	.8	4.82	.40
July	61.5	10.05	6.18	.8	4.94	.41
August	61.6	9.44	5.82	.8	4.66	.39
September	60.9	8.37	5.10	.8	4.08	.34
October	58.4	7.82	4.57	.7	3.20	.27
Subtotal	59.7	64.31	38.43	--	28.73	2.39
Annual	56.5	100.00	57.02	--	37.72	3.15

[1] Estimated from San Fernando Valley data.

$$f = \frac{tp}{100}$$

$$u = kf$$

TABLE 16

ESTIMATED NORMAL RATE OF CONSUMPTIVE USE OF WATER BY LETTUCE AND COVER CROPS IN PAJARO VALLEY, CALIFORNIA

Classification and crop	Growing season	Winter[1]	Irrigation season[2]					
		Consumptive use	Number of irrigations	Depth of water applied	Efficiency of irrigation[3]	Transpiration	Evaporation	Consumptive use
		Inches		Inches	Percent	Inches	Inches	Inches
Lettuce (1st crop)	2/ 1- 5/15	3.0	2	8.0	30	2.4	1.0	3.4
Lettuce (2d crop)	6/ 1- 9/ 1	---	4	15.0	30	4.5	2.0	6.5
Lettuce (3d crop)	9/15-10/31	---	3	12.0	30	3.6	1.5	5.1
Cover crop	11/ 1- 1/15	5.0	0	---	-	---	---	---

Annual consumptive use, 2 crops lettuce and cover crop = 17.9 inches.
Annual consumptive use, 3 crops lettuce = 20.5 inches.

[1] November 1 to March 31.
[2] April 1 to October 31.
[3] Efficiency of irrigation is defined as the percentage of water applied that can be accounted for as soil moisture increase in the soil occupied by the principal rooting system of the crop.

Lettuce

In Pajaro Valley lettuce is grown in the early spring, summer and fall. When only one crop is grown it is usually followed by a crop of vegetables or sugar beets. Two crops of lettuce or other crops are usually followed by a winter cover crop. During the winter period these crops depend for moisture almost entirely on precipitation. Experiments in southern California (*3*) indicate that a cover crop will use about two inches of water per month if the moisture is available. During the irrigation season, two crops of lettuce or one crop of lettuce and one truck crop may be grown, followed by a winter cover crop.

Irrigation experiments made by Veihmeyer and Holland (*19*) of the California Agricultural Experiment Station in 1938-39 indicate that evapo-transpiration by lettuce in Pajaro Valley may not exceed four inches per crop during the actual growing season. This figure does not include evaporation losses from soil after pre-irrigation and from free water surface during irrigation. In estimating total consumptive use these two losses should be considered. The use of water by lettuce in Pajaro Valley should be approximately equal to that in Salinas Valley since the normal annual temperatures in both valleys are the same and the consumptive factors are 57.02 and 57.03, respectively. However, the normal annual precipitation at Watsonville is 6.3 inches greater than that at Salinas. Thus the early spring crops in Pajaro Valley do not require as much irrigation as in the Salinas Valley. The Veihmeyer-Holland studies indicate that only about 30 percent of the irrigation water applied is transpired in plant growth.

Table 16 shows estimates of normal unit consumptive use for lettuce lands based on irrigation and other data.

Other Crops

No experimental data on consumptive use are available for other crops in the valley. Estimates of consumptive use are based on general irrigation practice, precipitation, temperature and length of growing season for winter and summer crops. The procedure is somewhat similar to that employed for lettuce.

Unit Values of Consumptive Use

Summaries of estimated normal unit values of consumptive use of water by irrigated crops for winter, summer and annual periods in the main floor of Pajaro Valley are shown in table 17. These are subject to revision as more data become available. These rates of use are applicable to the valley floor acreage lying within zones of rainfall of 15 to 20 inches and 20 to 25 inches per year. Acreages in these two zones should be combined when total consumptive use in acre-feet is being computed; the acreages for zones of rainfall of 25 to 30 inches and 30 to 35 inches per year should also be combined. For preliminary estimates of total water consumption, the tentative rates set up in table 16 may be used for these higher zones of precipitation until more information is available on irrigation and temperatures in these areas.

OTHER CLASSIFICATIONS

Other water-using areas which have not heretofore been discussed include areas mapped as ''irrigable dry-farm,'' which includes dry farmed crops, fallow land, grassland-pasture, holly trees, old orchard and young orchard; and ''miscellaneous'' which includes roads-railroads, town-farm lots, waste land and water surfaces.

Irrigable Dry-farm

Most of the dry farm and grass areas in Pajaro Valley are on the hillsides and benches where no underground water is available for plant growth. The use of water by these areas is dependent upon the amount and distribution of rainfall. These crops have their

TABLE 17

SUMMARY OF TENTATIVE ESTIMATES OF NORMAL UNIT CONSUMPTIVE USE OF WATER FOR IRRIGATED CROPS IN THE LOWER PAJARO VALLEY, CALIFORNIA

Crop	November 1 to March 31		Irrigation season April 1 to October 31		Annual	
	Inches	Feet	Inches	Feet	Inches	Feet
Irrigated						
Alfalfa	9.0	0.75	28.7	2.40	37.7	3.15
Artichokes	8.0	.67	12.5	1.04	20.5	1.71
Beans	8.0	.67	10.0	0.83	18.0	1.50
Beans[1]	8.0	.67	11.2	.93	19.2	1.60
Berries	8.0	.67	10.0	.83	18.0	1.50
Lettuce-truck[2]	8.0	.67	13.4	1.12	21.4	1.79
Lettuce-2 crops[2]	8.0	.67	9.9	.83	17.9	1.50
Lettuce-3 crops[3]	5.5	.46	15.0	1.25	20.5	1.71
Miscellaneous	8.0	.67	10.0	.83	18.0	1.50
Orchard (old)[2]	10.0	.83	14.0	1.17	24.0	2.00
Orchard (old)[4]	5.0	.42	14.0	1.17	19.0	1.59
Orchard (young)[2]	10.0	.83	11.0	.92	21.0	1.75
Orchard (young)[1]	8.0	.67	16.0	1.33	24.0	2.00
Pasture	9.0	.75	24.0	2.00	33.0	2.75
Strawberries	5.0	.42	14.1	1.18	19.1	1.60
Sugar beets	10.0	.83	11.5	.95	21.5	1.79
Sugar beets[1]	8.0	.67	19.2	1.60	27.2	2.27
Tomatoes	10.0	.83	11.5	.96	21.5	1.79
Truck	10.0	.83	10.0	.83	20.0	1.66

[1] With spring lettuce crop.
[2] With winter cover crop.
[3] Without cover crop.
[4] Clean cultivated.

greatest growing period during the winter and spring months.

Considering information from studies in southern California (*3*) and the distribution of rainfall in Pajaro Valley, the normal annual unit consumptive use of irrigable dry farm and grassland-pasture is estimated to be 1.3 feet.

The rate of use on fallow land is estimated at one inch per month for eight months of the year, or 0.70 foot per year.

Unit consumptive use of water by deciduous orchards and holly trees may vary, depending upon cultural practices, distribution of rainfall, and growth of cover crops. It is estimated that the annual normal rate of use for these trees will not exceed 1.5 feet.

Miscellaneous Areas

Roads-railroads. All improved roads and railroad rights-of-way are included under this classification. The loss of water from these areas is primarily by evaporation after rains. An annual unit consumptive use of 0.60 foot is assigned to these areas.

Town-farm lots. Areas mapped as "town and farm lots" are assigned an annual unit consumptive use of 2.0 feet. This allows for an actual use of 1.5 feet with 0.5 foot lost by evaporation after rains. It is estimated that 25 percent of the use occurs during the five-month winter period and 75 percent during the period April 1 to October 31.

Waste land. Areas placed under "waste land" are bare and consist of sandy or rocky soils. In some cases they are subject to overflow from the river or tributary streams during periods of high water. The normal annual unit consumptive use is estimated to be 0.75 foot.

Although no acreages for river channel are shown by the State survey, some of the waste land may include river channels that are subject to alternately wet and dry periods or intermittent streamflow. At narrow, constricted places, the water-table is held closer to the ground surface and consequently surface water here appears earlier in the winter and lasts longer in the spring. At a few places, flowing water may occur the year around. The normal annual unit

TABLE 18

ESTIMATED NORMAL UNIT CONSUMPTIVE USE FOR DRY-FARMED AND MISCELLANEOUS LANDS IN PAJARO AREA, CALIFORNIA

Classification	Consumptive use of water		
	Nov. 1 to Mar. 31	April 1 to Oct. 31	Annual
	Feet	Feet	Feet
Dry farmed crops	0.70	0.60	1.30
Fallow land	.40	.30	.70
Orchard (old)[1]	.50	.90	1.40
Orchard (young)[1]	.50	.80	1.30
Holly trees	.60	.90	1.50
Roads, railroads	0.40	0.20	0.60
Town, farm lots	.50	1.50	2.00
Waste land	.40	.20	.60
River channels	.50	1.30	1.80
Water surface	.70	2.90	3.60

[1] Clean cultivated.

consumptive use of river channel is estimated to be 1.80 feet.

Water surface. These areas include lakes, reservoirs and lagoons. The normal annual loss of water by evaporation from free water surfaces is estimated at 3.60 feet. (See table 10 for monthly evaporation.)

Summary of Estimated Unit Consumptive Use

Estimated normal unit consumptive-use values for winter, summer and annual periods for dry farmed crops and miscellaneous land are summarized in table 18.

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APPENDIX J

YIELD STUDIES

TABLE OF CONTENTS

YIELD STUDIES

YIELD STUDY
ARCHIBALD RESERVOIR ON SCOTT CREEK

Storage capacity: 3,150 acre-feet | Seasonal yield: 2,800 acre-feet

(In acre-feet)

Season	November-May			June-October				Storage, end of October	Spill, end of May
	Runoff	Demand, 40% of seasonal demand	Storage, end of May	Demand, 60% of seasonal demand	Apparent storage, end of October	Average summer storage	Evaporation		
1921-22	36,000	1,120	3,150	1,680	1,470	2,300	220	1,250	31,730
22-23	20,900	1,120	3,150	1,680	1,470	2,300	220	1,250	17,880
23-24	2,730	1,120	2,860	1,680	1,180	2,000	200	980	-----
1924-25	8,790	1,120	3,150	1,680	1,470	2,300	220	1,250	5,500
25-26	26,300	1,120	3,150	1,680	1,470	2,300	220	1,250	23,280
26-27	29,800	1,120	3,150	1,680	1,470	2,300	220	1,250	26,780
27-28	12,300	1,120	3,150	1,680	1,470	2,300	220	1,250	9,280
28-29	8,480	1,120	3,150	1,680	1,470	2,300	220	1,250	5,460
1929-30	7,690	1,120	3,150	1,680	1,470	2,300	220	1,250	4,670
30-31	2,010	1,120	2,140	1,680	460	1,300	150	310	-----
31-32	21,700	1,120	3,150	1,680	1,470	2,300	220	1,250	17,740
32-33	3,210	1,120	3,150	1,680	1,470	2,300	220	1,250	190
33-34	12,700	1,120	3,150	1,680	1,470	2,300	220	1,250	9,680
1934-35	15,200	1,120	3,150	1,680	1,470	2,300	220	1,250	12,180

YIELD STUDY
ZAYANTE CREEK RESERVOIR ON ZAYANTE CREEK

Storage capacity: 6,900 acre-feet | Seasonal yield: 3,900 acre-feet

(In acre-feet)

Season	November-May			June-October				Storage, end of October	Spill, end of May
	Runoff	Demand, 40% of seasonal demand	Storage, end of May	Demand, 60% of seasonal demand	Apparent storage, end of October	Average summer storage	Evaporation		
1921-22	13,200	1,560	6,900	2,340	4,560	5,700	270	4,290	4,740
22-23	8,640	1,560	6,900	2,340	4,560	5,700	270	4,290	4,470
23-24	1,130	1,560	3,860	2,340	1,520	2,700	170	1,350	-----
1924-25	3,860	1,560	3,650	2,340	1,310	2,500	160	1,150	-----
25-26	9,590	1,560	6,900	2,340	4,560	5,700	270	4,290	2,280
26-27	10,900	1,560	6,900	2,340	4,560	5,700	270	4,290	6,730
27-28	5,270	1,560	6,900	2,340	4,560	5,700	270	4,290	1,100
28-29	3,490	1,560	6,220	2,340	3,880	5,000	250	3,630	-----
1929-30	3,860	1,560	5,930	2,340	3,590	4,800	240	3,350	-----
30-31	940	1,560	2,730	2,340	390	1,600	120	270	-----
31-32	9,670	1,560	6,900	2,340	4,560	5,700	270	4,290	1,480
32-33	1,750	1,560	4,480	2,340	2,140	3,300	190	1,950	-----
33-34	4,890	1,560	5,280	2,340	2,940	4,100	220	2,720	-----
1934-35	6,450	1,560	6,900	2,340	4,560	5,700	270	4,290	710

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YIELD STUDY
DOYLE GULCH RESERVOIR WITH 20 SECOND-FOOT DIVERSION FROM SAN LORENZO RIVER

Storage capacity: 5,600 acre-feet | Seasonal yield: 6,500 acre-feet

(In acre-feet)

Season	November-May			June-October				Storage, end of October	Waste, end of May
	Available runoff with 20 second-foot diversion capacity	Demand, 40% of seasonal demand	Storage, end of May	Demand, 60% of seasonal demand	Apparent storage, end of October	Average summer storage	Evaporation		
1921-22	7,350	2,600	4,750	3,900	850	2,800	140	710	
22-23	7,350	2,600	5,460	3,900	1,560	3,500	160	1,400	
23-24	6,000	2,600	4,800	3,900	900	2,800	140	760	
1924-25	7,350	2,600	5,510	3,900	1,610	3,600	160	1,450	
25-26	7,350	2,600	5,600	3,900	1,700	3,700	170	1,530	600
26-27	7,350	2,600	5,600	3,900	1,700	3,700	170	1,530	680
27-28	7,350	2,600	5,600	3,900	1,700	3,700	170	1,530	680
28-29	7,350	2,600	5,600	3,900	1,700	3,700	170	1,530	680
1929-30	7,350	2,600	5,600	3,900	1,700	3,700	170	1,530	680
30-31	5,170	2,600	4,100	3,900	200	2,200	110	90	
31-32	7,350	2,600	4,840	3,900	940	2,900	140	800	
32-33	6,800	2,600	5,000	3,900	1,100	3,000	140	960	
33-34	7,350	2,600	5,600	3,900	1,700	3,700	170	1,530	110
1934-35	7,350	2,600	5,600	3,900	1,700	3,700	170	1,530	680

YIELD STUDY
GLENWOOD RESERVOIR ON WEST BRANCH OF SOQUEL CREEK

Storage capacity: 2,480 acre-feet | Seasonal yield: 2,000 acre-feet

(In acre-feet)

Season	November-May			June-October				Storage, end of October	Spill, end of May
	Runoff	Demand, 40% of seasonal demand	Storage, end of May	Demand, 60% of seasonal demand	Apparent storage, end of October	Average summer storage	Evaporation		
1921-22	13,100	800	2,480	1,200	1,280	1,900	90	1,190	9,820
22-23	8,680	800	2,480	1,200	1,280	1,900	90	1,190	6,590
23-24	1,320	800	1,710	1,200	510	1,100	60	450	
1924-25	4,060	800	2,480	1,200	1,280	1,900	90	1,190	1,230
25-26	9,560	800	2,480	1,200	1,280	1,900	90	1,190	7,470
26-27	11,000	800	2,480	1,200	1,280	1,900	90	1,190	8,910
27-28	5,380	800	2,480	1,200	1,280	1,900	90	1,190	3,290
28-29	3,660	800	2,480	1,200	1,280	1,900	90	1,190	1,570
1929-30	4,060	800	2,480	1,200	1,280	1,900	90	1,190	1,970
30-31	1,100	800	1,490	1,200	290	900	50	240	
31-32	9,650	800	2,480	1,200	1,280	1,900	90	1,190	6,610
32-33	1,940	800	2,330	1,200	1,130	1,700	80	1,050	
33-34	5,000	800	2,480	1,200	1,280	1,900	90	1,190	2,770
1934-35	6,560	800	2,480	1,200	1,280	1,900	90	1,190	4,470

YIELD STUDY
UPPER SOQUEL RESERVOIR ON SOQUEL CREEK

Storage capacity: 1,700 acre-feet — Seasonal yield: 2,100 acre-feet

(In acre-feet)

Season	November-May			June-October				Storage, end of October	Spill, end of May
	Runoff	Demand, 40% of seasonal demand	Storage, end of May	Demand, 60% of seasonal demand	Apparent storage, end of October	Average summer storage	Evaporation		
1921-22	22,900	840	1,700	1,260	440	1,100	70	370	20,360
22-23	15,200	840	1,700	1,260	440	1,100	70	370	13,030
23-24	2,310	840	1,700	1,260	440	1,100	70	370	140
1924-25	7,090	840	1,700	1,260	440	1,100	70	370	4,920
25-26	16,700	840	1,700	1,260	440	1,100	70	370	14,530
26-27	19,200	840	1,700	1,260	440	1,100	70	370	17,030
27-28	9,400	840	1,700	1,260	440	1,100	70	370	7,230
28-29	6,390	840	1,700	1,260	440	1,100	70	370	4,220
1929-30	7,090	840	1,700	1,260	440	1,100	70	370	4,920
30-31	1,920	840	1,450	1,260	190	800	50	140	----------
31-32	16,900	840	1,700	1,260	440	1,100	70	370	14,500
32-33	3,390	840	1,700	1,260	440	1,100	70	370	1,220
33-34	8,730	840	1,700	1,260	440	1,100	70	370	6,560
1934-35	11,500	840	1,700	1,260	440	1,100	70	370	9,330

YIELD STUDY
WATSONVILLE RESERVOIR WITH 200 SECOND-FOOT DIVERSION FROM PAJARO RIVER

Storage capacity: 21,000 acre-feet

Seasonal yield: 9,700 acre-feet

(In acre-feet)

Season	November-May			June-October					Storage, end of October	Waste, end of May
	Available runoff with 200 second-foot diversion capacity	Demand, 30% of seasonal demand	Storage, end of May	Demand, 70% of seasonal demand	Percolation	Apparent storage end of October	Average summer storage	Evaporation		
1921-22	49,000	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	25,100
22-23	36,000	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	24,470
23-24	1,100	2,900	10,570	6,800	1,000	2,770	6,670	470	2,300	----------
24-25	12,900	2,900	12,300	6,800	1,000	4,500	8,400	540	3,960	----------
1925-26	42,000	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	22,060
26-27	39,000	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	27,470
27-28	21,000	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	9,470
28-29	12,000	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	470
29-30	11,700	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	170
1930-31	2,100	2,900	11,570	6,800	1,000	3,770	7,670	510	3,260	----------
31-32	42,900	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	22,260
32-33	7,800	2,900	17,270	6,800	1,000	9,470	13,370	710	8,760	----------
33-34	17,300	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	2,160
34-35	27,800	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	16,270
1935-36	34,700	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	23,170
36-37	42,000	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	30,470
37-38	55,000	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	43,470
38-39	6,800	2,900	16,270	6,800	1,000	8,470	12,370	690	7,780	----------
39-40	41,100	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	24,980
1940-41	61,000	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	49,470
41-42	55,300	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	43,770
42-43	43,800	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	32,270
43-44	24,400	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	12,870
44-45	27,600	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	16,070
1945-46	22,700	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	11,170
46-47	14,900	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	3,370
47-48	3,000	2,900	12,470	6,800	1,000	4,670	8,570	530	4,140	----------
48-49	10,800	2,900	12,040	6,800	1,000	4,240	8,140	520	3,720	----------
49-50	7,800	2,900	8,620	6,800	1,000	820	4,720	380	440	----------
1950-51	42,800	2,900	21,000	6,800	1,000	13,200	17,100	830	12,370	19,340

APPENDIX K

ESTIMATES OF COST

TABLE OF CONTENTS

ESTIMATES OF COST

ESTIMATED COST OF ARCHIBALD DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 101 feet, U.S.G.S. datum
Elevation of spillway crest: 88 feet
Height of dam to spillway crest, above stream bed: 58 feet
Capacity of reservoir to spillway crest: 3,150 acre-feet
Capacity of spillway with 4-foot freeboard: 19,600 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation	31,900 cu.yd.	$1.00	31,900	
Excavation for embankment	135,000 cu.yd.	0.40	54,000	
Embankment				
Impervious	117,400 cu.yd.	0.25	29,400	
Pervious	38,400 cu.yd.	0.30	11,500	
Drilling grout holes	1,760 lin.ft.	3.00	5,300	
Pressure grouting	1,160 cu.ft.	4.00	4,600	
Riprap	7,800 cu.yd.	2.50	19,500	$161,200
Spillway				
Excavation	54,400 cu.yd.	1.00	54,400	
Concrete	1,325 cu.yd.	35.00	46,400	
Reinforcing steel	100,000 lbs.	0.15	15,000	115,800
Outlet Works				
Excavation	1,000 cu.yd.	3.00	3,000	
Backfill	268 cu.yd.	1.50	400	
Concrete				
Inlet structure	40 cu.yd.	60.00	2,400	
Pipe encasement	383 cu.yd.	30.00	11,500	
Reinforcing steel	55,800 lbs.	0.15	8,400	
Steel pipe, 24-inch diameter	41,200 lbs.	0.25	10,300	
Gate valve, 24-inch diameter, and actuators	1 each	4,000	4,000	
Howell-Bunger valve, 20-inch diameter		lump sum	$4,200	
Control house		lump sum	2,000	$46,200
Reservoir				
Land and improvements		lump sum	70,000	
Public utilities		lump sum	100,000	
Clearing	100 acres	$500.00	50,000	220,000
Subtotal				$543,200
Administration and engineering, 10%				$54,300
Contingencies, 15%				81,500
Interest during construction, none				
TOTAL				$679,000
Annual Costs				
Interest, 3%				$20,400
Repayment, 0.887%				6,000
Replacement, 0.07%				500
Operation and maintenance				2,500
TOTAL				$29,400

ESTIMATED COST OF ZAYANTE CREEK DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 616 feet, U.S.G.S. datum
Elevation of spillway crest: 603 feet
Height of dam to spillway crest, above stream bed: 127 feet
Capacity of reservoir to spillway crest: 6,900 acre-feet
Capacity of spillway with 5-foot freeboard: 8,900 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$10,000	
Stripping and preparation of foundation	76,600 cu.yd.	$1.00	76,600	
Excavation for embankment				
Impervious	147,400 cu.yd.	0.65	95,800	
Pervious	212,250 cu.yd.	0.60	127,400	
Embankment				
Impervious	128,200 cu.yd.	0.25	32,100	
Pervious	212,250 cu.yd.	0.20	42,500	
Pervious, salvage	81,850 cu.yd.	0.30	24,500	
Drilling grout holes	2,580 lin. ft.	3.00	7,700	
Pressure grouting	1,720 cu. ft.	4.00	6,900	
Riprap	11,500 cu.yd.	3.00	34,500	$458,000
Spillway				
Excavation	86,300 cu.yd.	1.50	129,500	
Concrete	1,430 cu.yd.	35.00	50,000	
Reinforcing steel	107,250 lbs.	0.15	16,100	195,600
Outlet Works				
Excavation	1,500 cu.yd.	4.00	6,000	
Concrete, pipe encasement	902 cu.yd.	30.00	27,100	
Reinforcing steel	90,200 lbs.	0.15	13,500	
Steel pipe, 36-inch and 48-inch diameter	115,900 lbs.	0.25	29,000	
Gate valve, 18-inch diameter, and actuators	4 each	2,500	10,000	
Gate valve, 30-inch diameter, manual control	1 each	$3,000	$3,000	
Howell-Bunger valve, 24-inch diameter		lump sum	5,400	
Control house		lump sum	2,000	$96,000
Reservoir				
Land and improvements		lump sum	77,500	
Public utilities		lump sum	128,400	
Clearing	168 acres	500.00	84,000	289,900
Subtotal				$1,039,500
Administration and engineering, 10%				$103,900
Contingencies, 15%				156,000
Interest during construction, none				
TOTAL				$1,299,400
Annual Costs				
Interest, 3%				$39,000
Repayment, 0.887%				11,500
Replacement, 0.07%				900
Operation and maintenance				2,500
TOTAL				$53,900

ESTIMATED COST OF DOYLE GULCH DAM, RESERVOIR, AND SAN LORENZO RIVER DIVERSION

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 266 feet, U.S.G.S. datum
Elevation of spillway crest: 257 feet
Height of dam to spillway crest, above stream bed: 147 feet

Capacity of reservoir to spillway crest: 5,600 acre-feet
Capacity of spillway with 4-foot freeboard: 2,700 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Unwatering dam site		lump sum	$2,000	
Stripping and preparation of foundation	60,800 cu.yd.	$1.00	60,800	
Excavation for embankment				
Impervious	350,000 cu.yd.	0.45	157,500	
Pervious	313,900 cu.yd.	0.60	188,300	
Embankment				
Impervious	306,100 cu.yd.	0.25	76,500	
Impervious, salvage	21,000 cu.yd.	0.30	6,300	
Pervious	313,900 cu.yd.	0.20	62,800	
Pervious, salvage	30,000 cu.yd.	0.25	7,500	
Drilling grout holes	4,020 lin.ft.	3.00	12,100	
Pressure grouting	2,680 cu.ft.	4.00	10,700	$584,500
Spillway				
Excavation	38,080 cu.yd.	1.75	66,600	
Concrete	24 cu.yd.	35.00	800	
Reinforcing steel	2,400 lbs.	0.15	400	67,800
Outlet Works				
Excavation	1,730 cu.yd.	4.00	6,900	
Concrete, pipe encasement	720 cu.yd.	30.00	21,600	
Reinforcing steel	72,000 lbs.	0.15	10,800	
Steel pipe, 30-inch and 48-inch diameter	101,400 lbs.	0.25	25,400	
Gate valve, and actuators				
18-inch diameter	4 each	2,000	8,000	
24-inch diameter	1 each	5,400	5,400	
Howell - Bunger valve, 24-inch diameter		lump sum	5,400	83,500
Reservoir				
Land	120 acres	300.00	36,000	
Improvements		lump sum	110,000	
Public utilities		lump sum	103,000	
Clearing	120 acres	100.00	12,000	261,000
Subtotal, dam and reservoir				$996,800
Diversion Works				
Inlet structure		lump sum	1,000	
Excavation	790 cu.yd.	4.00	3,200	
Backfill	290 cu.yd.	0.50	100	
Concrete	124 cu.yd.	75.00	9,300	
Reinforcing steel	12,400 lbs.	0.15	1,900	
Steel pipe, 48-inch diameter	5,600 lbs.	0.25	1,400	
Sluice gate, 2' x 2'	3 each	1,000	3,000	$19,900
Conduit				
Excavation	26,900 cu.yd.	0.50	13,500	
Backfill	22,200 cu.yd.	0.50	11,100	

Item	Quantity	Unit price	Cost	
Steel pipe, 30-inch diameter, in place	26,400 lin.ft.	$11.30	$298,300	
Stream crossing	3 each	1,500	4,500	
Road crossing	5 each	2,000	10,000	
Remove and replace pavement		lump sum	8,500	
Right of way	6.5 acres	5,000	32,500	$378,400
Pumping Plant No. 1				
Pump, motor, and electrical equipment				
2,200 g.p.m. units	2 each	5,350	10,700	
4,500 g.p.m. units	2 each	9,450	18,900	
Check valve				
8-inch diameter	2 each	600.00	1,200	
12-inch diameter	2 each	1,500	3,000	
Structure			15,000	48,800
Pumping Plant No. 2				
Pump, motor, and electrical equipment				
2,200 g.p.m. units	2 each	3,750	7,500	
4,500 g.p.m. units	2 each	7,500	15,000	
Check valve				
8-inch diameter	2 each	600.00	1,200	
12-inch diameter	2 each	1,500	3,000	
Gate valve for bypass, 24-inch diameter, manual control		lump sum	3,500	
Structure		lump sum	15,000	45,200
Subtotal, diversion system				$492,300
Total, dam and reservoir, and diversion system				$1,489,100
Administration and engineering, 10%				$148,900
Contingencies, 15%				223,400
Interest during construction				27,900
TOTAL				$1,889,300
Annual Costs				
Interest, 3%				$56,700
Repayment, 0.887%				16,800
Replacement				
Dam and reservoir, 0.07%				900
Diversion system, 0.5%				3,100
Electrical energy				10,400
Operation and maintenance				5,000
TOTAL				$92,900

ESTIMATED COST OF GLENWOOD DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 511 feet, U.S.G.S. datum
Elevation of spillway crest: 500 feet
Height of dam to spillway crest, above stream bed: 100 feet
Capacity of reservoir to spillway crest: 2,480 acre-feet
Capacity of spillway with 4-foot freeboard: 8,100 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$3,000	
Stripping and preparation of foundation	14,500 cu.yd.	$1.00	14,500	
Excavation for embankment				
Impervious	126,000 cu.yd.	0.45	56,700	
Pervious	9,200 cu.yd.	0.60	5,500	
Embankment				
Impervious	109,500 cu.yd.	0.25	27,400	
Pervious, salvage	29,000 cu.yd.	0.30	8,700	
Pervious	9,200 cu.yd.	0.20	1,800	
Drilling grout holes	1,500 lin.ft.	3.00	4,500	
Pressure grouting	1,000 cu.ft.	4.00	4,000	
Riprap	5,100 cu.yd.	3.00	15,300	$141,400
Spillway				
Excavation	22,300 cu.yd.	1.50	33,500	
Concrete	220 cu.yd.	35.00	7,700	
Reinforcing steel	16,500 lbs.	0.15	2,500	43,700
Outlet Works				
Excavation	1,700 cu.yd.	4.00	6,800	
Backfill	600 cu.yd.	1.50	900	
Concrete, pipe encasement	700 cu.yd.	30.00	21,000	
Reinforcing steel	70,000 lbs.	0.15	10,500	
Steel pipe, 30-inch and 48-inch diameter	83,000 lbs.	0.25	20,800	
Gate valve, 18-inch diameter, and actuators	3 each	$2,000	$6,000	
Howell - Bunger valve, 24-inch diameter		lump sum	5,400	
Control house		lump sum	2,000	$73,400
Reservoir				
Land and improvements		lump sum	184,500	
Public utilities		lump sum	10,000	
Clearing	75 acres	700.00	52,500	247,000
Subtotal				$505,500
Administration and engineering, 10%				$50,600
Contingencies, 15%				75,800
Interest during construction, none				
TOTAL				$631,900
Annual Costs				
Interest, 3%				$19,000
Repayment, 0.887%				5,600
Replacement, 0.07%				400
Operation and maintenance				2,500
TOTAL				$27,500

ESTIMATED COST OF UPPER SOQUEL DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 555 feet, U.S.G.S. datum
Elevation of spillway crest: 545 feet
Height of dam to spillway crest, above stream bed: 99 feet
Capacity of reservoir to spillway crest: 1,700 acre-feet
Capacity of spillway with 4-foot freeboard: 11,500 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$2,000	
Stripping and preparation of foundation	45,900 cu.yd.	$1.00	45,900	
Excavation for embankment				
Impervious	281,800 cu.yd.	0.45	126,800	
Embankment				
Impervious	245,000 cu.yd.	0.25	61,300	
Pervious, salvage	91,500 cu.yd.	0.20	18,300	
Riprap	10,000 cu.yd.	3.00	30,000	$284,300
Spillway				
Excavation	59,400 cu.yd.	1.50	89,100	
Concrete	1,450 cu.yd.	35.00	50,800	
Reinforcing steel	108,800 lbs.	0.15	16,300	156,200
Outlet Works				
Excavation	3,120 cu.yd.	3.00	9,400	
Concrete, pipe encasement	680 cu.yd.	30.00	20,400	
Reinforcing steel	56,000 lbs.	0.15	8,400	
Steel pipe, 24-inch and 48-inch diameter	105,200 lbs.	0.25	26,300	
Gate valve, 18-inch diameter, and actuators	3 each	2,000	6,000	
Howell-Bunger valve, 20-inch diameter		lump sum	$4,200	
Control house		lump sum	2,000	$76,700
Reservoir				
Land	50 acres	$300.00	15,000	
Clearing	50 acres	700.00	35,000	50,000
Subtotal				$567,200
Administration and engineering, 10%				$56,700
Contingencies, 15%				85,000
Interest during construction, none				
TOTAL				$708,900
Annual Costs				
Interest, 3%				$21,300
Repayment, 0.887%				6,300
Replacement, 0.07%				500
Operation and maintenance				2,500
TOTAL				$30,600

ESTIMATED COST OF WATSONVILLE DAM, RESERVOIR, AND PAJARO RIVER DIVERSION

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 211 feet, U.S.G.S. datum
Elevation of spillway crest: 205 feet
Height of dam to spillway crest, above stream bed: 152 feet
Capacity of reservoir to spillway crest: 21,000 acre-feet
Capacity of spillway with 4-foot freeboard: 750 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Stripping and preparation of foundation	123,500 cu.yd.	$0.60	$74,100	
Excavation for embankment				
Impervious	756,200 cu.yd.	0.55	415,900	
Pervious	471,800 cu.yd.	0.40	188,700	
Embankment				
Impervious	657,600 cu.yd.	0.25	164,400	
Pervious	471,800 cu.yd.	0.20	94,400	
Pervious, salvage	700,000 cu.yd.	0.25	175,000	
Riprap	49,000 cu.yd.	3.00	147,000	$1,259,500
Auxiliary Dams				
Stripping and preparation of foundation	59,700 cu.yd.	0.60	35,800	
Excavation for embankment				
Impervious	324,800 cu.yd.	0.55	179,000	
Embankment				
Impervious	282,400 cu.yd.	0.25	70,600	
Impervious, salvage	100,000 cu.yd.	0.25	25,000	
Riprap	24,500 cu.yd.	3.00	73,500	383,900
Spillway				
Excavation	9,000 cu.yd.	1.00	9,000	
Concrete	550 cu.yd.	35.00	19,300	
Reinforcing steel	40,000 lbs.	0.15	6,000	34,300
Outlet-Inlet Works				
Excavation	613,100 cu.yd.	0.50	306,600	
Concrete				
Structure	40 cu.yd.	90.00	3,600	
Pipe encasement	1,130 cu.yd.	30.00	33,900	
Reinforcing steel	117,000 lbs.	0.15	17,500	
Structural steel	11,400 lbs.	0.25	2,900	
Steel pipe, 72-inch diameter	452,000 lbs.	0.25	113,000	
Transition wye		lump sum	4,000	
Butterfly valve, 48-inch diameter	2 each	lump sum	30,000	
Howell-Bunger valve, 60-inch diameter		lump sum	21,000	532,500
Reservoir				
Land and improvements		lump sum	248,700	
Public utilities		lump sum	83,800	
Clearing	350 acres	50.00	17,500	350,000
Subtotal, dam and reservoir				$2,560,200
Diversion Dam				
Unwatering dam site		lump sum	$500	
Stripping and preparation of foundation	5,500 cu.yd.	$1.00	5,500	
Concrete				
Weir, aprons, piers	2,025 cu.yd.	25.00	50,600	
Control house	25 cu.yd.	100.00	2,500	
Reinforcing steel	71,000 lbs.	0.15	10,600	
Bascule gate, 6′ x 40′, and actuators	2 each	17,600	35,200	$104,900
Sand Trap				
Excavation	265 cu.yd.	$1.50	$400	
Concrete	40 cu.yd.	100.00	4,000	
Headgate, 5′ x 5′	2 each	2,000	4,000	
Sluice gate, 2′ x 2′	3 each	1,000	3,000	
Trash rack	1,700 lbs.	0.30	500	$11,900
Diversion Conduit				
Excavation	128,700 cu.yd.	0.50	64,300	
Railroad crossing	60 lin.ft.	100.00	6,000	
Highway crossing	100 lin.ft.	100.00	10,000	
Right of way	10 acres	3,000	30,000	
Fencing	1.6 miles	1,500	2,400	112,700
Pumping Plant				
Pump, motor, and starter				
8,000 g.p.m. units	2 each	17,000	34,000	
14,000 g.p.m. units	3 each	30,000	90,000	
45,000 g.p.m. units	1 each	100,000	100,000	
Check valve				
18-inch diameter	2 each	2,000	4,000	
20-inch diameter	3 each	3,400	10,200	
36-inch diameter	1 each	10,800	10,800	
Structure		lump sum	90,000	339,000
Subtotal, diversion system				$568,500
Total, dam and reservoir, and diversion system				$3,128,700
Administration and engineering, 10%				$312,900
Contingencies, 15%				469,300
Interest during construction				58,700
TOTAL				$3,969,600
Annual Costs				
Interest, 3%				$119,100
Repayment, 0.887%				35,200
Replacement				
Dam, reservoir, and diversion works, 0.07%				2,500
Pumping plants, 1.2%				5,200
Operation and maintenance				17,900
Electrical energy				13,000
TOTAL				$192,900

ESTIMATED COST OF EL OSO DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 265 feet, U.S.G.S. datum
Elevation of spillway crest: 250 feet
Height of dam to spillway crest, above stream bed: 188 feet
Capacity of reservoir to spillway crest: 21,000 acre-feet
Capacity of spillway with 5-foot freeboard: 16,000 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation	259,400 cu.yd.	$1.00	259,400	
Excavation for embankment				
Impervious	665,000 cu.yd.	0.80	532,000	
Pervious	932,500 cu.yd.	1.00	932,500	
Embankment				
Impervious	578,900 cu.yd.	0.25	144,700	
Pervious	932,500 cu.yd.	0.20	186,500	
Pervious, salvage	256,000 cu.yd.	0.30	76,800	
Drilling grout holes	4,500 lin.ft.	3.00	13,500	
Pressure grouting	3,000 cu.ft.	4.00	12,000	
Riprap	29,300 cu.yd.	2.50	73,300	$2,235,700
Spillway				
Excavation	81,600 cu.yd.	1.00	81,600	
Concrete	1,500 cu.yd.	35.00	52,500	
Reinforcing steel	150,000 lbs.	0.15	22,500	156,600
Outlet Works				
Excavation	3,000 cu.yd.	4.00	12,000	
Concrete, pipe encasement	996 cu.yd.	30.00	29,900	
Reinforcing steel	99,600 lbs.	0.15	14,900	
Steel pipe, 36-inch and 48-inch diameter	144,000 lbs.	0.25	36,000	
Gate valve, 18-inch diameter, and actuators	5 each	$2,000	$10,000	
Howell-Bunger valve, 30-inch diameter		lump sum	7,200	$110,000
Reservoir				
Land and improvements		lump sum	16,300	
Clearing	280 acres	500.00	140,000	156,300
Subtotal				$2,658,600
Administration and engineering, 10%				$265,900
Contingencies, 15%				398,800
Interest during construction				99,700
TOTAL				$3,423,000
Annual Costs				
Interest, 3%				$102,700
Repayment, 0.887%				30,400
Replacement, 0.07%				2,400
Operation and maintenance				4,200
TOTAL				$139,700

ESTIMATED COST OF ARCHIBALD NO. 1 DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 228 feet, U.S.G.S. datum
Elevation of spillway crest: 215 feet
Height of dam to spillway crest, above stream bed: 190 feet
Capacity of reservoir to spillway crest: 60,400 acre-feet
Capacity of spillway with 4-foot freeboard: 19,600 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation	337,000 cu.yd.	$1.00	337,000	
Excavation for embankment				
Impervious	1,681,000 cu.yd.	0.35	588,400	
Pervious	1,552,000 cu.yd.	0.50	776,000	
Embankment				
Impervious	1,462,000 cu.yd.	0.25	365,500	
Pervious	1,552,000 cu.yd.	0.20	310,400	
Pervious	226,000 cu.yd.	0.30	67,800	
Drilling grout holes	8,280 lin.ft.	3.00	24,800	
Pressure grouting	5,510 cu.ft.	4.00	22,000	$2,496,900
Spillway				
Excavation	90,000 cu.yd.	1.00	90,000	
Concrete	2,634 cu.yd.	35.00	92,200	
Reinforcing steel	197,000 lbs.	0.15	29,500	211,700
Outlets Works				
Excavation	3,285 cu.yd.	3.00	9,900	
Concrete, pipe encasement	2,220 cu.yd.	30.00	66,600	
Reinforcing steel	222,000 lbs.	0.15	33,300	
Steel pipe, 48-inch diameter	189,600 lbs.	0.25	47,400	
Gate valve, 24-inch diameter, and actuators	7 each	3,000	21,000	
Howell-Bunger valve, 42-inch diameter		lump sum	12,300	190,500
Reservoir				
Land and improvements		lump sum	$192,700	
Public utilities		lump sum	213,800	
Clearing	778 acres	$500.00	389,000	$795,500
Subtotal				$3,694,600
Administration and engineering, 10%				$369,500
Contingencies, 15%				554,200
Interest during construction				110,800
TOTAL				$4,729,100
Annual Costs				
Interest, 3%				
Repayment, 0.887%				$141,900
Replacement, 0.07%				41,900
Operation and maintenance				3,300
				8,500
TOTAL				
				$195,600

ESTIMATED COST OF ARCHIBALD NO. 2 DAM AND RESERVOIR TO PROVIDE 20,000 ACRE-FEET OF RESERVOIR STORAGE CAPACITY

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 164 feet, U.S.G.S. datum
Elevation of spillway crest: 152 feet
Height of dam to spillway crest, above stream bed: 122 feet
Capacity of reservoir to spillway crest: 20,000 acre-feet
Capacity of spillway with 4-foot freeboard: 19,600 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation	112,000 cu.yd.	1.00	112,000	
Excavation for embankment				
Impervious	425,300 cu.yd.	0.40	170,100	
Pervious	217,000 cu.yd.	0.60	130,200	
Embankment				
Impervious	369,800 cu.yd.	0.25	92,500	
Pervious	217,000 cu.yd.	0.20	43,400	
Pervious	220,000 cu.yd.	0.30	66,000	
Drilling grout holes	5,200 lin.ft.	3.00	15,600	
Pressure grouting	3,500 cu.ft.	4.00	14,000	$648,800
Spillway				
Excavation	169,400 cu.yd.	1.00	169,400	
Concrete	2,500 cu.yd.	35.00	87,500	
Reinforcing steel	187,500 lbs.	0.15	28,100	285,000
Outlet Works				
Excavation	3,200 cu.yd.	3.00	9,600	
Concrete, pipe encasement	580 cu.yd.	30.00	17,400	
Reinforcing steel	43,500 lbs.	0.15	6,500	
Steel pipe, 42-inch and 48-inch diameter	162,700 lbs.	0.25	40,700	
Gate valve, 18-inch diameter, and actuators	4 each	2,000	8,000	
Howell-Bunger valve, 36-inch diameter		lump sum	$9,600	
Control house		lump sum	2,000	$93,800
Reservoir				
Land, improvements, and public utilities		lump sum	338,300	
Clearing	430 acres	500.00	215,000	553,300
Subtotal				$1,580,900
Administration and engineering, 10%				$158,100
Contingencies, 15%				237,100
Interest during construction				29,600
TOTAL				$2,005,700
Annual Costs				
Interest, 3%				$60,200
Repayment, 0.887%				17,800
Replacement, 0.07%				1,400
Operation and maintenance				4,000
TOTAL				$83,400

ESTIMATED COST OF ARCHIBALD NO. 3 DAM AND RESERVOIR TO PROVIDE 14,400 ACRE-FEET OF RESERVOIR STORAGE CAPACITY

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 152 feet, U.S.G.S. datum
Elevation of spillway crest: 138 feet
Height of dam to spillway crest, above stream bed: 105 feet
Capacity of reservoir to spillway crest: 14,400 acre-feet
Capacity of spillway with 4-foot freeboard: 19,600 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation	150,000 cu.yd.	$1.00	150,000	
Excavation for embankment				
Impervious	672,600 cu.yd.	0.40	269,000	
Embankment				
Impervious	585,000 cu.yd.	0.25	146,300	
Pervious	113,200 cu.yd.	0.30	34,000	
Drilling grout holes	6,300 lin.ft.	3.00	18,900	
Pressure grouting	4,200 cu.ft.	4.00	16,800	
Riprap	24,000 cu.yd.	2.50	60,000	$700,000
Spillway				
Excavation	99,700 cu.yd.	1.00	99,700	
Concrete	1,900 cu.yd.	35.00	66,500	
Reinforcing steel	142,500 lbs.	0.15	21,400	187,600
Outlet Works				
Excavation	2,900 cu.yd.	3.00	8,700	
Concrete, pipe encasement	600 cu.yd.	30.00	18,000	
Reinforcing steel	60,000 lbs.	0.15	9,000	
Steel pipe, 36-inch and 48-inch diameter	86,200 lbs.	0.25	21,600	
Gate valve, 18-inch diameter, and actuators	4 each	2,000	8,000	
Howell-Bunger valve, 30-inch diameter		lump sum	$7,200	
Control house		lump sum	2,000	$74,500
Reservoir				
Land and improvements		lump sum	103,000	
Public utilities		lump sum	200,000	
Clearing	485 acres	500.00	242,500	545,500
Subtotal				$1,507,600
Administration and engineering, 10%				$150,800
Contingencies, 15%				226,200
Interest during construction, none				
TOTAL				$1,884,600
Annual Costs				
Interest, 3%				$56,500
Repayment, 0.887%				16,700
Replacement, 0.07%				1,300
Operation and maintenance				2,500
TOTAL				$77,000

ESTIMATED COST OF ARCHIBALD NO. 3 DAM AND RESERVOIR TO PROVIDE 43,200 ACRE-FEET OF RESERVOIR STORAGE CAPACITY

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 215 feet, U.S.G.S. datum
Elevation of spillway crest: 200 feet
Height of dam to spillway crest, above stream bed: 167 feet
Capacity of reservoir to spillway crest: 43,200 acre-feet
Capacity of spillway with 4-foot freeboard: 19,600 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation	208,900 cu.yd.	$1.00	208,900	
Excavation for embankment				
Impervious	1,031,000 cu.yd.	0.35	360,900	
Pervious	949,900 cu.yd.	0.50	475,000	
Embankment				
Impervious	896,000 cu.yd.	0.25	224,000	
Pervious	949,900 cu.yd.	0.20	19,000	
Pervious	200,000 cu.yd.	0.30	60,000	
Drilling grout holes	8,500 lin.ft.	3.00	25,500	
Pressure grouting	5,660 cu.ft.	4.00	22,600	$1,571,900
Spillway				
Excavation	125,400 cu.yd.	1.00	125,400	
Concrete	2,430 cu.yd.	35.00	85,100	
Reinforcing steel	182,250 lbs.	0.15	27,300	237,800
Outlet Works				
Excavation	3,140 cu.yd.	3.00	9,400	
Concrete, pipe encasement	1,250 cu.yd.	30.00	37,500	
Reinforcing steel	125,000 lbs.	0.15	18,800	
Steel pipe, 48-inch and 54-inch diameter	176,000 lbs.	0.25	44,000	
Gate valve, 18-inch diameter, and actuators	6 each	2,000	12,000	

Item	Quantity	Unit price	Cost	
Howell - Bunger valve, 42-inch diameter		lump sum	$12,300	
Control house		lump sum	2,000	$136,000
Reservoir				
Land, improvements, and public utilities		lump sum	345,000	
Clearing	688 acres	$500.00	344,000	689,000
Subtotal				$2,634,700
Administration and engineering, 10%				$263,500
Contingencies, 15%				395,200
Interest during construction				79,000
TOTAL				$3,372,400
Annual Costs				
Interest, 3%				$101,200
Repayment, 0.887%				29,900
Replacement, 0.07%				2,500
Operation and maintenance				7,000
TOTAL				$140,600

ESTIMATED COST OF ARCHIBALD NO. 4 DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 132 feet, U.S.G.S. datum
Elevation of spillway crest: 117 feet
Height of dam to spillway crest, above stream bed: 82 feet
Capacity of reservoir to spillway crest: 8,000 acre-feet
Capacity of spillway with 4-foot freeboard: 19,600 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation	118,700 cu.yd.	1.00	118,700	
Excavation for embankment				
Impervious	443,000 cu.yd.	0.40	177,200	
Embankment				
Impervious	384,800 cu.yd.	0.25	96,200	
Pervious	76,900 cu.yd.	0.30	23,100	
Drilling grout holes	2,000 lin.ft.	3.00	6,000	
Pressure grouting	1,400 cu.ft.	4.00	5,600	
Riprap	15,200 cu.yd.	2.50	38,000	$469,800
Spillway				
Excavation	42,500 cu.yd.	1.00	42,500	
Concrete	2,160 cu.yd.	35.00	75,600	
Reinforcing steel	162,000 lbs.	.15	24,300	142,400
Outlet Works				
Excavation	1,760 cu.yd.	4.00	7,000	
Concrete, pipe encasement	500 cu.yd.	30.00	15,000	
Reinforcing steel	45,100 lbs.	0.15	6,800	
Steel pipe, 27-inch and 48-inch diameter	70,700 lbs.	0.25	17,700	
Gate valve, 18-inch diameter, and actuators	3 each	2,000	6,000	

Item	Quantity	Unit price	Cost	
Howell - Bunger valve, 24-inch diameter		lump sum	$5,400	
Control house		lump sum	2,000	$59,900
Reservoir				
Land and improvements		lump sum	96,700	
Public utilities		lump sum	150,000	
Clearing	330 acres	$500.00	165,000	411,700
Subtotal				$1,083,800
Administration and engineering, 10%				$108,400
Contingencies, 15%				162,600
Interest during construction, none				
TOTAL				$1,354,800
Annual Costs				
Interest, 3%				$40,600
Repayment, 0.887%				12,000
Replacement, 0.07%				1,000
Operation and maintenance				2,500
TOTAL				$56,100

ESTIMATED COST OF LAGUNA CREEK DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 1,319 feet, U.S.G.S. datum
Elevation of spillway crest: 1,309 feet
Height of dam to spillway crest, above stream bed: 149 feet
Capacity of reservoir to spillway crest: 1,500 acre-feet
Capacity of spillway with 4-foot freeboard: 3,800 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation	80,600 cu.yd.	1.50	120,900	
Excavation for embankment				
Impervious	187,500 cu.yd.	0.60	112,500	
Pervious	292,300 cu.yd.	0.80	233,800	
Embankment				
Impervious	159,500 cu.yd.	0.25	39,900	
Pervious	292,300 cu.yd.	0.20	58,500	
Pervious, salvage	14,000 cu.yd.	0.30	4,200	
Drilling grout holes	2,380 lin.ft.	3.00	7,100	
Pressure grouting	1,520 cu.ft.	4.00	6,100	
Riprap	12,000 cu.yd.	3.00	36,000	$624,000
Spillway				
Excavation	10,880 cu.yd.	3.00	32,600	
Concrete	450 cu.yd.	35.00	15,800	
Reinforcing steel	29,900 lbs.	0.15	4,500	52,900
Outlet Works				
Excavation	4,000 cu.yd.	4.00	16,000	
Concrete, pipe encasement	690 cu.yd.	30.00	20,700	
Reinforcing steel	69,000 lbs.	0.15	10,400	
Steel pipe, 24-inch and 48-inch diameter	114,300 lbs.	0.25	28,600	

Item	Quantity	Unit price	Cost	
Gate valve, 18-inch diameter, and actuators	4 each	$2,000	$8,000	
Howell-Bunger valve, 20-inch diameter		lump sum	4,200	$87,900
Reservoir				
Land and improvements	30 acres	100.00	3,000	
Clearing	30 acres	300.00	9,000	12,000
Subtotal				$776,800
Administration and engineering, 10%				77,700
Contingencies, 15%				116,500
Interest during construction, none				
TOTAL				$971,000
Annual Costs				
Interest, 3%				$29,100
Repayment, 0.887%				8,600
Replacement, 0.07%				700
Operation and maintenance				2,500
TOTAL				$40,900

ESTIMATED COST OF BALD MOUNTAIN SCHOOL DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 630 feet, U.S.G.S. datum
Elevation of spillway crest: 622 feet
Height of dam to spillway crest, above stream bed: 132 feet
Capacity of reservoir to spillway crest: 2,800 acre-feet
Capacity of spillway with 4-foot freeboard: 6,200 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation	42,500 cu.yd.	$1.00	42,500	
Excavation for embankment				
Impervious	169,300 cu.yd.	0.75	127,000	
Pervious	112,900 cu.yd.	0.60	67,700	
Embankment				
Impervious	147,200 cu.yd.	0.25	36,800	
Pervious	112,900 cu.yd.	0.20	22,600	
Pervious, salvage	86,000 cu.yd.	0.30	25,800	
Drilling grout holes	2,400 lin.ft.	3.00	7,200	
Pressure grouting	1,600 cu.ft.	4.00	6,400	
Riprap	11,000 cu.yd.	2.50	27,500	$368,500
Spillway				
Excavation	74,700 cu.yd.	1.50	112,100	
Concrete	1,390 cu.yd.	35.00	48,700	
Reinforcing steel	104,000 lbs.	0.15	15,600	176,400
Outlet Works				
Excavation	1,400 cu.yd.	4.00	5,600	
Backfill	280 cu.yd.	1.50	400	
Concrete, pipe encasement	560 cu.yd.	35.00	19,600	
Reinforcing steel	56,000 lbs.	0.15	8,400	
Steel pipe, 24-inch and 48-inch diameter	73,000 lbs.	0.25	18,300	

Item	Quantity	Unit price	Cost	
Gate valve, 18-inch diameter, and actuators	3 each	$2,000	$6,000	
Howell - Bunger valve, 20-inch diameter		lump sum	4,200	$62,500
Reservoir				
Land and improvements	60 acres	500.00	30,000	
Public utilities		lump sum	13,500	
Clearing	60 acres	500.00	30,000	73,500
Subtotal				$680,900
Administration and engineering, 10%				$68,100
Contingencies, 15%				102,100
Interest during construction, none				
TOTAL				$851,100
Annual Costs				
Interest, 3%				$25,500
Repayment, 0.887%				7,500
Replacement, 0.07%				600
Operation and maintenance				2,500
TOTAL				$36,100

ESTIMATED COST OF WATERMAN SWITCH DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 830 feet, U.S.G.S. datum
Elevation of spillway crest: 820 feet
Height of dam to spillway crest, above stream bed: 110 feet
Capacity of reservoir to spillway crest: 2,800 acre-feet
Capacity of spillway with 4-foot freeboard: 6,800 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation	45,900 cu.yd.	1.50	68,900	
Excavation for embankment				
Impervious	98,100 cu.yd.	0.75	73,600	
Pervious	136,100 cu.yd.	0.60	81,700	
Embankment				
Impervious	85,300 cu yd.	0.25	21,300	
Pervious	136,100 cu.yd.	0.20	27,200	
Pervious, salvage	49,000 cu.yd.	0.30	14,700	
Drilling grout holes	2,000 lin.ft.	3.00	6,000	
Pressure grouting	1,340 cu.ft.	4.00	5,400	
Riprap	6,200 cu.yd.	2.50	15,500	$319,300
Spillway				
Excavation	34,700 cu.yd.	1.50	52,100	
Concrete	1,200 cu.yd.	35.00	42,000	
Reinforcing steel	90,000 lbs.	0.15	13,500	107,600
Outlet Works				
Excavation	4,320 cu.yd.	4.00	17,300	
Concrete, pipe encasement	410 cu.yd.	30.00	12,300	
Reinforcing steel	41,000 lbs.	0.15	6,200	
Steel pipe, 24-inch and 48-inch diameter	66,300 lbs.	0.25	16,600	

Item	Quantity	Unit price	Cost	
Gate valve, 18-inch diameter, and actuators	4 each	$2,000	$8,000	
Howell - Bunger valve, 20-inch diameter		lump sum	4,200	$64,600
Reservoir				
Land and improvements		lump sum	17,200	
Public utilities		lump sum	374,000	
Clearing	86 acres	500.00	43,000	434,200
Subtotal				$925,700
Administration and engineering, 10%				$92,600
Contingencies, 15%				138,900
Interest during construction, none				
TOTAL				$1,191,900
Annual Costs				
Interest, 3%				$35,800
Repayment, 0.887%				10,600
Replacement, 0.07%				800
Operation and maintenance				2,500
TOTAL				$49,700

ESTIMATED COST OF BEAR CREEK DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 870 feet, U.S.G.S. datum
Elevation of spillway crest: 861 feet
Height of dam to spillway crest, above stream bed: 176 feet
Capacity of reservoir to spillway crest: 8,500 acre-feet
Capacity of spillway with 4-foot freeboard: 10,300 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$10,000	
Stripping and preparation of foundation	106,500 cu.yd.	$1.00	106,500	
Excavation for embankment				
Impervious	417,100 cu.yd.	0.70	292,000	
Pervious	817,200 cu.yd.	0.60	490,300	
Embankment				
Impervious	362,700 cu.yd.	0.25	90,700	
Pervious	817,200 cu.yd.	0.20	163,400	
Pervious, salvage	137,200 cu.yd.	0.30	41,200	
Drilling grout holes	5,160 lin.ft.	3.00	15,500	
Pressure grouting	3,450 cu.ft.	4.00	13,800	
Riprap	38,700 cu.yd.	2.50	96,800	$1,320,100
Spillway				
Excavation	74,400 cu.yd.	1.50	111,600	
Concrete	2,350 cu.yd.	35.00	82,200	
Reinforcing steel	176,000 lbs.	0.15	26,400	220,200
Outlet Works				
Excavation	3,000 cu.yd.	4.00	12,000	
Concrete, pipe encasement	1,020 lbs.	30.00	30,600	
Reinforcing steel	100,000 lbs.	0.15	15,000	
Steel pipe, 30-inch and 48-inch diameter	122,500 lbs.	0.25	30,600	

Item	Quantity	Unit price	Cost	
Gate valve, 18-inch diameter, and actuators	6 each	$2,000	$12,000	
Howell - Bunger valve, 24-inch diameter		lump sum	5,400	$105,600
Reservoir				
Land and improvements		lump sum	169,400	
Public utilities		lump sum	85,000	
Clearing	150 acres	500.00	75,000	329,400
Subtotal				$1,975,300
Administration and engineering, 10%				$197,500
Contingencies, 15%				296,300
Interest during construction, none				
TOTAL				$2,469,100
Annual Costs				
Interest, 3%				$74,100
Repayment, 0.887%				21,900
Replacement, 0.07%				1,700
Operation and maintenance				2,500
TOTAL				$100,200

ESTIMATED COST OF JAMISON DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 851 feet, U.S.G.S. datum
Elevation of spillway crest: 840 feet
Height of dam to spillway crest, above stream bed: 126 feet

Capacity of reservoir to spillway crest: 5,930 acre-feet
Capacity of spillway with 4-foot freeboard: 7,500 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$10,000	
Stripping and preparation of foundation	66,600 cu.yd.	$1.00	66,600	
Excavation for embankment				
Impervious	241,200 cu.yd.	0.45	108,500	
Embankment				
Impervious	209,800 cu.yd.	0.25	52,400	
Pervious, salvage	66,300 cu.yd.	0.30	19,900	
Drilling grout holes	3,300 lin.ft.	3.00	9,900	
Pressure grouting	2,400 cu.ft.	4.00	9,600	
Riprap	10,750 cu.yd.	3.00	32,300	$309,200
Spillway				
Excavation	41,150 cu.yd.	1.50	61,700	
Concrete	1,270 cu.yd.	35.00	44,600	
Reinforcing steel	95,500 lbs.	0.15	14,300	120,600
Outlet Works				
Tunnel				
Portal excavation	1,300 cu.yd.	2.00	2,600	
Excavation	1,360 cu.yd.	50.00	68,000	
Concrete	780 cu.yd.	45.00	35,100	
Reinforcing steel	8,400 lbs.	0.15	1,300	
Steel support	40,900 lbs.	0.30	12,300	
Timber lagging	13 MBM	350.00	4,500	
Steel pipe, 36-inch diameter	52,300 lbs.	0.25	13,100	
Slide gate, 3' x 3'		lump sum	1,000	

Item	Quantity	Unit price	Cost	
Butterfly valve, 30-inch diameter		lump sum	$9,700	
Howell - Bunger valve, 30-inch diameter		lump sum	7,200	
Trash rack, steel	1,840 lbs.	$0.30	600	$155,400
Reservoir				
Land and improvements		lump sum	524,000	
Public utilities		lump sum	763,700	
Clearing	317 acres	500.00	158,500	1,446,200
Subtotal				$2,031,400
Administration and engineering, 10%				$203,100
Contingencies, 15%				304,700
Interest during construction, none				
TOTAL				$2,539,200
Annual Costs				
Interest, 3%				$76,200
Repayment, 0.887%				22,500
Replacement, 0.07%				1,800
Operation and maintenance				2,500
TOTAL				$103,000

ESTIMATED COST OF NEWELL CREEK DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 520 feet, U.S.G.S. datum
Elevation of spillway crest: 510 feet
Height of dam to spillway crest, above stream bed: 163 feet

Capacity of reservoir to spillway crest: 7,200 acre-feet
Capacity of spillway with 4-foot freeboard: 8,500 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation	98,000 cu.yd.	$1.00	98,000	
Excavation for embankment				
Impervious	423,000 cu.yd.	0.75	317,300	
Pervious	803,000 cu.yd.	0.75	602,200	
Embankment				
Impervious	357,800 cu.yd.	0.25	89,400	
Pervious	803,000 cu.yd.	0.20	160,600	
Pervious, salvage	98,500 cu.yd.	0.30	29,600	
Drilling grout holes	5,400 lin.ft.	3.00	16,200	
Pressure grouting	3,600 cu.ft.	4.00	14,400	
Riprap	33,400 cu.yd.	3.00	100,200	$1,432,900
Spillway				
Excavation	22,900 cu.yd.	1.50	34,400	
Concrete	1,710 cu.yd.	35.00	59,900	
Reinforcing steel	128,300 lbs.	0.15	19,200	113,500
Outlet Works				
Excavation	3,000 cu.yd.	4.00	12,000	
Concrete, pipe encasement	800 cu.yd.	30.00	24,000	
Reinforcing steel	60,000 lbs.	0.15	9,000	
Steel pipe, 24-inch and 48-inch diameter	136,400 lbs.	0.30	40,900	

Item	Quantity	Unit price	Cost	
Gate valve, 18-inch diameter, and actuators	4 each	$2,000	$8,000	
Howell - Bunger valve, 20-inch diameter		lump sum	4,200	$98,100
Reservoir				
Land	200 acres	100.00	20,000	
Clearing	145 acres	500.00	72,500	92,500
Subtotal				$1,737,000
Administration and engineering, 10%				$173,700
Contingencies, 15%				260,600
Interest during construction				32,600
TOTAL				$2,203,900
Annual Costs				
Interest, 3%				$66,100
Repayment, 0.887%				19,500
Replacement, 0.07%				1,500
Operation and maintenance				2,500
TOTAL				$89,600

ESTIMATED COST OF DOYLE GULCH DAM, RESERVOIR, AND SAN LORENZO RIVER DIVERSION TO PROVIDE 14,500 ACRE-FEET OF RESERVOIR STORAGE CAPACITY

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 320 feet, U.S.G.S. datum
Elevation of spillway crest: 314 feet
Height of dam to spillway crest, above stream bed: 204 feet
Capacity of reservoir to spillway crest: 14,500 acre-feet
Capacity of spillway with 4-foot freeboard: 2,700 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Unwatering dam site		lump sum	$2,000	
Stripping and preparation of foundation	80,600 cu.yd.	$1.00	80,600	
Excavation for embankment				
Impervious	587,000 cu.yd.	0.45	264,100	
Pervious	1,150,000 cu.yd.	0.60	690,000	
Embankment				
Impervious	511,500 cu.yd.	0.25	127,900	
Impervious, salvage	38,500 cu.yd.	0.30	11,500	
Pervious	1,150,000 cu.yd.	0.20	230,000	
Drilling grout holes	5,100 lin.ft.	3.00	15,300	
Pressure grouting	3,400 cu.ft.	4.00	13,600	$1,435,000
Spillway				
Excavation	3,700 cu.yd.	3.00	10,100	
Concrete	35 cu.yd.	35.00	1,200	
Reinforcing steel	3,500 lbs.	0.15	500	11,800
Outlet Works				
Excavation	2,700 cu.yd.	4.00	10,800	
Backfill	1,300 cu.yd.	1.50	2,000	
Concrete, pipe encasement	1,000 cu.yd.	30.00	30,000	
Reinforcing steel	10,000 lbs.	0.15	1,500	
Steel pipe, 42-inch and 48-inch diameter	129,900 lbs.	0.25	32,500	
Gate valve, and actuators				
18-inch diameter	6 each	2,000	12,000	
36-inch diameter		lump sum	12,000	
Howell-Bunger valve, 30-inch diameter		lump sum	7,200	108,000
Reservoir				
Land	400 acres	300.00	120,000	
Improvements		lump sum	120,000	
Public utilities		lump sum	128,700	
Clearing	400 acres	100.00	40,000	408,700
Subtotal, dam and reservoir				$1,963,500
Diversion Works				
Inlet structure		lump sum	$1,000	
Excavation	860 cu.yd.	4.00	3,400	
Backfill	370 cu.yd.	0.50	200	
Concrete	125 cu.yd.	75.00	9,400	
Reinforcing steel	12,500 lbs.	0.15	1,900	
Steel pipe, 60-inch diameter	9,000 lbs.	0.25	2,200	
Sluice gate, 2′ x 2′	4 each	1,000	4,000	$22,100
Diversion Conduit				
Excavation	35,000 cu.yd.	0.50	17,500	
Backfill	25,600 cu.yd.	0.50	12,800	
Steel pipe, 42-inch diameter, in place	26,400 lin.ft.	19.33	510,300	
Stream crossing	3 each	$1,500	$4,500	
Road crossing	5 each	2,000	10,000	
Remove and replace pavement		lump sum	9,700	
Right of way	6.5 acres	5,000	32,500	$597,300
Pumping Plant No. 1				
Pump, motor, and electrical equipment				
2,200 g.p.m. unit	2 each	5,350	10,700	
4,500 g.p.m. unit	1 each	9,500	9,500	
6,700 g.p.m. unit	3 each	13,400	40,200	
Check valve				
8-inch diameter	2 each	600.00	1,200	
12-inch diameter	4 each	1,500	6,000	
Structure		lump sum	20,000	87,600
Pumping Plant No. 2				
Pump, motor, and electrical equipment				
2,200 g.p.m. unit	2 each	5,350	10,700	
4,500 g.p.m. unit	1 each	9,500	9,500	
6,700 g.p.m. unit	3 each	13,400	40,200	
Check valve				
8-inch diameter	2 each	600.00	1,200	
12-inch diameter	4 each	1,500	6,000	
Gate valve for bypass, 36-inch diameter, manual control		lump sum	8,800	
Structure		lump sum	20,000	96,400
Subtotal, diversion system				$803,400
Total, dam and reservoir, and diversion system				$2,766,900
Administration and engineering, 10%				$276,700
Contingencies, 15%				415,000
Interest during construction				51,900
TOTAL				$3,510,500
Annual Costs				
Interest, 3%				$105,300
Repayment, 0.887%				31,100
Replacement				
Dam and reservoir, 0.07%				1,700
Diversion works, 0.5%				5,200
Electrical energy				24,300
Operation and maintenance				8,900
TOTAL				$176,500

ESTIMATED COST OF SOQUEL CREEK DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 402 feet, U.S.G.S. datum
Elevation of spillway crest: 390 feet
Height of dam to spillway crest, above stream bed: 195 feet
Capacity of reservoir to spillway crest: 31,000 acre-feet
Capacity of spillway with 4-foot freeboard: 21,600 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$20,000	
Stripping and preparation of foundation	513,200 cu.yd.	$1.00	513,200	
Excavation for embankment				
Impervious	1,517,400 cu.yd.	0.65	986,000	
Pervious	2,912,600 cu.yd.	0.60	1,747,600	
Embankment				
Impervious	1,319,400 cu.yd.	0.25	329,900	
Pervious	2,912,600 cu.yd.	0.20	582,500	
Pervious, salvage	271,500 cu.yd.	0.30	81,400	
Drilling grout holes	11,100 lin.ft.	3.00	33,300	
Pressure grouting	7,400 cu.ft.	4.00	29,600	
Riprap	126,200 cu.yd.	2.50	315,500	$4,639,000
Spillway				
Excavation	158,800 cu.yd.	1.50	238,200	
Concrete	2,054 cu.yd.	35.00	71,900	
Reinforcing steel	205,400 lbs.	0.15	30,800	340,900
Outlet Works				
Excavation	4,130 cu.yd.	4.00	16,500	
Backfill	1,900 cu.yd.	1.50	2,800	
Concrete, pipe encasement	1,440 cu.yd.	30.00	43,200	
Reinforcing steel	143,700 lbs.	0.15	21,600	
Steel pipe, 48-inch diameter	211,000 lbs.	0.25	52,800	

Item	Quantity	Unit price	Cost	
Gate valve, 18-inch diameter, and actuators	6 each	$2,000	$12,000	
Howell-Bunger valve, 40-inch diameter		lump sum	11,500	$160,400
Reservoir				
Land and improvements		lump sum	1,592,700	
Public utilities		lump sum	639,400	
Clearing	470 acres	500.00	235,000	2,467,100
Subtotal				$7,607,400
Administration and engineering, 10%				$760,700
Contingencies, 15%				1,141,100
Interest during construction				285,300
TOTAL				$9,794,500
Annual Costs				
Interest, 3%				$293,800
Repayment, 0.887%				86,900
Replacement, 0.07%				6,900
Operation and maintenance				5,600
TOTAL				$393,200

ESTIMATED COST OF APTOS CREEK DAM AND RESERVOIR

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 176 feet, assumed datum *
Elevation of spillway crest: 164 feet
Height of dam to spillway crest, above stream bed: 120 feet
Capacity of reservoir to spillway crest: 4,100 acre-feet
Capacity of spillway with 4-foot freeboard: 9,600 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation	102,500 cu.yd.	$1.00	102,500	
Excavation for embankment				
Impervious	218,000 cu.yd.	0.40	87,200	
Pervious	329,400 cu.yd.	0.60	197,600	
Embankment				
Impervious	185,500 cu.yd.	0.25	46,400	
Pervious	329,400 cu.yd.	0.20	65,900	
Pervious, salvage	75,000 cu.yd.	0.30	22,500	
Drilling grout holes	6,000 lin.ft.	3.00	18,000	
Pressure grouting	4,000 cu.ft.	4.00	16,000	
Riprap	11,000 cu.yd.	3.00	33,000	$594,100
Spillway				
Excavation	26,100 cu.yd.	1.50	39,100	
Concrete	1,400 cu.yd.	35.00	49,000	
Reinforcing steel	140,000 lbs.	0.15	21,000	109,100
Outlet Works				
Excavation	2,700 cu.yd.	4.00	10,800	
Concrete, pipe encasement	1,300 cu.yd.	30.00	39,000	
Reinforcing steel	130,000 lbs.	0.15	19,500	
Steel pipe, 30-inch and 48-inch diameter	176,100 lbs.	0.25	44,000	

Item	Quantity	Unit price	Cost	
Gate valve, 18-inch diameter, and actuators	3 each	$2,000	$6,000	
Howell-Bunger valve, 24-inch diameter		lump sum	5,400	$124,700
Reservoir				
Land and improvements		lump sum	100,000	
Public utilities		lump sum	129,200	
Clearing reservoir lands	135 acres	500.00	67,500	296,700
Subtotal				$1,124,600
Administration and engineering, 10%				$112,500
Contingencies, 15%				168,700
Interest during construction, none				
TOTAL				$1,405,800
Annual Costs				
Interest, 3%				$42,200
Repayment, 0.887%				12,500
Replacement, 0.07%				1,000
Operation and maintenance				2,500
TOTAL				$58,200

* Subtract 6 feet to convert to U.S.G.S. datum.

ESTIMATED COST OF PINTO LAKE DAM, RESERVOIR, AND CORRALITOS CREEK DIVERSION

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 137 feet, U.S.G.S. datum
Elevation of spillway crest: 130 feet
Height of dam to spillway crest, above stream bed: 27 feet
Capacity of reservoir to spillway crest: 4,800 acre-feet
Capacity of spillway with 4-foot freeboard: 1,500 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Stripping and preparation of foundation	14,000 cu.yd.	$1.00	$14,000	
Excavation for embankment				
Impervious	95,400 cu.yd.	0.65	62,000	
Gravel	19,200 cu.yd.	0.65	12,500	
Embankment				
Impervious	82,900 cu.yd.	0.25	20,700	
Gravel	19,200 cu.yd.	0.30	5,800	$115,000
Spillway				
Excavation	3,850 cu.yd.	1.50	5,800	
Concrete	260 cu.yd.	35.00	9,100	
Reinforcing steel	26,000 lbs.	0.15	3,900	18,800
Outlet Works				
Excavation	150 cu.yd.	4.00	600	
Concrete				
Outlet structure and stilling basin		lump sum	1,000	
Pipe encasement	116 cu.yd.	30.00	3,500	
Reinforcing steel	12,600 lbs.	0.15	1,900	
Steel pipe, 18-inch diameter	13,200 lbs.	0.25	3,300	
Gate valve, 12-inch diameter, manual control	1 each	1,500	1,500	11,800
Reservoir				
Land	275 acres	600.00	165,000	
Improvements		lump sum	23,300	
Clearing	222 acres	100.00	22,200	210,500
Subtotal, dam and reservoir				$356,100
Diversion Works				
Excavation	350 cu.yd.	4.00	1,400	
Concrete, structural	110 cu.yd.	70.00	7,700	
Reinforcing steel	11,240 lbs.	$0.15	$1,700	
Slide gate, 4′ x 4′	2 each	300.00	600	
Sluice gate, 1′ x 1′	3 each	100.00	300	
Stop logs and hoist		lump sum	500	$12,200
Canal				
Excavation	39,000 cu.yd.	0.60	23,400	
Private road crossing	4 each	1,000	4,000	
County road crossing	1 each	2,000	2,000	
Right of way	12 acres	1,800	21,600	
Flume	250 feet	25.00	6,200	
Compacted fill	39,000 cu.yd.	0.35	13,600	
Fence	3.42 miles	1,500	5,100	
Clearing	12 acres	300.00	3,600	79,500
Subtotal, diversion system				$91,700
Total, dam and reservoir, and diversion system				$447,800
Administration and engineering, 10%				$44,800
Contingencies, 15%				67,200
Interest during construction, none				
TOTAL				$559,800
Annual Costs				
Interest, 3%				$16,800
Repayment, 0.887%				5,000
Replacement, 0.07%				400
Operation and maintenance				1,500
TOTAL				$23,700

ESTIMATED COST OF ELKHORN SLOUGH DAM, RESERVOIR, AND PAJARO RIVER DIVERSION

(Based on prices prevailing in fall, 1952)

Elevation of crest of dam: 158 feet, U.S.G.S. datum
Elevation of spillway crest: 150 feet
Height of dam to spillway crest, above stream bed: 140 feet

Capacity of reservoir to spillway crest: 117,000 acre-feet
Capacity of spillway with 4-foot freeboard: 4,000 second-feet

Item	Quantity	Unit price	Cost	
Capital Costs				
Dam				
Unwatering dam site		lump sum	$2,000	
Stripping and preparation of foundation	607,300 cu.yd.	$0.50	303,600	
Excavation for embankment				
Impervious	4,098,700 cu.yd.	0.35	1,434,500	
Embankment				
Impervious	3,480,700 cu.yd.	0.20	696,100	
Random, salvage	1,446,000 cu.yd.	0.25	361,500	
Riprap	123,270 cu.yd.	3.00	369,800	$3,167,500
Auxiliary Dam				
Stripping and preparation of foundation	18,100 cu.yd.	0.50	9,000	
Embankment				
Impervious, salvage	70,300 cu.yd.	0.35	24,600	
Riprap	6,000 cu.yd.	3.00	18,000	51,600
Spillway				
Excavation	33,100 cu.yd.	1.00	33,100	
Concrete	1,860 cu.yd.	35.00	65,100	
Reinforcing steel	140,000 lbs.	0.15	21,000	119,200
Outlet-Inlet Works				
Excavation	905,000 cu.yd.	0.50	452,500	
Backfill	30,000 cu.yd.	1.50	45,000	
Concrete				
Structural	40 cu.yd.	100.00	4,000	
Pipe encasement	2,000 cu.yd.	30.00	60,000	
Reinforcing steel	204,000 lbs.	0.15	30,600	
Steel pipe, 72-inch diameter	192,000 lbs.	0.25	48,000	
Trash rack, steel	7,800 lbs.	0.25	2,000	
Butterfly valve, 48-inch diameter	2 each	15,000	30,000	
Howell - Bunger valve, 60-inch diameter		lump sum	21,000	693,100
Reservoir				
Land and improvements		lump sum	4,008,000	
Public utilities		lump sum	1,103,000	5,111,000
Subtotal, dam and reservoir				$9,142,400
Diversion Dam				
Unwatering dam site		lump sum	500	
Stripping and preparation of foundation	5,500 cu.yd.	1.00	5,500	
Concrete in weir, aprons, piers	2,025 cu.yd.	25.00	50,600	
Concrete control house	25 cu.yd.	100.00	2,500	
Reinforcing steel	71,000 lbs.	0.15	10,600	
Bascule gate, 6' x 40', and actuators	2 each	17,600	35,200	104,900
Sand Trap				
Excavation	265 cu.yd.	$1.50	$400	
Concrete	40 cu.yd.	100.00	4,000	
Headgate, 5' x 5'	2 each	2,000	4,000	
Sluice gate, 2' x 2'	3 each	1,000	3,000	
Trash rack	1,700 lbs.	0.30	500	$11,900
Diversion Conduit				
Excavation	570,000 cu.yd.	0.35	199,500	
Railroad crossing		lump sum	6,000	
Highway crossing		lump sum	10,000	
Right of way	32 acres	3,000	96,000	
Fencing	3.5 miles	1,500	5,300	316,800
Pumping Plant				
Pump, motor, starter				
12,000 g.p.m. unit	2 units	17,150	34,300	
25,000 g.p.m. unit	2 units	25,600	51,200	
50,000 g.p.m. unit	1 unit	45,000	45,000	
Check valve				
18-inch diameter	2 each	3,500	7,000	
24-inch diameter	2 each	4,800	9,600	
36-inch diameter	1 each	10,900	10,900	
Structure		lump sum	50,000	208,000
Subtotal, diversion system				$641,600
Total, dam and reservoir, and diversion system				$9,784,000
Administration and engineering, 10%				978,400
Contingencies, 15%				1,467,600
Interest during construction				366,900
TOTAL				12,596,900
Annual Costs				
Interest, 3%				$377,900
Repayment, 0.887%				111,700
Replacement				
Dam, reservoir, and diversion works, 0.07%				8,600
Pumping plant, 1.2%				3,100
Operation and maintenance				23,300
Electrical energy				17,200
TOTAL				$541,800

APPENDIX L

ALTERNATIVE PLANS CONSIDERED

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ALTERNATIVE PLANS CONSIDERED

ALTERNATIVE PLANS CONSIDERED

NORTH COASTAL UNIT

El Oso Dam and Reservoir

This dam site is located on Waddell Creek about 3 miles upstream from its mouth, in the southeast quarter of Section 23, Township 9 South, Range 4 West, M. D. B. & M., where the stream bed elevation is about 62 feet. The construction of a dam at the site to an elevation of 265 feet, with spillway crest at elevation of 250 feet, would create a reservoir having a storage capacity of about 21,000 acre-feet, including 500 acre-feet of dead storage. Estimated mean seasonal runoff from the drainage area of about 21.5 square miles above the dam site is about 16,600 acre-feet. The estimated safe seasonal yield of the reservoir would be about 8,800 acre-feet. Principal features of the El Oso Dam are shown on Plate L-1, entitled "El Oso Dam on Waddell Creek."

A topographic map of the El Oso dam and reservoir sites, at a scale of 1 inch to 500 feet, with contour interval of 20 feet, was made by the Division of Water Resources in 1951, using photogrammetric survey methods. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation:

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
62	0	0
80	10	75
100	38	555
120	57	1,500
140	81	2,880
160	112	4,820
180	142	7,360
200	172	10,500
220	203	14,200
240	236	18,600
250	253	21,000
260	271	23,700
280	311	29,500
300	351	36,100
320	392	43,600
340	438	51,900
360	486	61,100

The El Oso dam site lies in an area of the Monterey formation of Miocene age. The strata consist primarily of shales and mudstones. Bedrock is in very poor condition, especially where weathered, and much of the heavy overburden on both abutments consists of landslide detritus. Soil creep is prominent at this site. The site is suitable only for an earthen type of dam. Stripping under the impervious section would approximate 20 feet normal to the surface on the abutments, and slightly more than 20 feet in the channel section. An even greater amount of stripping would be necessary if, as seems possible, a major fault were to be uncovered in the channel section. Materials for the embankment might be obtained from granitic deposits located northeast of the site on the ridge between Scott and Boulder Creeks.

The dam for the El Oso site, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 750 feet, a crest width of 28 feet, and upstream and downstream slopes of 2.5 : 1. The impervious core would have a top width of 10 feet and 0.8 : 1 slopes, and the upstream slope of the dam would be faced with a 3-foot layer of riprap. The dam would have an estimated volume of fill of 1,797,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the right abutment of the dam, and discharging through a chute into Waddell Creek about 200 feet below the dam. It would have a capacity of 16,000 second-feet required for an estimated discharge of about 750 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 10 feet, and an additional 5 feet of freeboard would be provided. Water would be released from the reservoir through a 36-inch diameter steel pipe encased in concrete and placed in a trench excavated beneath the dam. Releases would be controlled by gates in an inclined inlet structure on the slope of the left abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with five 18-inch gate valves hydraulically operated from a control house at the top of the structure.

The lands in the reservoir area are used only for pasture, and there are no improvements or utilities that would require relocation.

The capital cost of the El Oso Dam and Reservoir, based on prices prevailing in the fall of 1952, was estimated to be about $3,423,000. Corresponding annual costs were estimated to be about $139,700. The resultant estimated average unit cost of the 8,800 acre-feet of water per season conserved by the reservoir was about $15.90 per acre-foot, at the dam. Detailed cost estimates of the El Oso Dam and Reservoir are presented in Appendix K.

Archibald No. 1 Dam and Reservoir

This dam site is located on Scott Creek about 1.5 miles upstream from its mouth, in the southeast quarter of Section 18, Township 10 South, Range 3 West, M. D. B. & M., where the stream bed elevation is about 25 feet. The construction of a dam at the site to an elevation of 228 feet, with spillway crest at an elevation of 215 feet, would create a reservoir having a storage capacity of about 60,400 acre-feet, including 460 acre-feet of dead storage. Estimated mean seasonal runoff from the drainage area of about 28 square miles above the dam site is about 21,600 acre-feet. The estimated safe seasonal yield of the reservoir would be 15,600 acre-feet. Principal features of the Archibald No. 1 dam are shown on Plate L-2 entitled "Archibald No. 1 Dam on Scott Creek."

A topographic map of the Archibald No. 1 dam and reservoir sites, at a scale of 1 inch to 500 feet, with contour interval of 20 feet, was made by the Division of Water Resources in 1951, using photogrammetric survey methods. The dam site topography was field-checked by a plane table survey. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation:

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
25	0	0
40	15	153
60	66	971
80	128	2,910
100	206	6,250
120	291	11,200
140	376	17,900
160	466	26,300
180	579	36,800
200	686	49,400
215	758	60,400
220	778	64,100
240	872	80,600
260	966	98,900
280	1,060	119,200
300	1,170	141,600
320	1,290	166,100

Archibald No. 1 dam site lies in an area of the Monterey formation of Miocene age. The strata consist of a series of shales that are badly distorted, sheared, and finely jointed, especially where weathered. However, the foundation rock at depth is not appreciably stronger than that of the weathered zone. The rock is adaptable for the foundation of an earthen dam and a structure of moderate height could undoubtedly be constructed at the site. Stripping normal to the surface and under the impervious section of an earthfill dam would include about 3 feet of overburden from the right abutment, 8 feet of overburden from the left abutment, and 8 feet of underlying bedrock from both abutments. About 10 feet of stripping of silt and gravel in the channel section is indicated, in addition to a cutoff trench up to 25 feet deep which would probably also be required. A very large quantity of mixed soils, silts, and sands, probably suitable for use in the impervious section of an earthfill dam, can be obtained from flats within the reservoir area or from flats a very short distance downstream from the site. Material for riprap is available from the massive sandstone cliffs high on the right abutment. It is doubtful that any use could be made of the Monterey shales excavated during stripping of the site.

The dam for the Archibald No. 1 site, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 1,350 feet, a crest width of 30 feet, and upstream and downstream slopes of 2.5 : 1. The impervious core would have a top width of 20 feet and 1 : 1 slopes. The dam would have an estimated volume of fill of 3,240,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the left abutment of the dam, and discharging through a chute into Scott Creek about 600 feet below the dam. It would have a capacity of 19,600 second-feet required for an estimated discharge of about 700 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 9 feet and an additional 4 feet of freeboard would be provided. Water would be released from the reservoir through a 48-inch diameter steel pipe encased in concrete and placed in a trench excavated beneath the dam. Releases would be controlled by gates in an inclined inlet structure on the slope of the right abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with seven 24-inch gate valves hydraulically operated from a control house at the top of the structure.

Bottom land in the reservoir is used for truck crops and pasture, and surrounding lands in the reservoir area are covered by brush and second-growth redwood. Improvements consist of the Scott Valley School House, cottages and outbuildings, a ranchhouse with barns and outbuildings, and the village of Swanton. Public utilities that would require relocation consist of about 5 miles of county road, and power and telephone lines.

The capital cost of the Archibald No. 1 Dam and Reservoir, based on prices prevailing in the fall of 1952, was estimated to be about $4,729,000. Corresponding annual costs were estimated to be about $195,600. The resultant estimated average unit cost of the 15,600 acre-feet of water per season conserved by the reservoir was about $12.50 per acre-foot, at the dam. Detailed cost estimates of the Archibald No. 1 Dam and Reservoir are presented in Appendix K.

Archibald No. 2 Dam and Reservoir (20,000 Acre-Foot Reservoir Storage Capacity)

This dam site is located on Scott Creek about 1.9 miles upstream from its mouth, in the southeast quarter of Section 18, Township 10 South, Range 3 West, M. D. B. & M., where the stream bed elevation is about 30 feet. This is the same site as that for the Archibald Project described in some detail in Chapter IV. The construction of a dam at the site to an elevation of 164 feet, with spillway crest at elevation of 152 feet, would create a reservoir having a storage capacity of about 20,000 acre-feet, including 230 acre-feet of dead storage. Estimated mean seasonal runoff from the drainage area of about 28 square miles above the dam site is about 21,600 acre-feet. The estimated safe seasonal yield of the reservoir would be about 10,000 acre-feet. Principal features of the Archibald No. 2 Dam to provide 20,000 acre-feet of storage capacity are shown on Plate L-3 entitled "Archibald No. 2 Dam on Scott Creek (Reservoir Storage Capacity of 20,000 Acre-Feet)."

Areas and capacities of the reservoir at various stages of water surface elevation, a description of the reservoir area, and a discussion of the geology of the Archibald No. 2 dam site are presented in the section on the Archibald Project in Chapter IV of this bulletin.

The dam for the Archibald No. 2 site to provide 20,000 acre-feet of reservoir storage capacity, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 870 feet, a crest width of 30 feet, and upstream and downstream slopes of 2.5 : 1. The impervious core would have a top width of 10 feet and 1 : 1 slopes. The dam would have an estimated volume of fill of 807,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the left abutment of the dam, and discharging through a chute into Scott Creek about 300 feet below the dam. It would have a capacity of 19,600 second-feet required for an estimated discharge of about 700 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 8 feet and an additional 4 feet of freeboard would be provided. The water would be released from the reservoir through a 42-inch diameter steel pipe encased in concrete and placed in a trench excavated beneath the dam. Releases would be controlled by gates in an inclined inlet structure on the slope of the left abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe incased in concrete, and would be provided with four 18-inch gate valves hydraulically operated from a control house at the top of the structure.

The capital cost of the Archibald No. 2 Dam and Reservoir to provide 20,000 acre-feet of reservoir storage capacity, based on prices prevailing in the fall of 1952, was estimated to be about $2,006,000. Corresponding annual costs were estimated to be about $83,400. The resultant estimated average unit cost of the 10,000 acre-feet of water per season conserved by the reservoir was about $8.30 per acre-foot at the dam. Detailed cost estimates of the Archibald No. 2 Dam and Reservoir to provide 20,000 acre-feet of reservoir storage capacity are presented in Appendix K.

Archibald No. 3 Dam and Reservoir (14,400 and 43,200 Acre-Foot Reservoir Storage Capacities)

This dam site is located on Scott Creek about 2.0 miles upstream from its mouth, in the southeast quarter of Section 18, Township 10 South, Range 3 West, M. D. B. & M., where the stream bed elevation is about 33 feet. Two capacities of reservoir were studied at the site. The construction of the dam to an elevation of 152 feet, with spillway crest at an elevation of 138 feet, would create a reservoir having a storage capacity of about 14,400 acre-feet, including 200 acre-feet of dead storage. Construction of a dam to an elevation of 215 feet, with spillway crest at an elevation of 200 feet, would create a reservoir having a storage capacity of about 43,200 acre-feet, including 200 acre-feet of dead storage.

Estimated mean seasonal runoff from the drainage area of about 28 square miles above the dam site is about 21,600 acre-feet. The estimated safe seasonal yield of the reservoir with 14,400 acre-feet of storage capacity would be about 8,400 acre-feet, while with the 43,200 acre-foot reservoir the estimated safe seasonal yield would be about 14,200 acre-feet. Principal features of the dams studied for the Archibald No. 3 site are shown on Plate L-4 entitled "Archibald No. 3 Dam on Scott Creek (Reservoir Storage Capacity of 14,400 Acre-Feet)," and Plate L-5 entitled "Archibald No. 3 Dam on Scott Creek (Reservoir Storage Capacity of 43,200 Acre-Feet)."

A topographic map of the Archibald No. 3 dam and reservoir sites, at a scale of 1 inch to 500 feet, with contour interval of 20 feet, was made by the Division of Water Resources in 1951, using photogrammetric survey methods. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation.

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
33	0	0
40	4	35
60	46	535
80	101	2,000
100	172	4,740
120	251	8,970
138	324	14,400
140	332	14,800
160	417	22,300
180	524	31,700
200	623	43,200

The Archibald No. 3 dam site lies in the Monterey formation of Miocene age. The strata consist of tan siliceous and diatomaceous shales, bedded in thin layers, which are badly distorted and finely jointed, especially where exposed to weathering. Shears are present in great numbers but are of small scale and not easily differentiated from joints. The bedrock is probably not appreciably stronger at depth than in the weathered zone. A cutoff trench, back-filled with earth, would probably be advisable, as would some grouting. Stripping normal to the surface from both abutments under the impervious section of an earthfill dam would be about 3 feet of overburden and humus and about 8 feet of fragmental bedrock. Stripping from the channel section would include about 8 feet of silt and gravel and about 8 feet of bedrock. A large quantity of mixed soils, silts, and sands, probably suitable for use in the impervious section of an earthfill dam, can be obtained from flats either within the reservoir area or a short distance downstream from the site. Material for riprap is available from the massive sandstone cliffs high on the right abutment. It is doubtful that any use could be made of the Monterey shale excavated during stripping of the site.

As designed for cost estimating purposes, the dam for the Archibald No. 3 site to provide 14,400 acre-feet of reservoir storage capacity would consist of a rolled earthfill structure with a crest length of about 1,060 feet, a crest width of 30 feet, and 3:1 upstream and 2:1 downstream slopes. The upstream impervious section of the dam would have a top width of 20 feet and 3:1 upstream and 1:1 downstream slopes. The upstream slope of the dam would be faced with a 3-foot layer of riprap. The dam would have an estimated volume of fill of 722,000 cubic yards.

As designed for cost estimating purposes, the dam for the Archibald No. 3 site to provide 43,200 acre-feet of reservoir storage capacity would consist of a rolled earthfill structure with a crest length of about 1,470 feet, a crest width of 30 feet, and 2.5:1 upstream and downstream slopes. The impervious core would have a top width of 10 feet and 1:1 slopes. The dam would have an estimated volume of fill of 2,046,000 cubic yards.

The concrete-lined spillway for both dams would be of the ogee weir type, located across the left abutment of the dams, and discharging through a chute into Scott Creek below the dams. In each case the spillway would have a capacity of 19,600 second-feet required for an estimated discharge of about 700 second-feet per square mile of drainage area. In the case of the smaller reservoir the maximum depth of water above the spillway lip would be 10 feet and an additional 4 feet of freeboard would be provided. In the case of the larger reservoir the maximum depth of water above the spillway lip would be 11 feet and an additional 4 feet of freeboard would be provided.

Water would be released from both sizes of reservoir through a steel pipe encased in concrete and placed in a trench excavated beneath the dam. In the case of the smaller reservoir the pipe would be 36 inches in diameter, and in the case of the larger reservoir 48 inches in diameter. Releases would be controlled by gates in an inclined inlet structure on the slope of the right abutment upstream from the dam. For the smaller reservoir this structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with four 18-inch gate valves hydraulically operated from a control house at the top of the structure. For the larger reservoir the manifold pipe would be 54 inches in diameter, and six 18-inch gate valves would be provided.

Portions of the bottom lands in the reservoir area are being used for truck crops and pasture, but much of the area is covered by brush and second-growth redwood. Improvements consist of the Scott Valley School House, cottages and outbuildings, a ranchhouse with barns and outbuildings, and the village of Swanton. Public utilities that would require relocation consist of about 5 miles of county road, and power and telephone lines.

The capital cost of the Archibald No. 3 Dam and Reservoir to provide 14,400 acre-feet of storage capacity, based on prices prevailing in the fall of 1952, was estimated to be about $1,885,000. Corresponding annual costs were estimated to be about $77,000. The resultant estimated average unit cost of the 8,400 acre-feet of water per season conserved by the reservoir was about $9.20 per acre-foot at the dam.

The capital cost of the Archibald No. 3 Dam and Reservoir to provide 43,200 acre-feet of storage capacity, based on prices prevailing in the fall of 1952, was estimated to be about $3,372,000. Corresponding annual costs were estimated to be about $140,600. The resultant estimated average unit cost of the 14,200 acre-feet of water per season conserved by the reservoir was about $9.90 per acre-foot at the dam.

Detailed cost estimates of the two dams and reservoirs studies at the Archibald No. 3 site are presented in Appendix K.

Archibald No. 4 Dam and Reservoir

This dam site is located on Scott Creek about 2.1 miles upstream from its mouth, in the southeast quarter of Section 18, Township 10 South, Range 3 West, M. D. B. & M., where the stream bed elevation is about 35 feet. The construction of a dam at the site to an elevation of 132 feet, with spillway crest at an elevation of 117 feet, would create a reservoir having a storage capacity of about 8,000 acre-feet, including 150 acre-feet of dead storage. Estimated mean seasonal runoff from the drainage area of about 28 square miles above the dam site is about 21,600 acre-feet. The estimated safe seasonal yield of the reservoir would be about 5,800 acre-feet. Principal features of the Archibald No. 4 Dam are shown on Plate L-6 entitled "Archibald No. 4 Dam on Scott Creek."

A topographic map of the Archibald No. 4 dam and reservoir sites at a scale of 1 inch to 500 feet, with contour interval of 20 feet, was made by the Division of Water Resources in 1951, using photogrammetric survey methods. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation.

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
35	0	0
40	2	18
60	44	474
80	97	1,880
100	168	4,530
117	232	8,000
120	246	8,670
140	326	14,400

Geology of the Archibald No. 4 dam site is essentially the same as that already described for Archibald No. 3 dam site.

The dam for the Archibald No. 4 site, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 800 feet, a crest width of 30 feet, and 3:1 upstream and 2:1 downstream slopes. The upstream impervious section of the dam would have a top width of 20 feet and 3:1 upstream and 1:1 downstream slopes. The upstream slope of the dam would be faced with a 3-foot layer of riprap, and the dam would have an estimated volume of fill of 477,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the left abutment of the dam, and discharging through a chute into Scott Creek about 200 feet below the dam. It would have a capacity of 19,600 second-feet required for an estimated discharge of about 700 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 11 feet and an additional 4 feet of freeboard would be provided. Water would be released from the reservoir through a 28-inch diameter steel pipe encased in concrete and placed in a trench excavated beneath the dam. Releases would be controlled by gates in an inclined inlet structure on the slope of the right abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with three 18-inch gate valves hydraulically operated from a control house at the top of the structure.

Portions of the bottom lands in the reservoir area are being used for truck crops and pasture, but much of the area is covered by brush and second-growth redwood. Improvements consist of the Scott Valley School House, cottages and outbuildings, a ranchhouse with barns and outbuildings, and the village of Swanton. Public utilities that would require relocation consist of about 5 miles of county road, and power and telephone lines.

The capital cost of the Archibald No. 4 Dam and Reservoir, based on prices prevailing in the fall of 1952, was estimated to be about \$1,355,000. Corresponding annual costs were estimated to be about \$56,100. The resultant estimated average unit cost of the 5,800 acre-feet of water per season conserved by the reservoir was about \$9.70 per acre-foot at the dam. Detailed cost estimates of the Archibald No. 4 Dam and Reservoir are presented in Appendix K.

Laguna Creek Dam and Reservoir

This dam site is located on Laguna Creek about 5 miles upstream from its mouth, in the southwest quarter of Section 19, Township 10 South, Range 2 West, M. D. B. & M., where the stream bed elevation is about 1,160 feet. The construction of a dam at the site to an elevation of 1,319 feet, with spillway crest at an elevation of 1,309 feet, would create a reservoir having a storage capacity of about 1,500 acre-feet, including 200 acre-feet of dead storage. The estimated mean seasonal runoff from the drainage area of about 3 square miles above the dam site is about 2,300 acre-feet. The estimated safe seasonal yield of the reservoir would be about 900 acre-feet. Principal features of the Laguna Dam are shown on Plate L-7 entitled "Laguna Creek Dam on Laguna Creek."

Topography of the Laguna Creek dam and reservoir sites was obtained from a map provided by Mr. A. M. Baldwin, County Surveyor of Santa Cruz County, and prepared by him in 1921, at which time he was a member of the staff of the Water Department of the City of Santa Cruz. The scale of the map is 1 inch to 100 feet, with contour interval of 25 feet. Topography of the dam site was extended by comparison with that shown on the Ben Lomond quadrangle of the United States Geological Survey. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation.

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
1,160	0	0
1,180	1	10
1,200	3	46
1,220	5	130
1,240	9	270
1,260	14	510
1,280	19	840
1,300	25	1,300
1,309	28	1,500
1,320	33	1,700

The Laguna Creek dam site lies in an area of granitic rock of pre-Franciscan age. The bedrock is a granitic material which is relatively hard where fresh. It is coarse-grained and contains some flow structures. Shears or faults were not observed, but the rock is strongly block-jointed to a considerable depth. Wide separation along the joints was noted and even large trees were observed wedging into these cracks. Stripping under the impervious section of an earthfill dam would include about 3 feet of overburden and 3 feet of broken rock from both abutments, and additional stripping of 3 feet of sand and gravel in the channel section. There is a possibility that some water would be lost from the reservoir through percolation into limestone formations which exist in the area. Materials suitable for an impervious section could be obtained from a decomposed granite source along the Empire Grade. Rock for pervious sections or for riprap could be quarried at the site.

The dam for the Laguna Creek site, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 380 feet, crest width of 28 feet, and upstream and downstream slopes of 2.5 : 1. The impervious core would have a top width of 10 feet and 0.8 : 1 slopes, and the upstream slope of the dam would be faced with a 3-foot layer of riprap. The dam would have an estimated volume of fill of 478,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the left abutment of the dam, and discharging through a chute into Laguna Creek about 200 feet below the dam. It would have a capacity of 3,800 second-feet required for an estimated discharge of about 1,300 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 6 feet and an additional 4 feet of freeboard would be provided. Water would be released from the reservoir through a 24-inch diameter steel pipe encased in concrete and placed in a trench excavated beneath the dam. Releases would be controlled by gates in an inclined inlet structure on the slope of the right abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with four 18-inch gate valves hydraulically operated from a control house at the top of the structure.

There are little or no improvements in the reservoir area, and it is generally covered by brush, oak, and second-growth redwood.

The capital cost of the Laguna Creek Dam and Reservoir, based on prices prevailing in the fall of 1952, was estimated to be about $971,000. Corresponding annual costs were estimated to be about $40,900. The resultant estimated average unit cost of the 900 acre-feet of water per season conserved by the reservoir was about $45.40 per acre-foot at the dam. Detailed cost estimates of the Laguna Creek Dam and Reservoir are presented in Appendix K.

Bald Mountain School Dam and Reservoir

This dam site is located on Laguna Creek near the Bald Mountain School, in the southwest quarter of Section 31, Township 10 South, Range 2 West, M. D. B. & M., where the stream bed elevation is about 490 feet. The construction of a dam at the site to an elevation of 630 feet, with spillway crest at an elevation of 622 feet, would create a reservoir having a storage capacity of about 2,800 acre-feet, including 140 acre-feet of dead storage. The estimated mean seasonal runoff from the drainage area of about 5.8 square miles above the dam site is about 4,500 acre-feet. The estimated safe seasonal yield of the reservoir would be about 1,800 acre-feet. Principal features of the Bald Mountain School Dam are shown on Plate L-8 entitled "Bald Mountain School Dam on Laguna Creek."

Topography of the Bald Mountain School dam and reservoir sites was obtained by the Division of Water Resources by reconnaissance plane table surveys made in 1952. The dam site was surveyed to a scale of 1 inch to 200 feet, with 20-foot contour interval, and the reservoir site to a scale of 1 inch to 400 feet, with 40-foot contour interval. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation.

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
490	0	0
500	0.3	1
520	6	60
540	14	141
560	23	430
580	31	1,050
600	40	1,800
620	53	2,710
622	54	2,800
640	67	3,946
660	82	5,410
680	99	7,300
700	117	9,410

The Bald Mountain School dam site lies in an area of the Vaqueros formation of Miocene age. Bedrock in the immediate vicinity of the site consists primarily of massive sandstone. Attitude of the bedding is not readily apparent. The sandstone varies from fine- to medium-grained and is of variable hardness. At several places along the creek the formation is especially hard and fine-grained. The formation is notable in that no shearing or jointing was observed. Some separation of the sandstone has been caused by wedging of vegetation roots. Stripping under the impervious section of an earthfill dam is estimated to average 10 feet on the abutments, and 2 feet of gravel and an additional 2 feet of bedrock in the channel section. Riprap and rockfill material may be quarried from the sandstone in the vicinity. Impervious material is available from a decomposed granitic area about 2 miles to the northeast. The reservoir area was inspected especially from the viewpoint of leakage. There is little possibility that porous limestone formations exist within the reservoir area. The Vaqueros sandstones are quite stable and should not deteriorate as a result of repeated saturation.

The dam for the Bald Mountain School site, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 390 feet, a crest width of 28 feet, and upstream and downstream slopes of 2.5:1. The impervious core would have a top width of 10 feet and 1:1 slopes, and the upstream slope of the dam would be faced with a 3-foot layer of riprap. The dam would have an estimated volume of fill of 346,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the left abutment of the dam, and discharging through a chute into Laguna Creek about 100 feet below the dam. It would have a capacity of 6,200 second-feet required for an estimated discharge of about 1,100 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 4 feet, and an additional 4 feet of freeboard would be provided. Water would be released from the reservoir through a 24-inch diameter steel pipe encased in concrete and placed in a trench excavated beneath the dam. Releases would be controlled by gates in an inclined structure on the slope of the right abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with three 18-inch gate valves hydraulically operated from a control house at the top of the structure.

The reservoir area is densely covered by brush, oak, and second-growth redwood. There are few improvements within the area. A short reach of county road and utility lines would require relocation.

The capital cost of the Bald Mountain School Dam and Reservoir, based on prices prevailing in the fall of 1952, was estimated to be about $851,000. Corresponding annual costs were estimated to be about $36,100.

The resultant estimated average unit cost of the 1,800 acre-feet of water per season conserved by the reservoir was about $20.00 per acre-foot at the dam. Detailed cost estimates of the Bald Mountain School Dam and Reservoir are presented in Appendix K.

SAN LORENZO UNIT

Waterman Switch Dam and Reservoir

This dam site is located on the San Lorenzo River about 6 miles north of the town of Boulder Creek, in the southwest quarter of Section 25, Township 8 South, Range 3 West, M. D. B. & M., where the stream bed elevation is about 710 feet. The site is sometimes referred to as the "Waterman Gap" site. The construction of a dam at the site to an elevation of 830 feet, with spillway crest at an elevation of 820 feet, would create a reservoir having a storage capacity of about 2,800 acre-feet, including 100 acre-feet of dead storage. The estimated mean seasonal runoff from the drainage area of about 6.5 square miles above the dam site is about 6,400 acre-feet. The estimated safe seasonal yield of the reservoir would be about 2,000 acre-feet. Principal features of the Waterman Switch Dam are shown on Plate L-9 entitled "Waterman Switch Dam on San Lorenzo River."

Topography of the Waterman Switch dam site and area-capacity data of the reservoir site were made available by the District Engineer, San Francisco District, Corps of Engineers, U. S. Army. The dam site topography was to a scale of 1 inch to 50 feet, with a contour interval of 5 feet, and was obtained by surveys made by the Army in 1945. Areas and capacities of various stages of water surface elevation are given in the following tabulation.

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
710	0	0
720	2	30
740	6	110
760	18	350
780	34	820
800	50	1,600
820	69	2,800
840	92	4,400
860	115	6,500

The Waterman Switch dam site lies in an area of sediments of late Tertiary age. The strata along the axis consist of moderately well-cemented tan sandstones intercalated with occasional thin layers of gray shale. Shears in the rock are minor, but jointing is prominent and joint planes are often highly developed with separation up to 1 inch commonly noted. Beds dip generally downstream and into the right abutment at about a 40° angle. The most prominent joint set noted strikes roughly parallel to the bedding and dips at right angles to it. It is estimated that stripping under the impervious section of an earthfill dam would consist of about 3 feet of soil and 3 feet of jointed sandstone on the left abutment, about 3 feet of boulders and sand and 1 foot of loose bedrock in the channel section, and about 5 feet of soil and 3 feet of loose and/or badly jointed bedrock on the right abutment. Heavy grouting would be required in the sandstone bedrock to seal off leakage along the closely spaced joint planes, as well as along bedding planes. Small amounts of sandstone might prove recoverable from stripping operations for use as rockfill. Good earthfill material occurs in the San Lorenzo Valley downstream from the site. Broken sandstones and shales from sidehills near the site might roll into suitable impervious fill material, and probably would prove the most economical source if usable for this purpose.

The dam for the Waterman Switch site, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 350 feet, a crest width of 28 feet, and upstream and downstream slopes of 2.5:1. The impervious core would have a top width of 10 feet and 0.8:1 slopes, and the upstream slope of the dam would be faced with a 3-foot layer of riprap. The dam would have an estimated volume of fill of 270,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the left abutment of the dam, and discharging through a chute into the San Lorenzo River about 300 feet below the dam. It would have a capacity of 6,800 second-feet required for an estimated discharge of about 1,000 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 6 feet and an additional 4 feet of freeboard would be provided. Water would be released from the reservoir through a 24-inch diameter steel pipe encased in concrete and placed in a trench excavated beneath the dam. Releases would be controlled by gates in an inclined inlet structure on the slope of the right abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with four 18-inch gate valves hydraulically operated from a control house at the top of the structure.

The reservoir area is densely covered by brush, oak, and second-growth redwood. There is practically no development in the area. Relocation of about 2 miles of state highway and 2 miles of power lines would be required.

The capital cost of the Waterman Switch Dam and Reservoir, based on prices prevailing in the fall of 1952, was estimated to be about $1,192,000. Corresponding annual costs were estimated to be about $49,700. The resultant estimated average unit cost of the 2,000 acre-feet of water per season conserved by the reservoir was about $24.90 per acre-foot at the dam. Detailed cost estimates of the Waterman Switch Dam and Reservoir are presented in Appendix K.

Bear Creek Dam and Reservoir

This dam site is located on Bear Creek about 4 miles northeast of the town of Boulder Creek, in the southwest quarter of Section 10, Township 9 South, Range 2 West, M. D. B. & M., where the stream bed elevation is about 685 feet. The construction of a dam at this site to an elevation of 870 feet, with spillway crest at an elevation of 861 feet, would create a reservoir having a storage capacity of about 8,500 acre-feet, including 110 acre-feet of dead storage. The estimated mean seasonal runoff from the drainage area of about 11.7 square miles above the dam site is about 11,000 acre-feet. The estimated safe seasonal yield of the reservoir would be about 4,900 acre-feet. Principal features of the Bear Creek Dam are shown on Plate L-10 entitled "Bear Creek Dam on Bear Creek."

Topographic maps of the Bear Creek dam and reservoir sites were obtained from the District Engineer, San Francisco District, Corps of Engineers, U. S. Army. The dam site topography was to a scale of 1 inch to 50 feet, with contour interval of 5 feet, and the reservoir topography was to a scale of 1:10,000, with contour interval of 20 feet. The maps were prepared in 1945. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation.

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
685	0	0
700	2	30
720	7	110
740	14	300
760	25	680
780	42	1,300
800	54	2,400
820	87	3,900
840	112	5,900
860	140	8,400
861	142	8,500
880	170	11,400
900	207	15,200

The Bear Creek dam site lies in an area underlain by the Vaqueros formation of Miocene age. The strata are composed chiefly of moderately well-bedded sandstones interbedded with a few thin shale layers. The sandstones are well-cemented, and occasional very resistant ribs are encountered standing at the stream edges and across the channel section. Joints and shears are probably not of primary importance at this site. Observed shears are generally tight and show little or no gouge. Attitudes are consistent over a large area with dips at about 60 degrees upstream and into the right abutment. Stripping requirements under the impervious section of an earthfill dam would include about 8 feet of soil and rock from both abutments, and about 3 feet of stream gravels and loose rock, and 2 feet of bedrock from the channel section. Moderate to heavy grouting of joint planes probably will be necessary. Material suitable for an impervious fill is found only in small isolated patches within Bear Creek Valley. The harder and more massive of the sandstones near the site could probably be quarried for rockfill or riprap. A small amount of rock suited to these uses might also prove salvageable from stripped material.

The dam for the Bear Creek site, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 850 feet, a crest width of 28 feet, and upstream and downstream slopes of 2.5:1. The impervious core would have a top width of 10 feet and 0.8:1 slopes, and the upstream slope of the dam would be faced with a 3-foot layer of riprap. The dam would have an estimated volume of fill of 1,317,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the right abutment of the dam, and discharging through a chute into Bear Creek about 300 feet below the dam. It would have a capacity of 10,300 second-feet required for an estimated discharge of about 900 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 5 feet, and an additional 4 feet of freeboard would be provided. Water would be released from the reservoir through a 30-inch diameter steel pipe encased in concrete and placed in a trench excavated beneath the dam. Releases would be controlled by gates in an inclined inlet structure on the slope of the left abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with six 18-inch gate valves hydraulically operated from a control house at the top of the structure.

The reservoir area includes lands planted to apple orchards and to field crops. Growth of brush and large trees including redwood is very dense throughout portions of the remaining area. Improvements in the reservoir area consist of several ranchhouses with barns and outbuildings, a summer resort, a portable sawmill, several cottages, and weekend cabins. Relocation of about 2 miles of county road and of electric power and telephone lines would be required.

The capital cost of the Bear Creek Dam and Reservoir, based on prices prevailing in the fall of 1952, was estimated to be about $2,469,000. Corresponding annual costs were estimated to be about $100,200. The resultant estimated average unit cost of the 4,800 acre-feet of water per season conserved by the reservoir was about $20.90 per acre-foot at the dam. Detailed cost estimates of the Bear Creek Dam and Reservoir are presented in Appendix K.

Jamison Dam and Reservoir

This dam site is located on Boulder Creek about 2.5 miles northwest of the town of Boulder Creek, in the southeast quarter of Section 14, Township 9 South, Range 3 West, M. D. B. & M., where the stream bed elevation is about 714 feet. The construction of a dam at the site to an elevation of 851 feet, with spillway crest at an elevation of 840 feet, would create a reservoir having a storage capacity of about 5,900 acre-feet, including 50 acre-feet of dead storage. The estimated mean seasonal runoff from a drainage area of about 7.5 square miles above the dam site is about 7,100 acre-feet. The estimated safe seasonal yield of the reservoir would be about 3,100 acre-feet. Principal features of the Jamison Dam are shown on Plate L-11 entitled "Jamison Dam on Boulder Creek."

Topography of the Jamison dam site was obtained from a map prepared by the District Engineer, San Francisco District, Corps of Engineers, U. S. Army, in 1945, at a scale of 1 inch to 50 feet, with contour interval of 5 feet. A topographic map of the reservoir site at a scale of 1 inch to 500 feet, with contour interval of 20 feet, was made by the Division of Water Resources in 1950, using photogrammetric survey methods. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation.

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
714	0	0
720	0.2	0.5
740	1	13
760	3	50
780	13	210
800	55	890
820	123	2,700
840	203	5,900
860	317	11,100
880	403	18,300
900	493	26,300

The Jamison dam site lies in an area underlain by the San Lorenzo formation of Oligocene age. The strata are composed chiefly of moderately hard, fine-grained sandstones. These sandstones are generally thickly bedded, becoming harder and thinner with depth. The lowest exposed 15 feet consists of hard sandstone-shale layers intercalated with coarse concretionary beds. Shearing and jointing are minor, and major folding is not apparent. Attitude of the bedding is fairly consistent, the beds dipping slightly upstream and into the right abutment. Stripping under the impervious section of an earthfill dam would include the following: 1 foot of soil and loose rock to a height of 110 feet above the stream bed, and 3 feet of soil and 1 foot of fractured sandstone above this height from the left abutment, 4 feet of sand and large granitic blocks from the channel section, and 1 foot of soil and 2 feet of loose rock to a height of 80 feet above the stream bed from the right abutment. Above this height, the sandstone bedrock is covered by an estimated depth of 25 feet of rock landslide debris admixed with soil. A moderate amount of material suitable for use in an impervious fill may be obtained from within the reservoir area. Additional supplies might prove salvageable from stripping operations on the right abutment above the 80-foot level, which should also furnish considerable granitic rock for riprap after sorting. Large quantities of decomposed granite for the impervious fill are available within 2 miles by road of the site. Solid granitic rock could also be quarried in this area for use as riprap.

The dam for the Jamison site, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 490 feet, a crest width of 30 feet, upstream slope of 3:1, and downstream slope of 2.5:1. The upstream impervious section would have a top width of 15 feet and 3:1 upstream and 1.25:1 downstream slopes. The upstream slope of the dam would be faced with a 3-foot layer of riprap, and the downstream slope would be similarly protected up to an elevation of 750 feet. The dam would have an estimated volume of fill of 287,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the right abutment of the dam, and discharging through a chute into Boulder Creek about 300 feet below the dam. It would have a capacity of 7,500 second-feet required for an estimated discharge of about 1,000 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 7 feet and an additional 4 feet of freeboard would be provided. Water would be released from the reservoir through a 6-foot diameter tunnel in the left abutment of the dam. Flow through the outlet would be controlled by a 30-inch diameter butterfly valve located in a chamber about 300 feet downstream from the tunnel portal and about 100 feet upstream from the axis of the dam. From the valve the water would be carried through the remainder of the tunnel in a 36-inch diameter steel pipe.

The reservoir area is covered by oak, cottonwood, madrone, and second-growth redwood. Improvements consist of a private landing field, a nursery, several residences occupied during the entire year, and about 30 cottages occupied during parts of the year. About 3.5 miles of 2-lane state highway, 2.3 miles of county road, 5 miles of water pipe line, and electric power and telephone lines would require relocation.

The capital cost of the Jamison Dam and Reservoir, based on prices prevailing in the fall of 1952, was estimated to be about $2,539,000. Corresponding annual costs were estimated to be about $103,000. The resultant estimated average unit cost of the 3,100 acre-feet of water per season conserved by the reservoir was about $33.20 per acre-foot at the dam. Detailed cost estimates of the Jamison Dam and Reservoir are presented in Appendix K.

Newell Creek Dam and Reservoir

This dam site is located on Newell Creek about 1 mile northeast of the town of Ben Lomond, in the northwest quarter of Section 3, Township 10 South, Range 2 West, M. D. B. & M., where the stream bed elevation is about 347 feet. The construction of a dam at the site to an elevation of 520 feet, with spillway crest at an elevation of 510 feet, would create a reservoir having a storage capacity of about 7,200 acre-feet, including 200 acre-feet of dead storage. The estimated mean seasonal runoff from the drainage area of about 9 square miles above the dam site is about 4,200 acre-feet. The estimated safe seasonal yield of the reservoir would be about 2,700 acre-feet. Principal features of the Newell Creek Dam are shown on Plate L-12 entitled "Newell Creek Dam on Newell Creek."

A topographic map of the Newell Creek dam site at a scale of 1 inch to 100 feet, with contour interval of 5 feet, based on topography taken in 1945, was obtained from the District Engineer, San Francisco District, Corps of Engineers, U. S. Army. Data on reservoir areas and capacities were likewise obtained from the District Engineer. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation.

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
347	0	0
360	1	10
380	8	100
400	18	370
420	29	870
440	41	1,600
460	56	2,530
480	79	3,950
500	122	5,900
510	145	7,200
520	169	8,800
540	210	12,900

The Newell Creek dam site lies in an area underlain by the Monterey formation of Miocene age. The strata consist of shales and finely bedded siltstones, with intercalated layers of fine-grained tan sandstone up to eight feet in thickness. All of the rock, with the exception of the more massive sandstone, is finely jointed, although this jointing probably occurs chiefly near weathered surfaces. Joints should not persist with depth. Folds are not apparent and, if present, exist only in the nature of broad and gentle warps. Shears are also of minor importance. Attitude of the bedding is consistent with the strike directly across the channel section and the slight dip downstream. It is estimated that stripping under the impervious section of an earthfill dam would include the following: about 2 feet of soil and 3 feet of broken rock from the left abutment, about 2 feet of gravel, sand, and soil in addition to 2 feet of the underlying bedrock from the channel section, and about 12 feet of soil, terrace deposits, and fractured rock from the lowermost 30 feet, and about 8 feet of soil and rock from above 30 feet on the right abutment. Small amounts of slightly sandy material suitable for use in an impervious fill might be recoverable from the reservoir area. However, unless rock as exposed in the abutments should prove suitable for rolling into an impervious section, it seems probable that the greater part of the construction materials for an earthfill structure would have to be imported from flats downstream in the vicinity of Ben Lomond. Large deposits of well-sorted sand (Santa Margarita formation) occurring near the mouth of Newell Creek might be usable in the pervious sections of a dam. Material suitable for use as rockfill or riprap is not readily available at or near the site.

The dam for the Newell Creek site, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 940 feet, a crest width of 28 feet, and upstream and downstream slopes of 2.5:1. The impervious core would have a top width of 15 feet and 0.75:1 slopes. The upstream slope of the dam would be faced with a 3-foot layer of riprap, and the dam would have an estimated volume of fill of 1,293,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the left abutment of the dam, and discharging through a chute into Newell Creek about 400 feet below the dam. It would have a capacity of 8,500 second-feet required for an estimated discharge of about 950 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 6 feet and an additional 4 feet of freeboard would be provided. Water would be released from the reservoir through a 24-inch diameter steel pipe encased in concrete and placed in a trench excavated beneath the dam. Releases would be controlled by gates in an inclined inlet structure on the slope of the right abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with four 18-inch gate valves hydraulically operated from a control house at the top of the structure.

The reservoir area is unimproved, and there are no roads or utilities that would require relocation. The native vegetation consists of dense growth of brush, oak and second-growth redwood.

The capital cost of the Newell Creek Dam and Reservoir, based on prices prevailing in the fall of 1952, was estimated to be about $2,204,000. Corresponding annual costs were estimated to be about $89,600. The resultant estimated average unit cost of the 2,700 acre-feet of water per season conserved by the reservoir was about $33.20 per acre-foot at the dam. Detailed cost estimates of the Newell Creek Dam and Reservoir are presented in Appendix K.

Doyle Gulch Dam, Reservoir, and San Lorenzo River Diversion (14,500 Acre-Foot Reservoir Storage Capacity)

As regards location and general features, this plan is similar to that described in the section on the Doyle Gulch Project in Chapter IV of this bulletin, but includes a reservoir of 14,500 acre-foot storage capacity in Doyle Gulch, rather than one of 5,600 acre-foot capacity as described under the Doyle Gulch Project. The construction of a dam at the Doyle Gulch site to an elevation of 320 feet, with spillway crest at an elevation of 314 feet, would create a reservoir having a storage capacity of 14,500 acre-feet, including 100 acre-feet of dead storage. With capacity of diversion works on the San Lorenzo River, and conduit capacity of 50 second-feet, the estimated safe seasonal yield of the reservoir would be about 13,200 acre-feet. Principal features of the Doyle Gulch Dam with 14,500 acre-foot reservoir capacity are shown on Plate L-13 entitled "Doyle Gulch Dam on Doyle Gulch (Reservoir Storage Capacity of 14,500 Acre-feet)."

Areas and capacities of the reservoir at various stages of water surface elevation, a discussion of geology of the dam site, and descriptions of the diversion conduit and reservoir sites are presented in the section of Chapter IV of this bulletin on the Doyle Gulch Project.

In general, the diversion works on the San Lorenzo River would be the same as those described for the Doyle Gulch Project. However, water would be pumped from the sand trap by a battery of 6 electrically driven, horizontal centrifugal pumping units, consisting of two pumps of 5 second-foot capacity, one pump of 10 second-foot capacity, and three pumps of 15 second-foot capacity. These three different sizes of pumps would be driven by 125, 250, and 350 horsepower motors, respectively. This installed pumping capacity would include 15 second-feet of capacity for standby purposes. The pumps would discharge through a manifold into a 42-inch diameter dipped and wrapped welded steel pipe that would constitute the conveyance conduit. An 8-inch check valve would be installed in the discharge line of each 5 second-foot capacity pump, and an 18-inch check valve would be installed in the discharge line of each of the four larger pumps. The design of the pumping plant at the dam would be essentially the same as that for the plant at the river.

As designed for cost estimating purposes, the dam for the Doyle Gulch site to provide reservoir storage capacity of 14,500 acre-feet would consist of a rolled earthfill structure with a crest length of about 930 feet, a crest width of 30 feet, upstream slope of 3:1, and downstream slope of 2.5:1. The impervious core would have a top width of 20 feet and 0.8:1 slopes. The dam would have an estimated volume of fill of 1,700,000 cubic yards.

The concrete-lined spillway would be similar to that described in Chapter IV for the smaller reservoir. The inlet and outlet works to the reservoir would likewise be similar to those described for the Doyle Gulch Project, but would include a 36-inch diameter steel pipe beneath the dam, rather than a 30-inch diameter pipe.

The capital cost of the Doyle Gulch Dam, Reservoir, and San Lorenzo River Diversion, with reservoir storage capacity of 14,500 acre-feet, based on prices prevailing in the fall of 1952, was estimated to be about $3,510,000. Corresponding annual costs were estimated to be about $176,500. The resultant estimated average unit cost of the 13,200 acre-feet of water per season conserved by the reservoir was about $13.40 per acre-foot at the dam. Detailed cost estimates of the Doyle Gulch Dam, Reservoir, and San Lorenzo River Diversion, with 14,500 acre-foot reservoir storage capacity, are presented in Appendix K.

SOQUEL UNIT

Soquel Creek Dam and Reservoir

This dam site is located on Soquel Creek about four miles north of the town of Soquel, in the southwest quarter of Section 23, Township 10 South, Range 1 West, M. D. B. & M., where the stream bed elevation is about 195 feet. The construction of a dam at the site to an elevation of 402 feet, with spillway crest at an elevation of 390 feet, would create a reservoir having a storage capacity of about 31,000 acre-feet, including 100 acre-feet of dead storage. The estimated mean seasonal runoff from the drainage area of about 31.5 square miles above the dam site is about 38,600 acre-feet. The estimated safe seasonal yield of the reservoir would be about 18,300 acre-feet. Principal features of the Soquel Creek dam are shown on Plate L-14 entitled "Soquel Creek Dam on Soquel Creek."

Topography of the Soquel Creek dam and reservoir sites was obtained from reconnaissance plane table surveys made by the Division of Water Resources in 1949. The dam site was mapped to a scale of 1 inch to 200 feet, with contour interval of 5 feet, and the reservoir area was mapped to a scale of 1 inch to 500 feet, with contour interval of 20 feet. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation:

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
195	0	0
220	3	34
240	16	226
260	44	822
280	94	2,200
300	138	4,530
320	205	7,960
340	278	12,800
360	347	19,000
380	430	26,800
390	470	31,000
400	490	36,000

The area surrounding the Soquel Creek dam site is underlain by a thick series of marine sediments of Pliocene age (Purisima formation). These are capped in many places by Quaternary terrace gravels and on the valley floor of Soquel Valley are covered by a thin mantle of Recent alluvium. Granitic Coast Range basement complex rock is exposed nearby in isolated outcrops. The rock at the site consists primarily of soft and only slightly consolidated fine-grained sandstones and siltstones. These are thickly bedded and intercalated with occasional layers of thin shales and pebble conglomerates. Large numbers of Pliocene marine shell casts and fragments were noted in some horizons of the sandstone series. Well-defined terrace gravel deposits up to 15 feet in depth cap these sediments in several places on both abutments. The sandstones have been disturbed to some extent both by folding and by minor shearing. Folds are in the nature of gentle warps, however, and do not materially affect the general attitude of the beds which dip downstream and slightly into the left abutment. Shears as noted were generally tight and no gouge was found. Jointing is also developed to a minor extent in these rocks, but separation is slight and moderate grouting should prevent excessive leakage along the joints. The area is one of considerable seismic activity. The granitic outcrop two miles north of the site is apparently an upthrown block between two intersecting faults of major importance. The San Andreas fault zone passes six miles to the north of the site and activity along this fault locally in recent geologic times seems probable.

It is estimated that stripping requirements under the impervious section of an earthfill dam would include about 8 feet of soil and loose rock and 3 feet of soft sandstone bedrock from the left abutment, about 5 feet of sand and gravel and 2 feet of soft sandstone bedrock from the channel section, and about 6 feet of soil, loose rock, and humus, and 3 feet of soft sandstone and associated bedrock from the right abutment. The only material salvageable from these stripping operations would be a small quantity of alluvium, usable as impervious fill, located on the flats of the lower left abutment. Other potential sources of impervious fill material exist from one-half to two miles downstream on the floor of the valley. Large supplies of earthfill material are also available from terraces along both edges of the valley. Quantities of granitic rock suitable for use in the impervious section (where decomposed) and for riprap exist at a quarry on the east slope of Sugarloaf Mountain, about two miles upstream from the site.

The dam for the Soquel Creek site, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 1,850 feet, a crest width of 30 feet, 3:1 upstream slope, and 2.5:1 downstream slope. The impervious core would have a top width of 10 feet and 1:1 slopes, and the upstream slope of the dam would be faced with a 3-foot layer of riprap. The dam would have an estimated volume of fill of 4,630,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the left abutment of the dam, and discharging through a chute into Soquel Creek about 800 feet below the dam. It would have a capacity of 21,600 second-feet required for an estimated discharge of about 680 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 8 feet, and an additional 4 feet of freeboard would be provided. Water would be released from the reservoir through a 48-inch diameter steel pipe encased in concrete and placed in a trench excavated beneath the dam. Releases would be controlled by gates in an inclined inlet structure on the slope of the right abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with six 18-inch gate valves hydraulically operated from a control house at the top of the structure.

The reservoir area is largely covered by brush, oak, and second-growth redwood. Improvements consist of about 40 permanent residences and more than 100 cottages and cabins occupied during summer months and on weekends. Construction of a reservoir at this site would necessitate the relocation of about 11 miles of county roads, and electric power lines and telephone lines.

The capital cost of the Soquel Creek Dam and Reservoir, based on prices prevailing in the fall of 1952, was estimated to be about $9,794,000. Corresponding annual costs were estimated to be about $393,200. The resultant estimated average unit cost of the 18,300 acre-feet of water per season conserved by the reservoir was about $21.50 per acre-feet at the dam. Detailed cost estimates of the Soquel Creek Dam and Reservoir are presented in Appendix K.

Aptos Creek Dam and Reservoir

This dam site is located on Aptos Creek about 1 mile north of the Town of Aptos, in the northwest quarter of Section 7, Township 11 South, Range 1 East, M. D. B. & M., where the stream bed elevation is about 44 feet. The construction of a dam at the site to an elevation of 176 feet, with spillway crest at an elevation of 164 feet, would create a reservoir having a storage capacity of about 4,100 acre-feet, including 160 acre-feet of dead storage. The estimated mean seasonal runoff from the drainage area of about 10.7 square miles above the dam site is about 7,800 acre-feet. The estimated safe seasonal yield of the reservoir would be about 2,300 acre-feet. Principal features of the Aptos Creek Dam are shown on Plate L-15 entitled "Aptos Creek Dam on Aptos Creek."

Topography of the Aptos Creek dam and reservoir sites was obtained from reconnaissance plane table surveys made by the Division of Water Resources in 1952. A topographic map of the dam site was prepared at a scale of 1 inch to 200 feet, with contour interval of 20 feet, and one of the reservoir site was prepared to a scale of 1 inch to 400 feet, with contour interval of 20 feet. An assumed datum was utilized in the preparation of the maps, and a correction of 6 feet should be subtracted from the elevations shown, to convert to U. S. G. S. datum. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation:

Water surface elevation, in feet *	*Area, in acres*	*Capacity, in acre-feet*
44	0	0
80	4	46
100	16	244
120	33	726
140	69	1,750
160	114	3,580
164	122	4,100
180	159	6,320
200	216	10,100

* To obtain elevations on U.S.G.S. datum, subtract 6 feet from elevations shown.

The bedrock at the Aptos Creek dam site is a massive gray-colored sandstone which is harder than the typical Purisima sandstone found elsewhere in the region. No joints or shears of major importance were found in the rock. Bedding is almost nonexistent at the site, although quite prominent at other places nearby where the Purisima outcrops. This material should prove satisfactory for the foundation of an earthfill type of dam. Average stripping under the impervious section of the dam would consist of about 4 feet of overburden and 2 feet of weathered sandstone on both abutments. In the channel stripping would consist of about 4 feet of gravels along the narrowest section and 10 feet of gravels and silt elsewhere. Only the overburden need be removed from beneath the pervious dam sections on the abutments. The typical soil of this region is rich in humus and black in color. It has been deeply penetrated by the roots of myriads of trees and plants which form a tangled mass for several feet immediately beneath the ground surface. However, there is a good possibility that a small amount of this material, relatively free of organic matter and suitable for use in a minimum impervious section, can be found within a mile of the site. The Purisima sandstone might be usable to a limited extent in the pervious sections of the dam. This rock could readily be quarried in the immediate vicinity of the site.

The dam for the Aptos Creek site, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 1,020 feet, a crest width of 28 feet, and upstream and downstream slopes of 2.5 : 1. The impervious core would have a top width of 10 feet and 1 : 1 slopes, and the upstream slope of the dam would be faced with a 3-foot layer of riprap. The dam would have an estimated volume of fill of 601,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the left abutment of the dam, and discharging through a chute into Aptos Creek about 400 feet below the dam. It would have a capacity of 9,600 second-feet required for an estimated discharge of about 900 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 8 feet and an additional 4 feet of freeboard would be provided. Water would be released from the reservoir through a 30-inch diameter steel pipe encased in concrete and placed in a trench excavated beneath the dam. Releases would be controlled by gates in an inclined inlet structure on the slope of the right abutment upstream from the dam. This structure would consist of a 48-inch diameter steel pipe encased in concrete, and would be provided with three 18-inch gate valves hydraulically operated from a control house at the top of the structure.

The land in the reservoir area is covered by oak, brush, and second-growth redwood. Improvements consist of a few cottages with outbuildings and several small cabins. About 2 miles of county fire road and 6,000 feet of telephone cable would require relocation.

The capital cost of the Aptos Creek Dam and Reservoir, based on prices prevailing in the fall of 1952, was estimated to be about $1,406,000. Corresponding annual costs were estimated to be about $58,200. The resultant estimated average unit cost of the 2,300 acre-feet of water per season conserved was about $25.30 per acre-foot at the dam. Detailed cost estimates of the Aptos Creek Dam and Reservoir are presented in Appendix K.

PAJARO UNIT

Pinto Lake Dam, Reservoir, and Corralitos Creek Diversion

This project contemplates the diversion of winter flow of Corralitos Creek, conveyance of the water to off-stream storage in a reservoir created by enlarging Pinto Lake, and later release of the water for use during the irrigation season. The diversion site is located about 3.5 miles northwest of Watsonville, in the southwest quarter of Section 19, Township 11 South, Range 2 East, M. D. B. & M., where the stream bed elevation is about 135 feet. An unlined earth canal would convey the diverted water a distance of about 2 miles to Pinto Lake. The dam site at Pinto Lake is located about 2.5 miles north of Watsonville, in the northeast quarter of Section 29, Township 11 South, Range 2 East, M. D. B. & M., where the stream bed elevation is about 103 feet. The construction of a dam at the site to an elevation of 137 feet, with spillway crest at an elevation of 130 feet, would create a reservoir having a storage capacity of about 4,800 acre-feet, including 1,600 acre-feet of dead storage. Estimated mean seasonal runoff from the approximately 23 square miles of drainage area above the diversion point on Corralitos Creek is about 9,500 acre-feet. The estimated safe seasonal yield of the reservoir and diversion would be about 1,100 acre-feet. Runoff from the 2.4 square miles of drainage area above the Pinto Lake dam site is small and was not taken into account in the yield studies. Principal features of the Pinto Lake Dam are shown on Plate L-16 entitled "Pinto Lake Dam." Locations of diversion point and conduit are shown on Plate 19.

The diversion works on Corralitos Creek would include a 30-foot wide reinforced-concrete open weir structure across the creek, divided by 2-foot wide concrete piers into four 6-foot openings. The openings would be provided with removable flashboards. The top of the weir structure would be at an elevation of 146 feet, and the elevation of the weir crest with flashboards removed would be about 135 feet. Waters of Corralitos Creek would be diverted at the left abutment of the weir structure through two 4-foot square slide gates in a reinforced-concrete headwall and into a reinforced-concrete sand trap. The sand trap would be about 24 feet by 16 feet, and would be compartmented by two vertical baffle walls. Three 1-foot square slide sluice gates would be provided, one for each compartment of the sand trap. From the sand trap the diverted water would enter an unlined canal with capacity of 130 second-feet. The canal would be of trapezoidal section, with bottom width of 12 feet, depth of water of 4 feet, freeboard of 1 foot, side slopes of 1.5 : 1, and a slope of 1 foot per mile. The canal would be approximately 10,700 feet in length, leading in a southeasterly direction from the sand trap to a terminus near the right abutment of Pinto Lake Dam. Water surface elevation at the terminus of the canal would be approximately 138 feet. From this point a short semi-circular metal flume would carry the water into Pinto Lake Reservoir.

A topographic map of the Pinto Lake dam and reservoir sites and the conduit route, at a scale of 1 inch to 500 feet, with contour interval of 20 feet, was made by the Division of Water Resources in 1950, based on a plane table survey. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation.

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
109	121	1,600
110	125	1,720
120	153	3,110
130	189	4,820
140	233	6,930

Bluffs are situated on either side of Pinto Lake to a height of about 25 feet above the present water surface of the lake. These bluffs appear to be composed of sediments of the Pliocene Purisima formation and are capped by a thin Quaternary terrace deposit. The valley in which the lake lies is filled with Quaternary alluvium. The Purisima formation in this vicinity consists chiefly of conglomerates interbedded with massive sandstones. Large amounts of leakage may be expected through this formation should the level of the lake be raised. The alluvium on the valley floor is probably 40 or 50 feet thick and is underlain by Purisima sediments. About four feet of stripping from both the channel section and the abutments would be required. Construction materials are plentiful in the vicinity. The valley alluvium either upstream or immediately downstream from the lake could be used as impervious fill. The Purisima sediments or terrace gravels on either side of the lake might be usable in the pervious sections.

The dam at the Pinto Lake site, as designed for cost estimating purposes, would consist of a rolled earthfill impervious structure with a crest length of about 1,750 feet, a crest width of 10 feet, upstream slope of 3 : 1, and downstream slope of 2.5 : 1. The upstream slope of the dam would be faced with a 3-foot layer of riprap and the downstream slope with a 2-foot layer of the same material. The dam would have an estimated volume of fill of 102,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located across the right abutment of the dam, and discharging through a chute and wasteway into Corralitos Creek about a mile below the dam. Estimates of cost of the wasteway were not made. It would have a capacity of 1,500 second-feet required for an estimated discharge of about 880 second-feet per square mile of drainage area above the dam. The maximum depth of water above the spillway lip would be 3 feet and an additional 4 feet of freeboard would be provided. Water would be released from the reservoir through an 18-inch diameter steel pipe encased in concrete and placed in a trench excavated beneath the dam. Releases would be controlled by a 12-inch square slide gate, manually operated by a steel rod supported on concrete footings upstream from the right abutment of the dam.

The reservoir area includes the existing lake which has a surface area of about 120 acres and a storage capacity of 1,600 acre-feet. The remainder of the reservoir area is covered by water-loving vegetation and brush. Several diversion works and boat landings exist around the edge of the present reservoir, and lands along the west side of the lake are used as picnic grounds.

The capital cost of the Pinto Lake Dam, Reservoir, and Corralitos Creek Diversion, based on prices prevailing in the fall of 1952, was estimated to be about $560,000. Corresponding annual costs were estimated to be about $23,700. The resultant estimated average unit cost of the 1,100 acre-feet of water conserved by the reservoir was about $21.50 per acre-foot at the dam. Detailed cost estimates of the Pinto Lake Dam, Reservoir, and Corralitos Creek Diversion are presented in Appendix K.

Elkhorn Slough Dam, Reservoir, and Pajaro River Diversion

Elkhorn Slough Dam and Reservoir would be located on Elkhorn Slough, at a site about four miles southeast of Watsonville. A small auxiliary dam would be required on the northerly rim of the reservoir. Surplus winter flow of the Pajaro River would be diverted at a point on that stream about 4.5 miles east of Watsonville, and conveyed in an unlined canal about 1.7 miles in length to a pumping plant on the south side of the valley, about 3.5 miles southeast of Watsonville. From this pumping plant the water would be lifted into the upstream end of Elkhorn Slough Reservoir, for temporary storage and later release to Pajaro Valley. The released water would return to the Pajaro River through the canal to the original point of diversion, on the Pajaro River, for downstream diversion and use.

Principal features of the Elkhorn Slough Dam are shown on Plate L-17 entitled "Elkhorn Slough Dam on Elkhorn Slough." The dam site would be located in the southeast quarter of Section 28, Township 12 South, Range 2 East, M. D. B. & M., where the stream bed elevation is about 10 feet. The elevation of the water surface at the point of diversion on the Pajaro River is about 46 feet and the minimum water surface elevation in Elkhorn Slough Reservoir would be about 45 feet. Locations of the diversion weir, canal, and pumping plant are shown on Plate 19.

The construction of a dam at the Elkhorn Slough site to an elevation of 158 feet, with spillway crest at an elevation of 150 feet, would create a reservoir having a storage capacity of about 117,000 acre-feet, including 3,500 acre-feet of dead storage. Estimated mean seasonal impaired runoff of the Pajaro River from the approximately 1,200 square miles of drainage area above the point of diversion is about 150,000 acre-feet. The estimated safe seasonal yield of the reservoir would be about 26,500 acre-feet.

The diversion works on the Pajaro River would include a concrete gravity weir structure located in the southeast quarter of Section 7, Township 12 South, Range 3 East, M. D. B. & M. The structure would include a fixed ogee overflow weir section with length of 60 feet, and two weir sections controlled by bascule gates, each with a length of 40 feet. The top of the weir structure would be at an elevation of 60 feet. Elevation of the crest of the fixed section of the weir would be 46 feet, and elevation of the crest of the gated sections with the gates lowered would be 40 feet.

Waters of the Pajaro River would be diverted at the left abutment of the weir structure through two 5-foot square slide gates in a reinforced-concrete headwall and into a reinforced-concrete sand trap. The sand trap would be 20 feet by 20 feet and would be compartmented by two vertical baffle walls. Three 2-foot square slide sluice gates would be provided, one for each compartment of the sand trap.

From the sand trap the diverted water would enter an unlined canal with capacity of 200 second-feet. The canal would be of trapezoidal section, with bottom width of 10 feet, depth of water of 6 feet, side slopes of 1.5 : 1, and would have a flat grade. The canal would be approximately 9,200 feet in length, leading in a southerly direction from the sand trap to the bottom of the bluff bounding Pajaro Valley on the south, and terminating in the northwest quarter of Section 19, Township 12 South, Range 3 East, M. D. B. & M.

At the terminus of the canal a pumping plant would lift the water through a 72-inch diameter steel pipe to Elkhorn Slough Reservoir. The pipe line would pass beneath the auxiliary dam on the northern rim of Elkhorn Slough Reservoir, and would be entrenched in the dam foundation and encased in concrete. At its reservoir end the pipe line would divide into two 54-inch diameter pipe outlets, each of which would contain a 48-inch diameter butterfly valve, hydraulically controlled from the top of the auxiliary dam. The pumping plant would consist of a battery of five pumps, two with capacities of approximately 27 second-feet, two with capacities of approximately 55 second-feet, and one of about 110 second-foot capacity. A check valve would be installed in the discharge line of each pump. The maximum flow line in Elkhorn Slough Reservoir would be at an elevation of about 154 feet, and elevation of the water surface at the intake of the pumping plant would be about 44 feet. The plant was designed for an average pumping head of approximately 90 feet. Water would be released from the reservoir through the 72-inch diameter steel pipe passing beneath the auxiliary dam and would by-pass the pumping plant and be returned to the canal.

Topography of the Elkhorn Slough dam site was determined from a plane table survey made by the Division of Water Resources in 1952. The dam site was mapped to a scale of one inch to 200 feet, with 10-foot contour interval. Topography of Elkhorn Slough Reservoir was determined from the U. S. G. S. San Juan Bautista Quadrangle, scale 1 : 62,500, with 25-foot contour interval. Areas and capacities of the reservoir at various stages of water surface elevation are given in the following tabulation:

Water surface elevation, in feet	*Area, in acres*	*Capacity, in acre-feet*
10	0	0
25	31	75
50	355	4,890
75	668	17,900
100	1,060	39,700
125	1,470	72,000
150	2,030	117,000
175	2,550	168,500

The Elkhorn Slough dam site lies in an area underlain by the Aromas formation of Pleistocene age. The formation outcrops on both abutments at the site, but is overlain by about 60 feet of Quaternary fill across the bottom of the channel section. A few thin layers of sandy clay are intercalated with the thick sand beds generally comprising the Aromas. The formation, being composed chiefly of sand with little cementation, has a tendency to slide or "run" when saturated. Well logs from the valley floor of Elkhorn Slough indicate that most of the Quaternary fill lying beneath the top soil and above the top of the Aromas formation consists of a blue clay. It seems likely that an earthfill dam could be founded on this clay, which is about 50 feet thick, but a backfilled cutoff trench would probably have to be provided under the entire impervious section of the dam. Grouting of the channel or abutment foundation materials would not be possible.

Stripping under the impervious section across the channel section would consist of about 15 feet of soil and clay. Stripping under the pervious sections would include about 5 feet of soil. About 8 feet of soil and sand would have to be stripped from the abutments, since the Aromas sediments would not improve appreciably beneath that depth.

Large quantities of earth could be obtained from flats of the reservoir area which would be suitable for use in an impervious section. Rock suitable for use as rockfill or riprap is not locally available. Ample material, both residual and alluvial, suitable for the pervious sections of the dam, is available in the immediate vicinity of the site. Riprap would probably have to be imported from the granite quarry at Pajaro Gap.

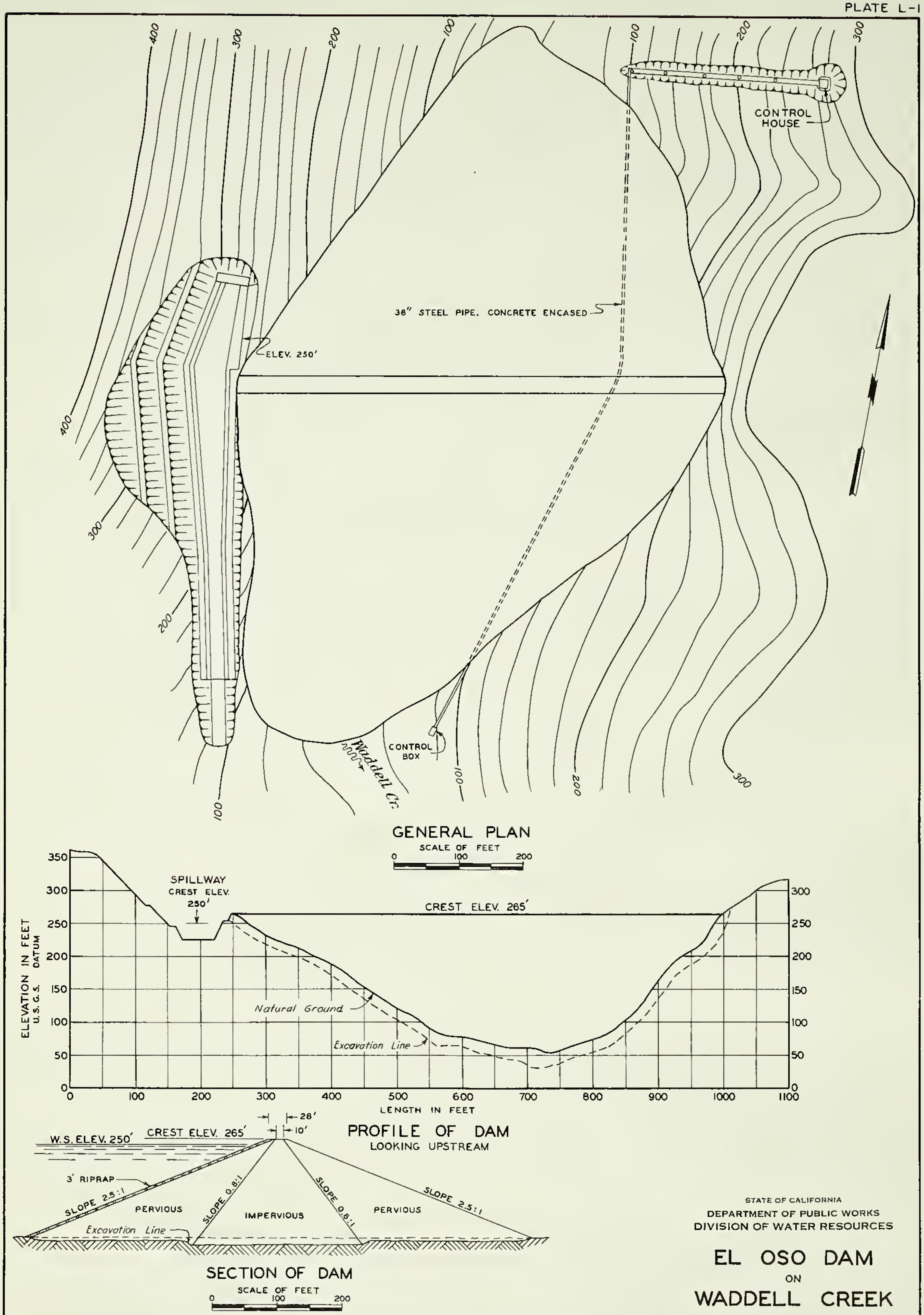
The dam for the Elkhorn Slough site, as designed for cost estimating purposes, would consist of a rolled earthfill structure with a crest length of about 4,000 feet, a crest width of 30 feet, and upstream slope of 3:1 and downstream slope of 2.5:1. The impervious section would have a top width of 20 feet, and 3:1 upstream and 1:1 downstream slopes, and the upstream slope of the dam would be faced with a 3-foot layer of riprap. The dam would have an estimated fill of 5,050,000 cubic yards.

The concrete-lined spillway would be of the ogee weir type, located in a saddle about 1,500 feet north of the right abutment of the dam, and discharging through a chute into Elkhorn Slough below the dam. It would have a capacity of 4,000 second-feet required for an estimated discharge of about 135 second-feet per square mile of drainage area. The maximum depth of water above the spillway lip would be 4 feet, and an additional 4 feet of freeboard would be provided. The outlet works would consist of the inlet facilities already described, supplemented by a trash rack at the reservoir, and by a short 72-inch diameter steel pipe to by-pass the pumping plant and convey the released water to the canal. The by-pass line would contain a 60-inch diameter Howell-Bunger valve.

The auxiliary dam on the northern rim of Elkhorn Slough Reservoir would consist of a rolled earth section, with 20-foot crest width and 2:1 side slopes. Total crest length of the dam would be about 700 feet, and its maximum height of fill would be about 70 feet. The slopes of the auxiliary dam facing the reservoir would be protected with three feet of riprap. The total volume of fill of the auxiliary dam would be an estimated 76,000 cubic yards.

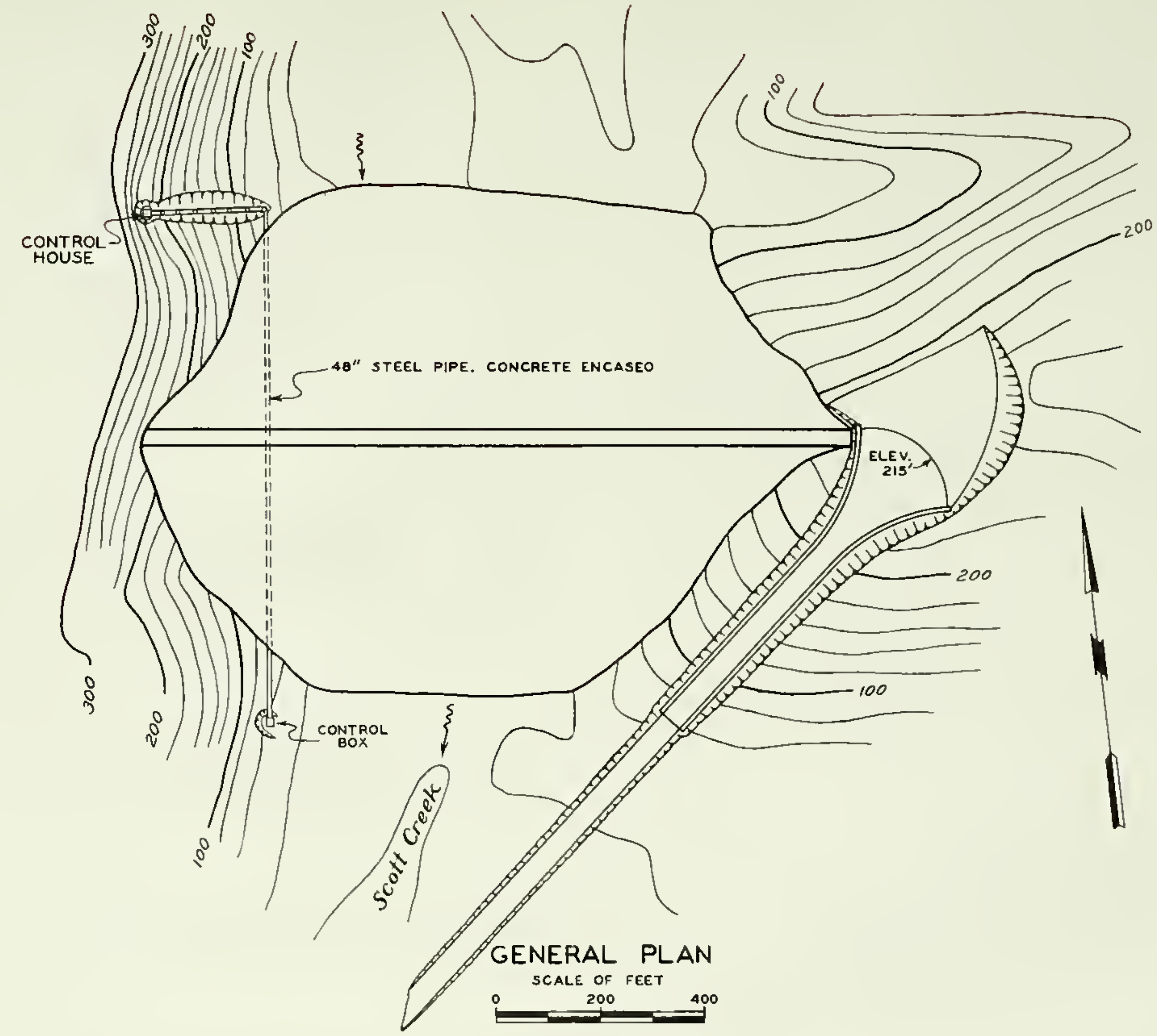
Improvements within the reservoir area include about 200 cottages and cabins, and a number of ranch-houses. The lands in the reservoir area are nearly all cultivated, with about 55 per cent devoted to cultivated field crops and pasture. The remainder of the cultivated area is devoted mostly to irrigated orchards and truck crops. Public utilities that would require relocation include about 1.5 miles of state highway, 9 miles of county roads, 5 miles of power transmission lines, and 8 miles of telephone lines.

The capital cost of the Elkhorn Slough Dam, Reservoir, and Pajaro River Diversion, based on prices prevailing in the fall of 1952, was estimated to be about $12,597,000. Corresponding annual costs were estimated to be about $541,800. The resultant estimated average unit cost of the 26,500 acre-feet of water per season conserved by the reservoir was about $20.40 per acre-foot. Detailed cost estimates of the Elkhorn Slough Dam, Reservoir, and Pajaro River Diversion are presented in Appendix K.

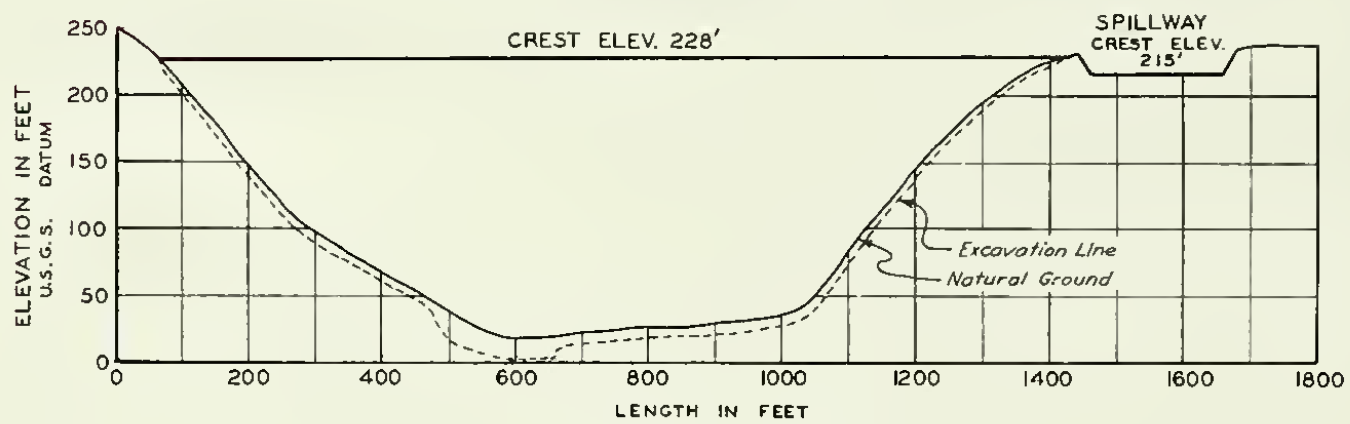


STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

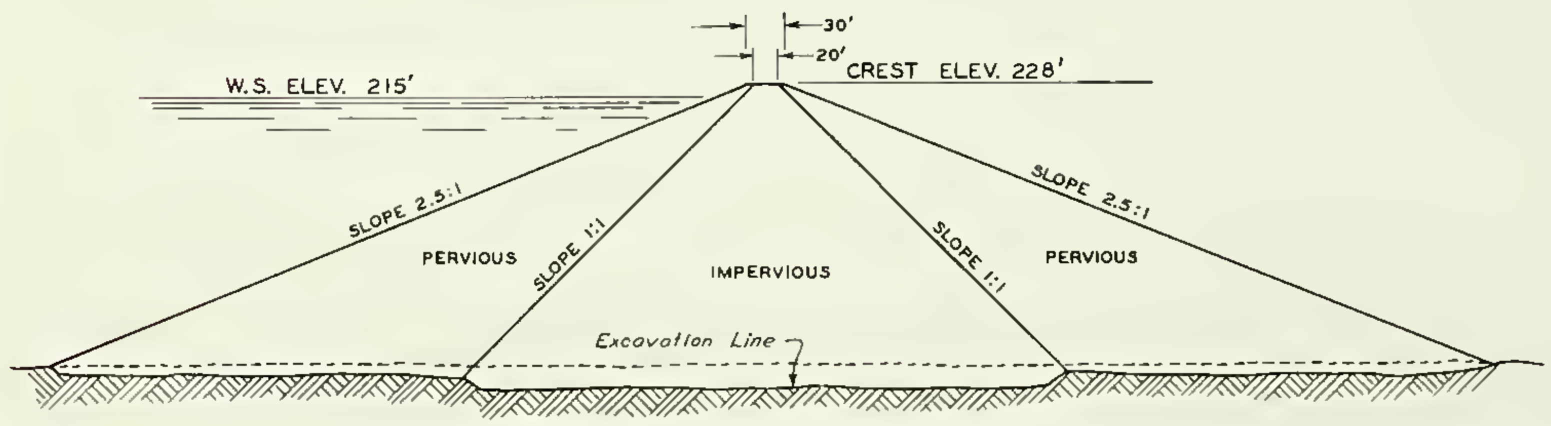
EL OSO DAM
ON
WADDELL CREEK



GENERAL PLAN
SCALE OF FEET
0 200 400



PROFILE OF DAM
LOOKING UPSTREAM



SECTION OF DAM
SCALE OF FEET
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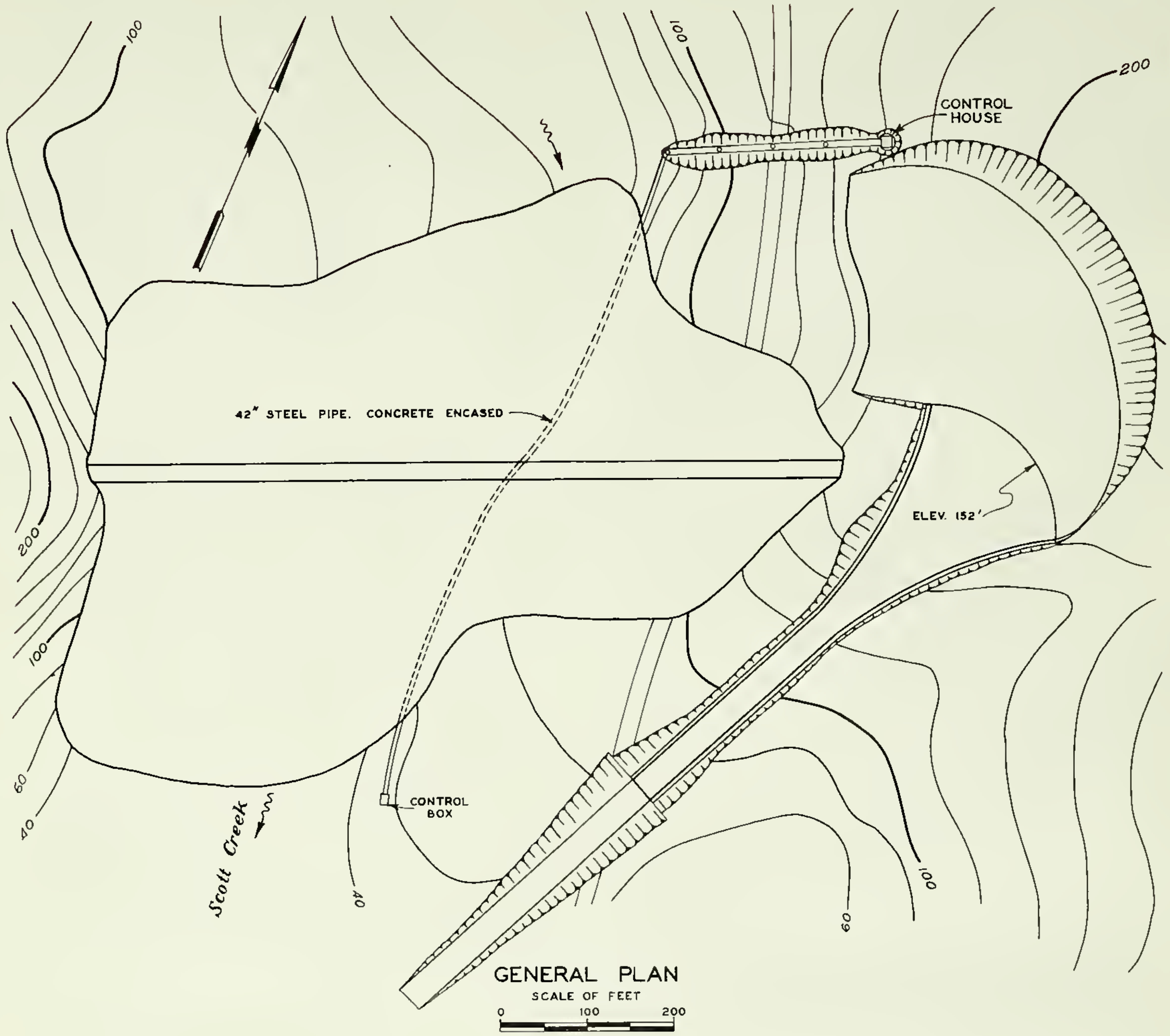
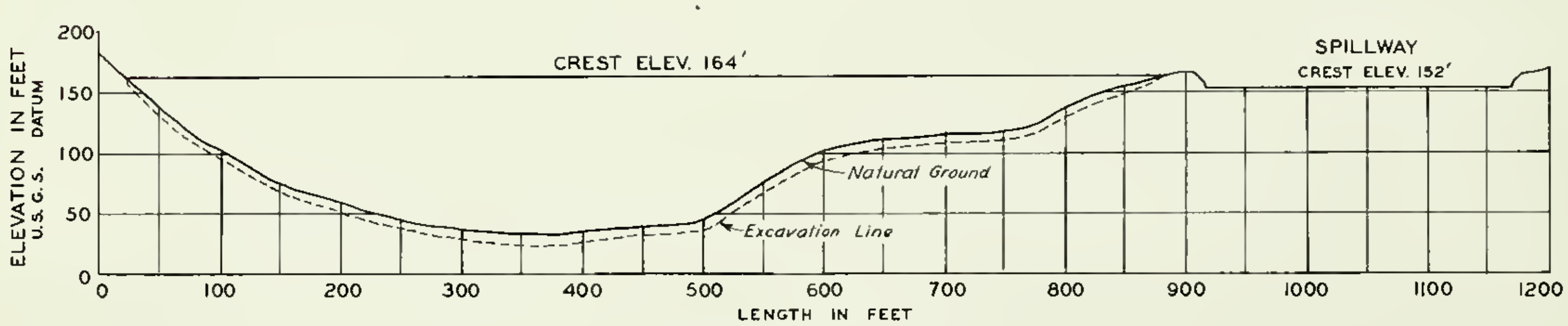
ARCHIBALD NO. I DAM
ON
SCOTT CREEK

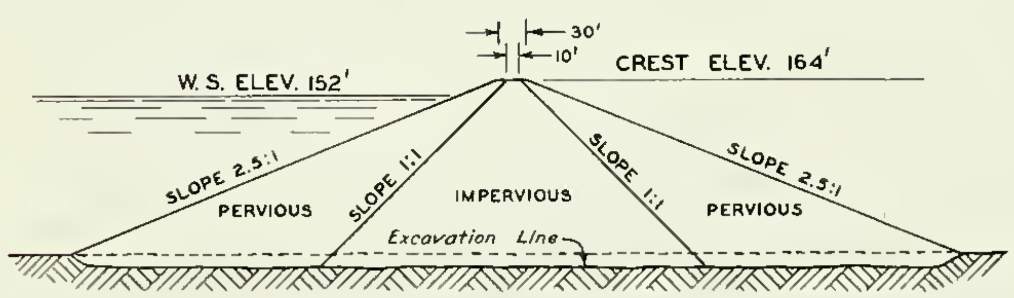


GENERAL PLAN



PROFILE OF DAM

LOOKING UPSTREAM



SECTION OF DAM

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

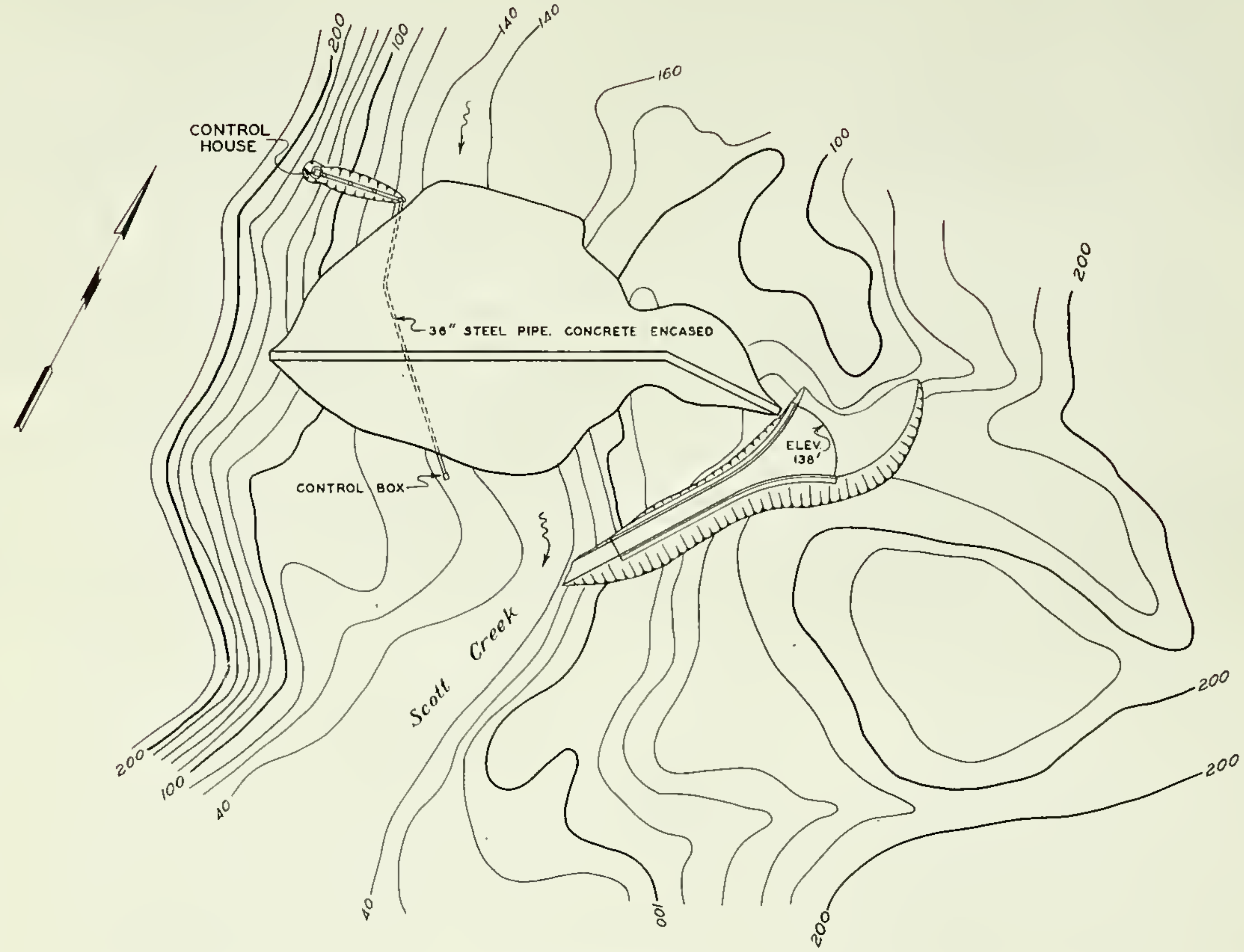
ARCHIBALD NO. 2 DAM

ON

SCOTT CREEK

RESERVOIR STORAGE CAPACITY OF 20,000 ACRE-FEET

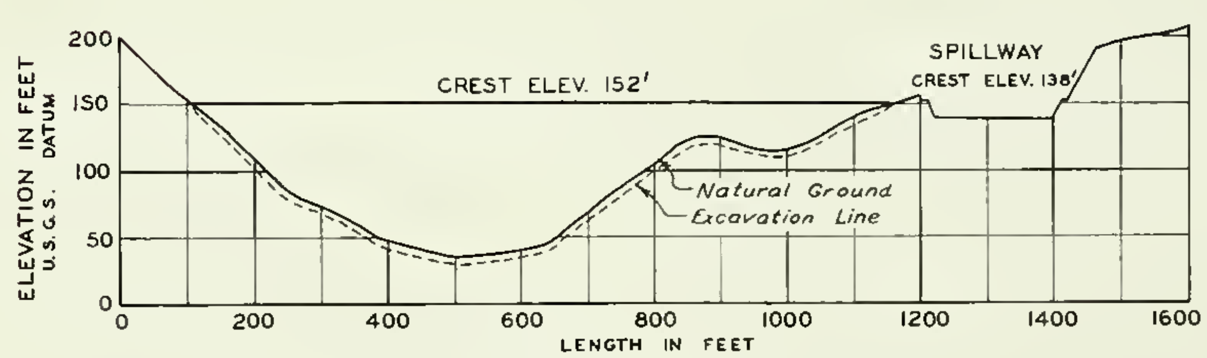
PLATE L-4



GENERAL PLAN

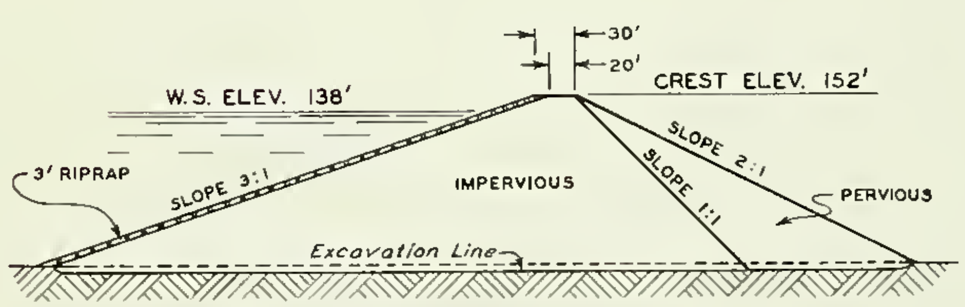
SCALE OF FEET

0 200 400



PROFILE OF DAM

LOOKING UPSTREAM



SECTION OF DAM

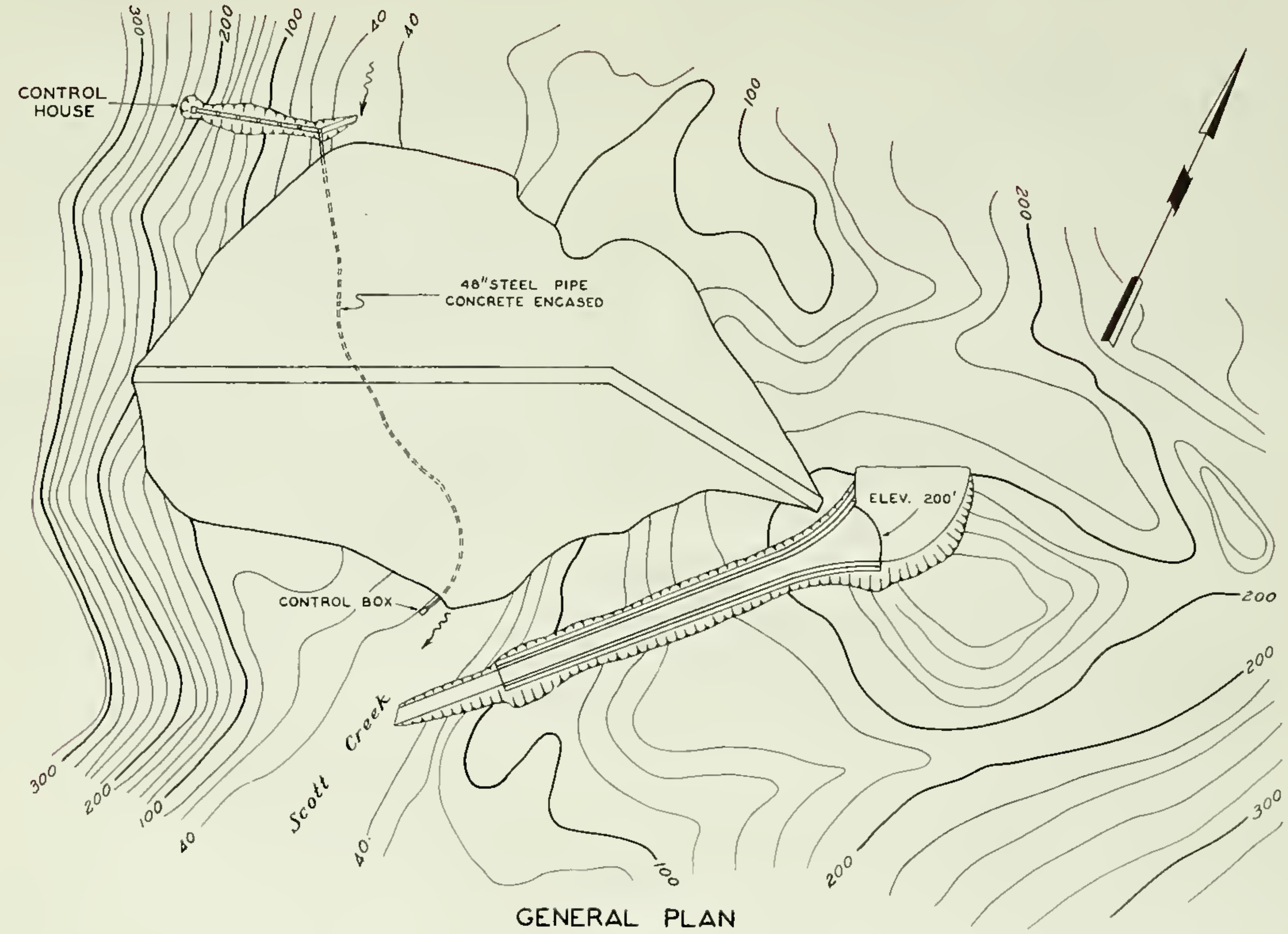
SCALE OF FEET

0 100 200

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

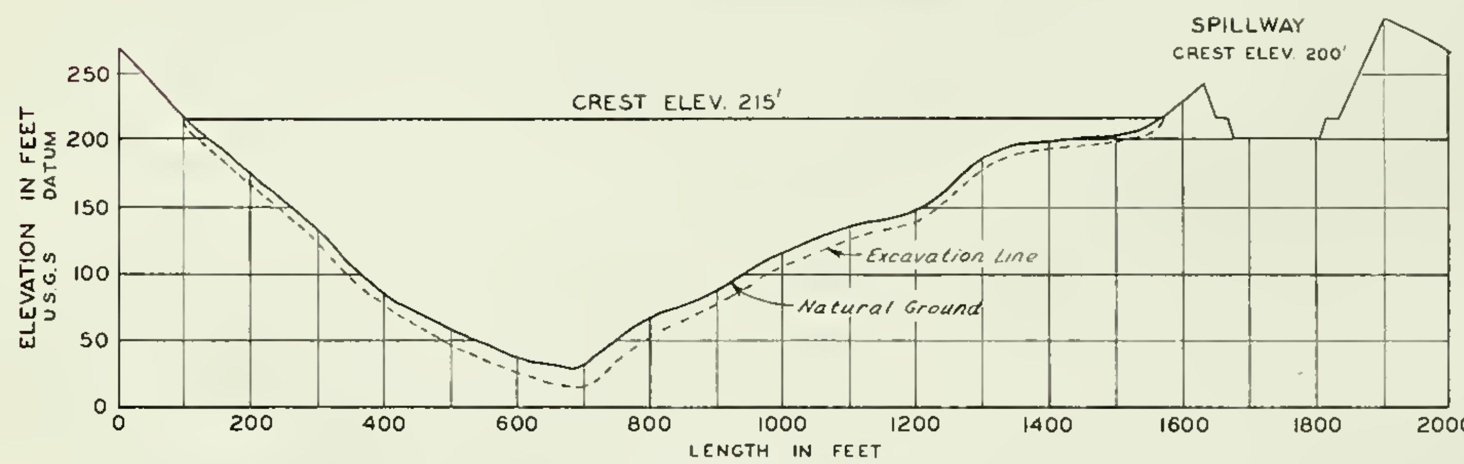
ARCHIBALD NO. 3 DAM
ON
SCOTT CREEK

RESERVOIR STORAGE CAPACITY OF 14,400 ACRE-FEET



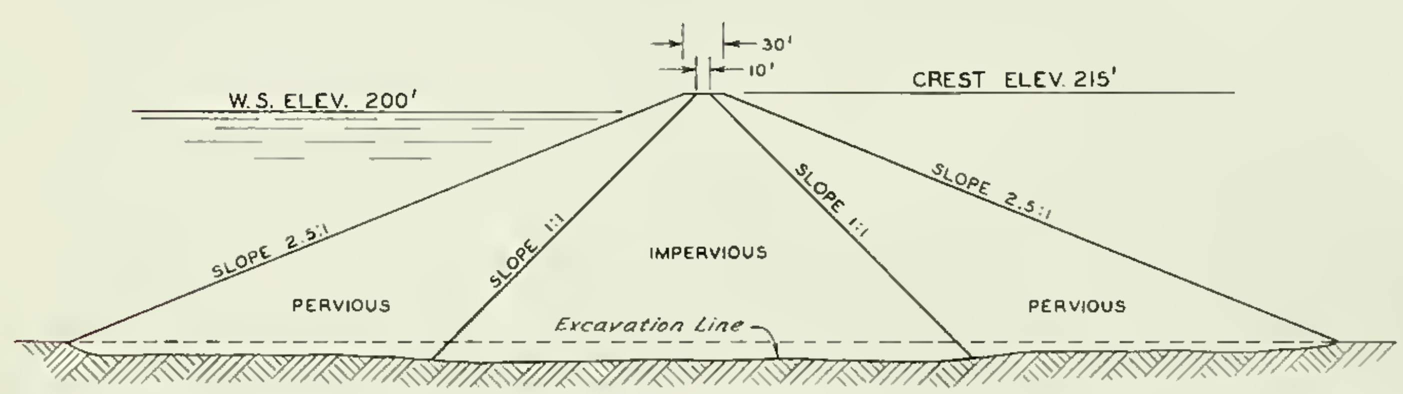
GENERAL PLAN

SCALE OF FEET



PROFILE OF DAM

LOOKING UPSTREAM



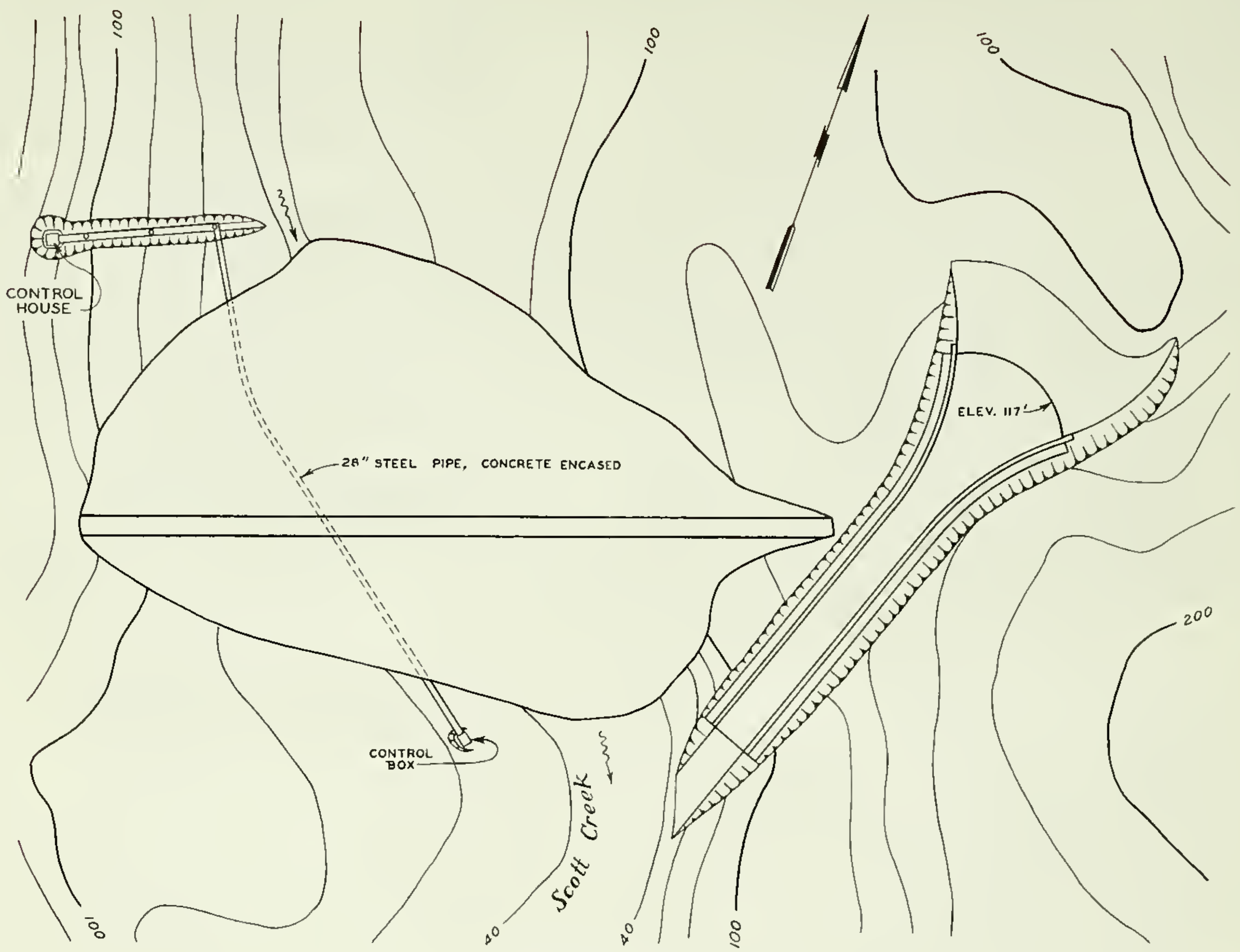
SECTION OF DAM

SCALE OF FEET

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

ARCHIBALD NO. 3 DAM
ON
SCOTT CREEK

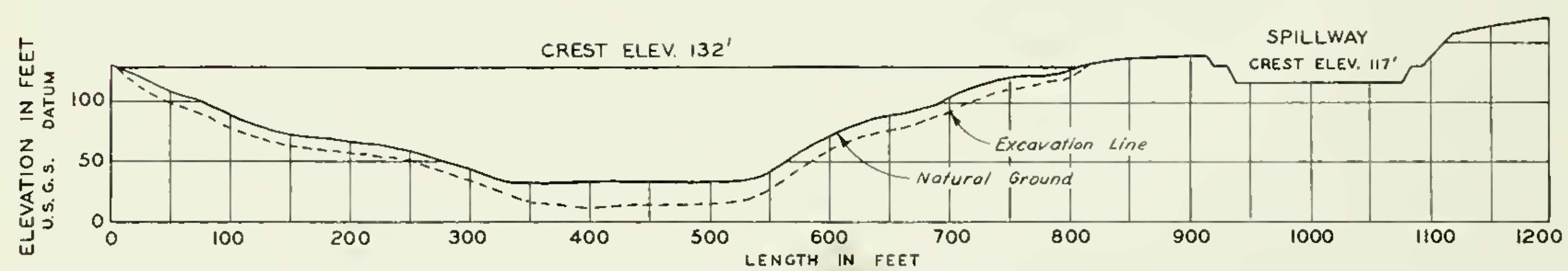
RESERVOIR STORAGE CAPACITY OF 43,200 ACRE-FEET



GENERAL PLAN

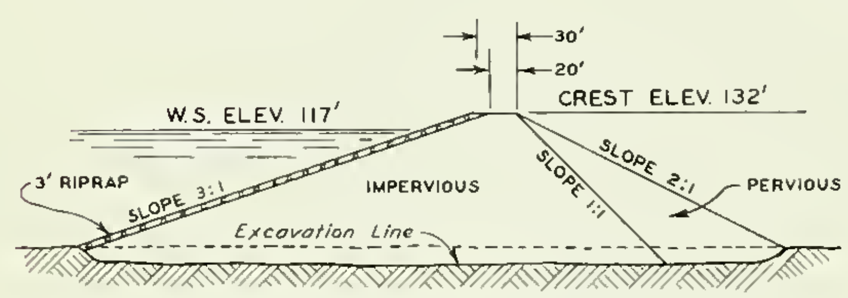
SCALE OF FEET

0 100 200



PROFILE OF DAM

LOOKING UPSTREAM



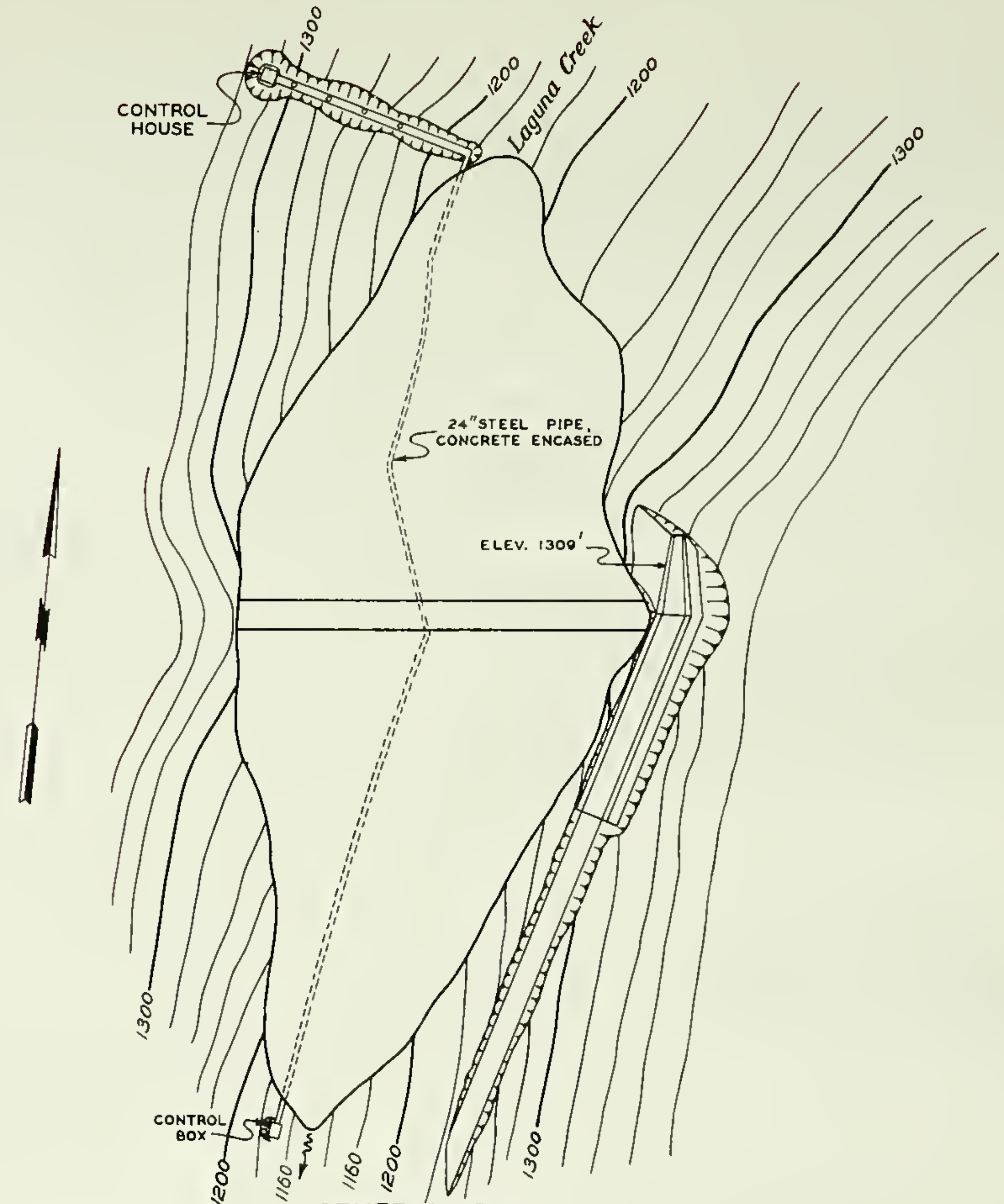
SECTION OF DAM

SCALE OF FEET

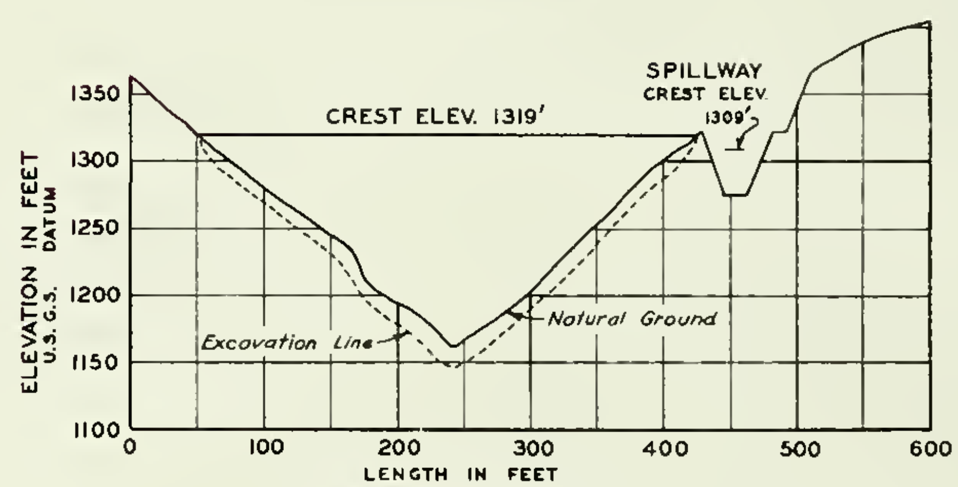
0 100 200

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

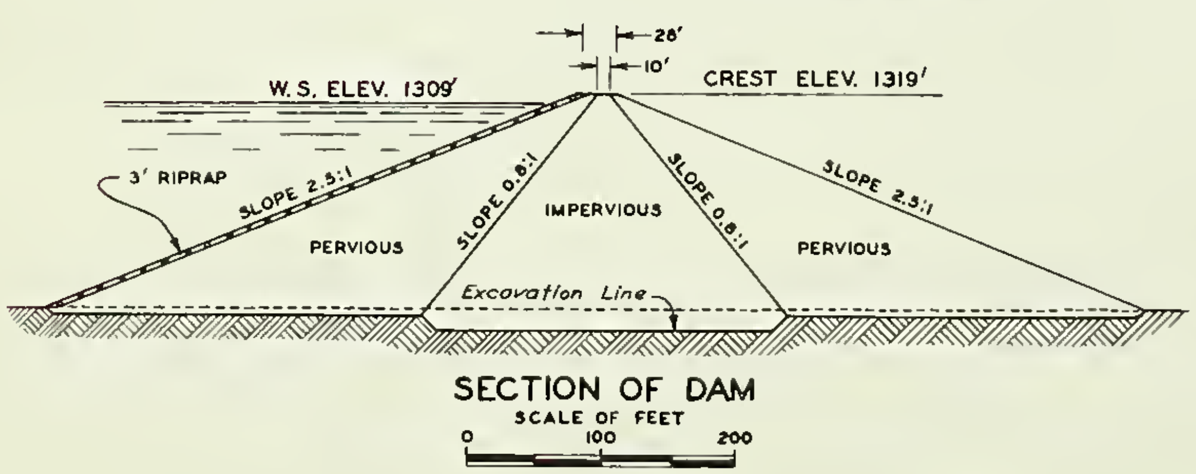
ARCHIBALD NO.4 DAM
ON
SCOTT CREEK



GENERAL PLAN



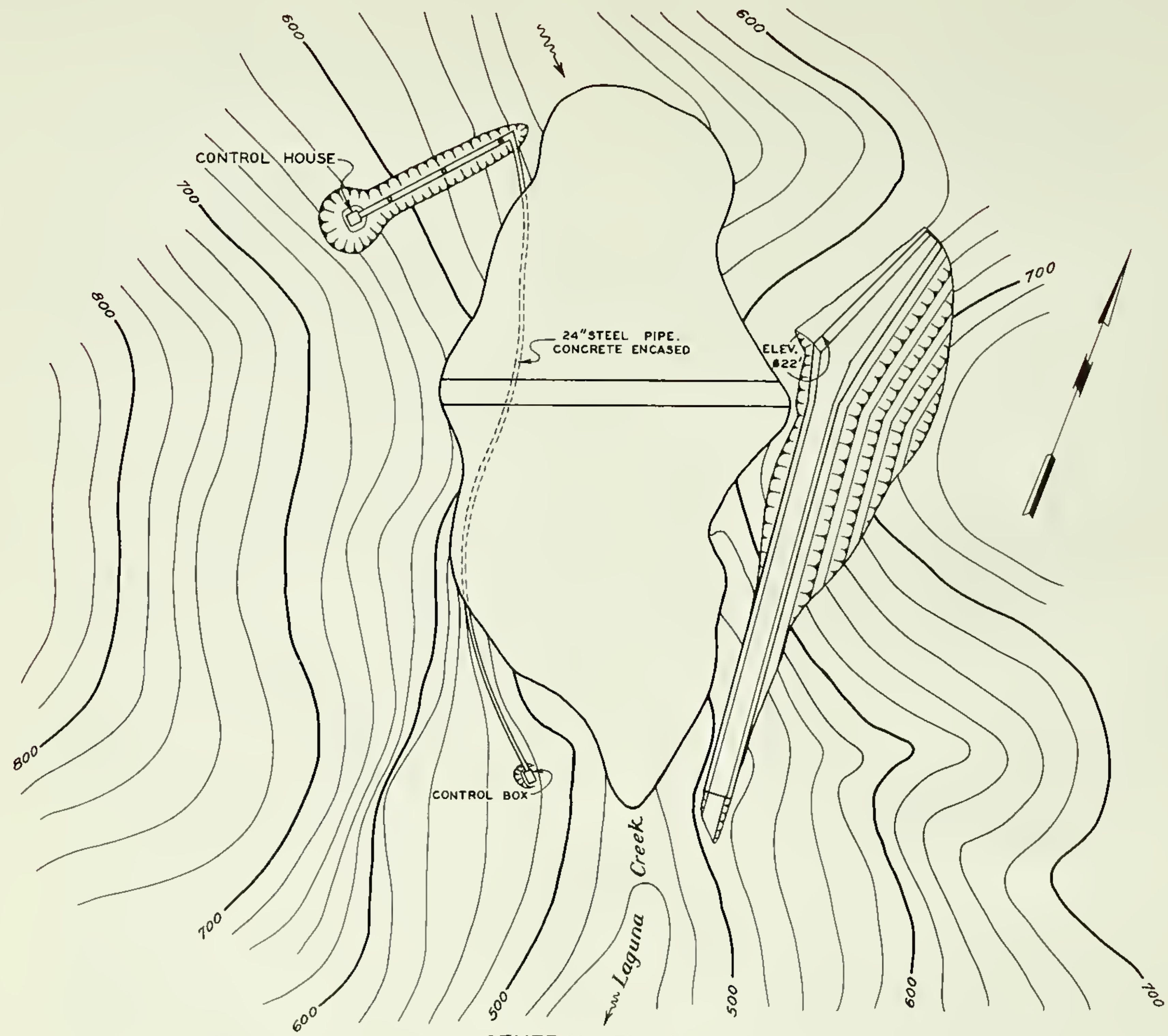
PROFILE OF DAM
LOOKING UPSTREAM



SECTION OF DAM

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

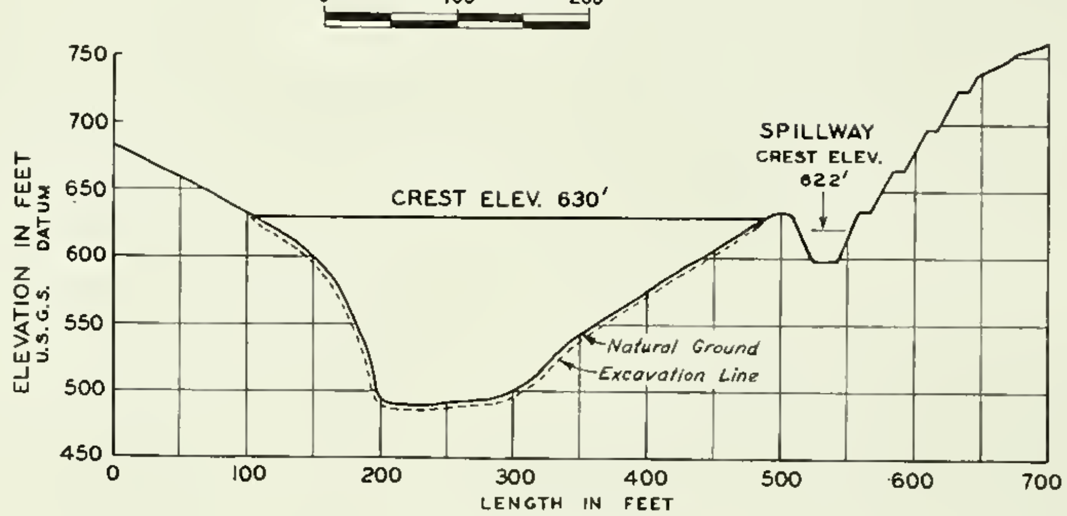
LAGUNA CREEK DAM
ON
LAGUNA CREEK



GENERAL PLAN

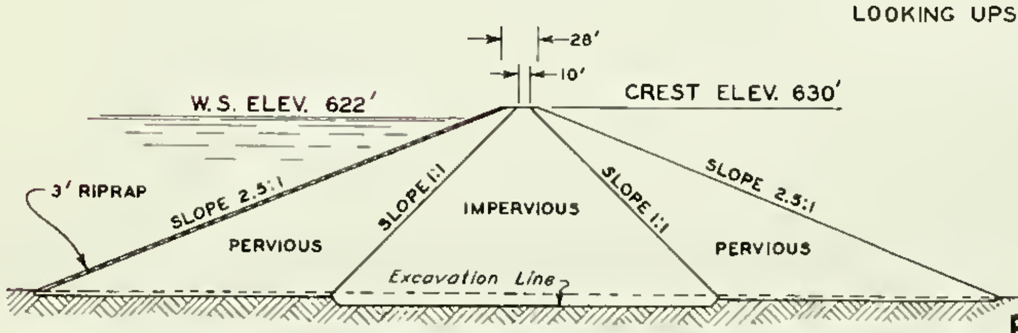
SCALE OF FEET

0 100 200



PROFILE OF DAM

LOOKING UPSTREAM



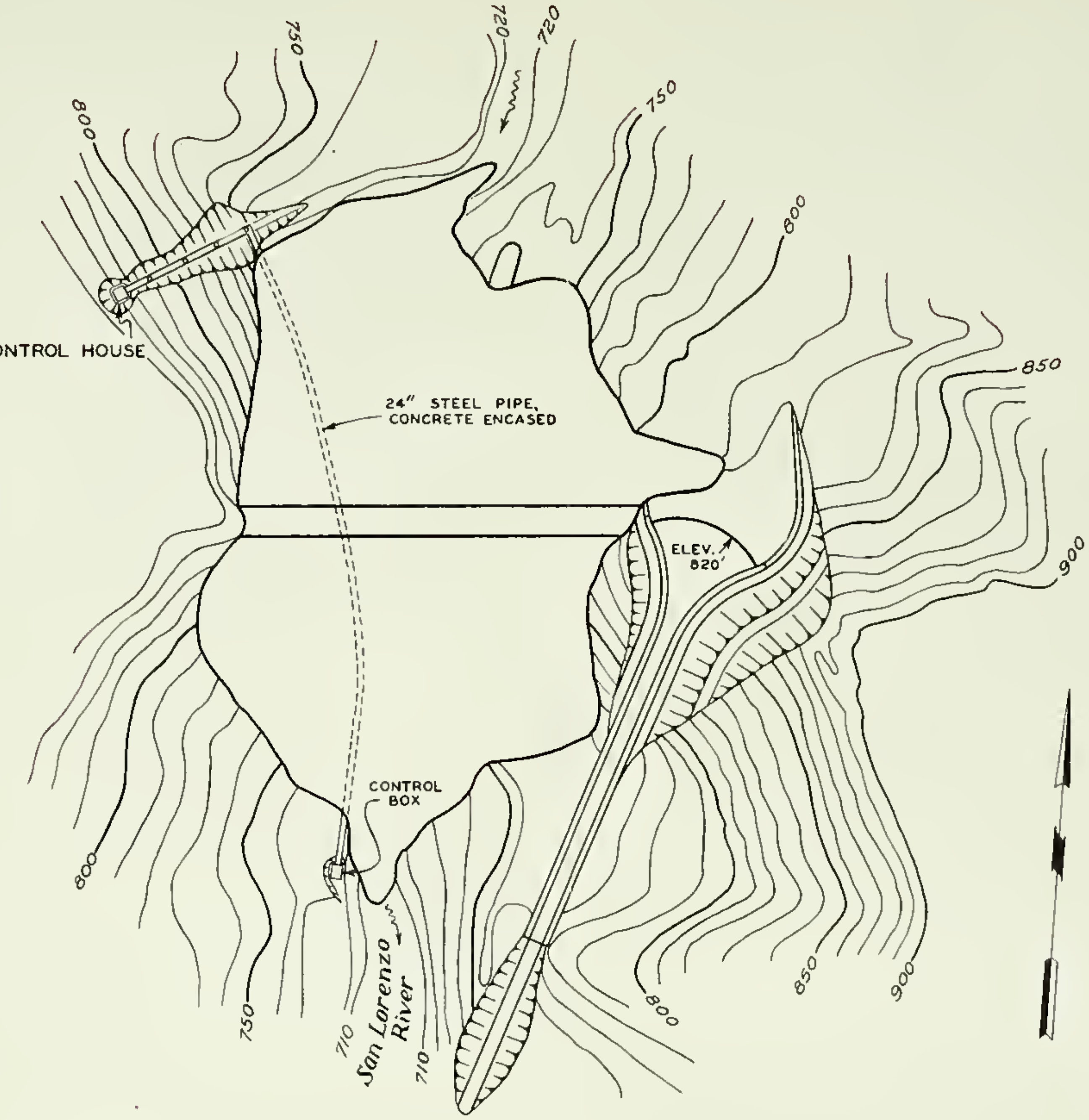
SECTION OF DAM

SCALE OF FEET

0 100 200

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

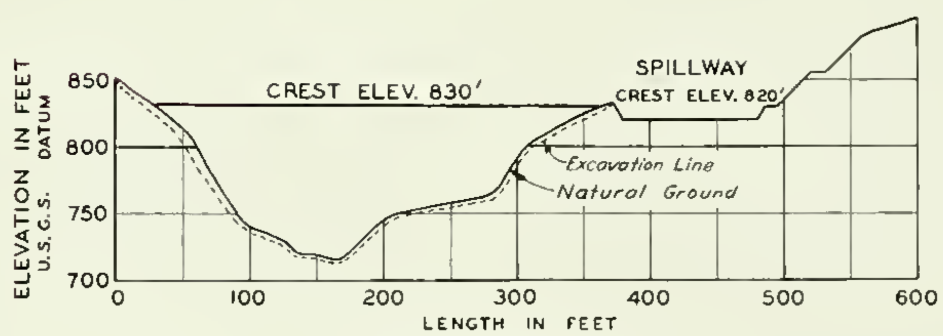
BALD MOUNTAIN SCHOOL DAM
ON
LAGUNA CREEK



GENERAL PLAN

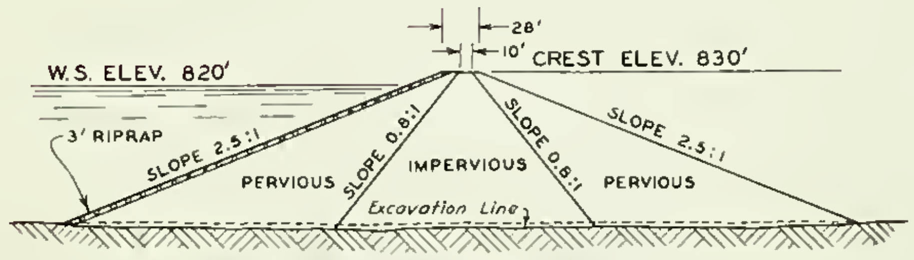
SCALE OF FEET

0 100 200



PROFILE OF DAM

LOOKING UPSTREAM



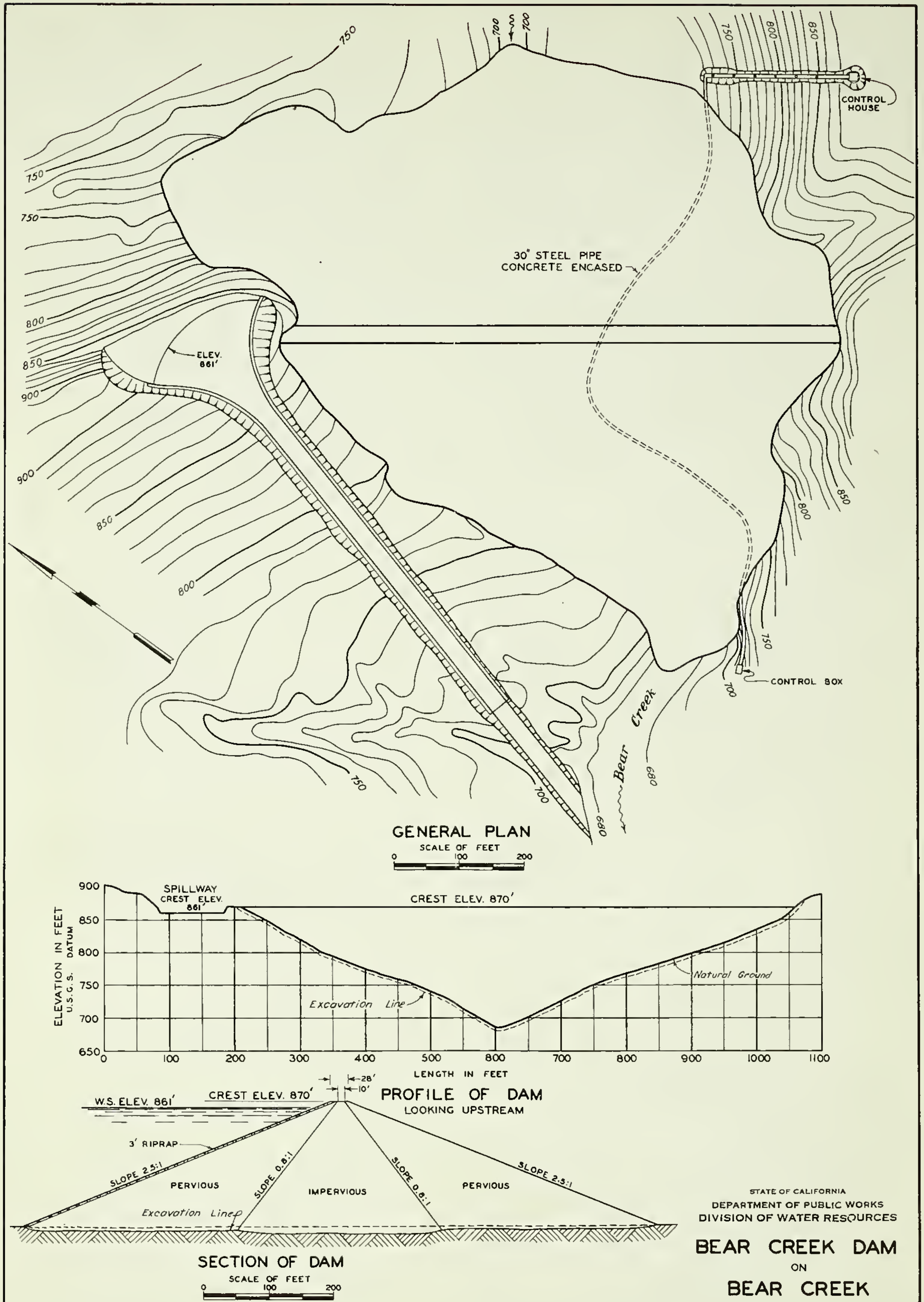
SECTION OF DAM

SCALE OF FEET

0 100 200

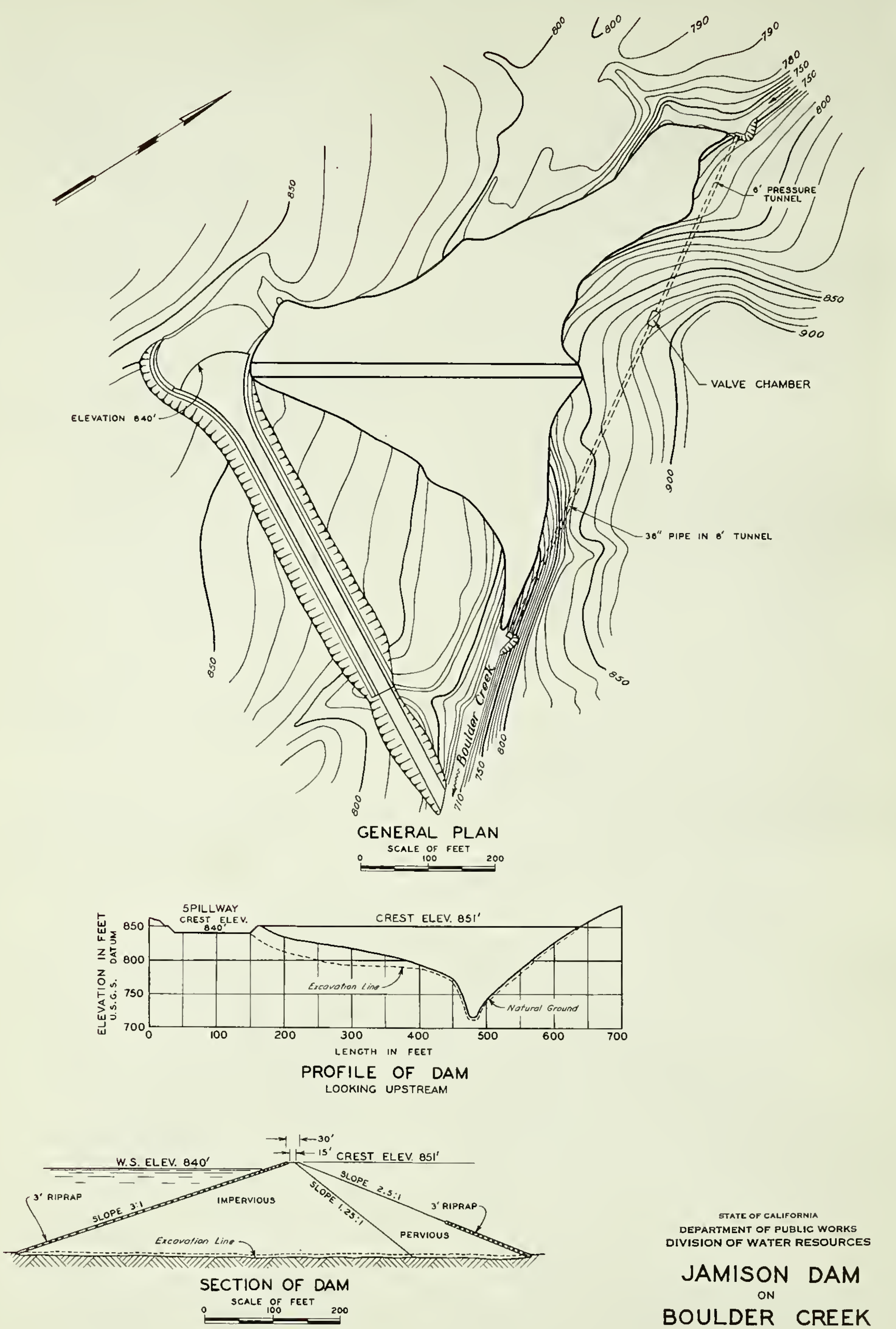
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

WATERMAN SWITCH DAM
ON
SAN LORENZO RIVER



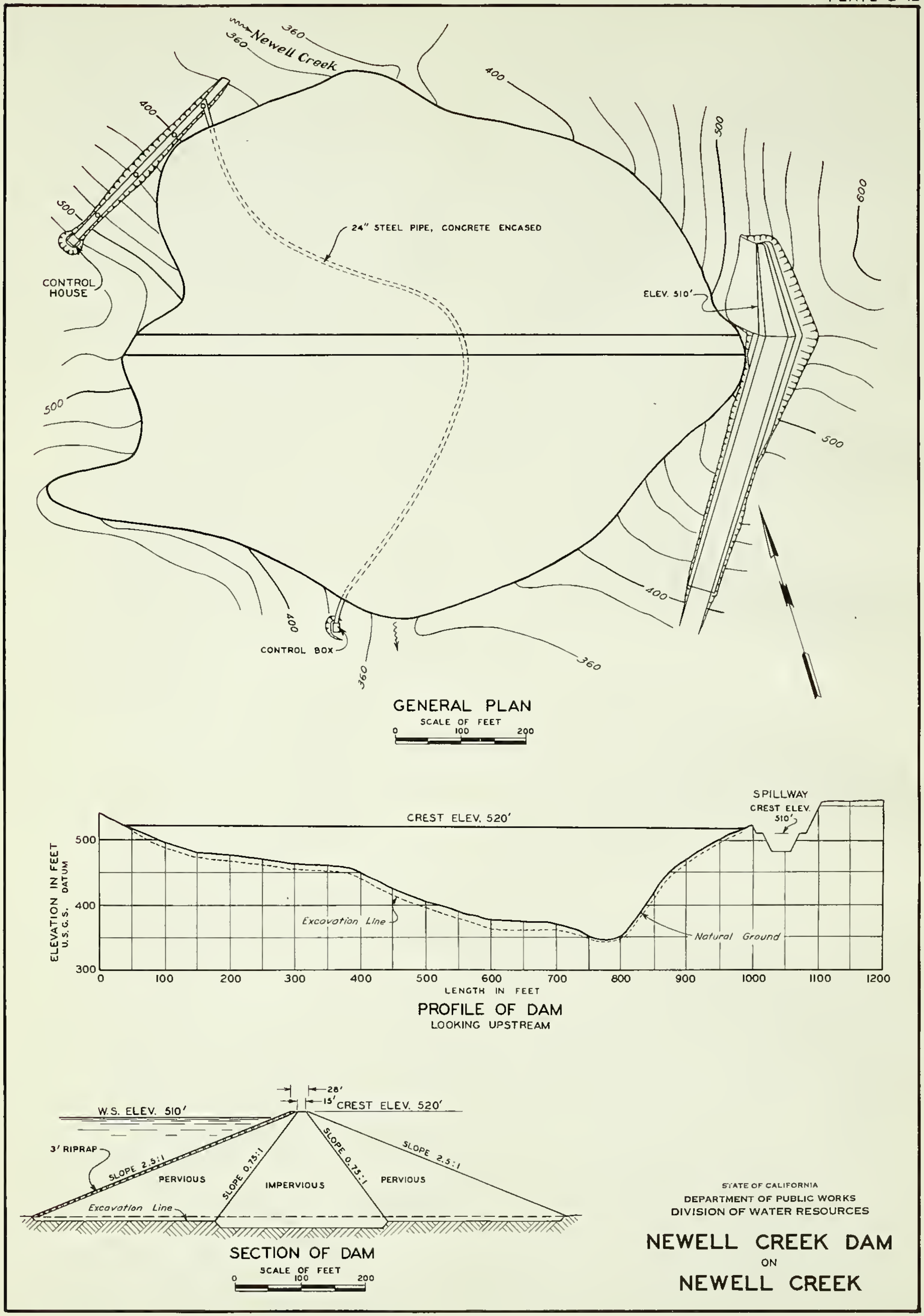
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

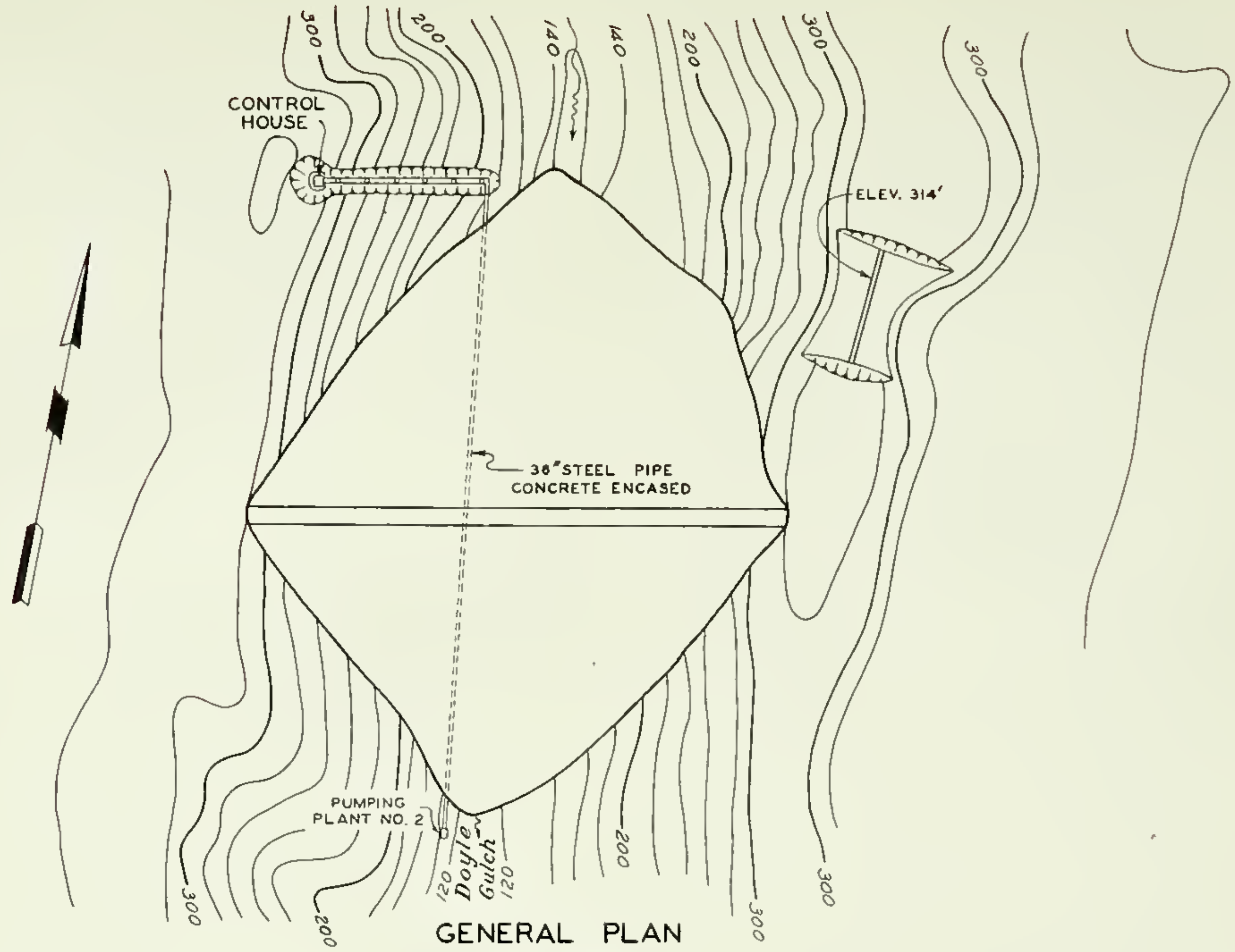
BEAR CREEK DAM ON BEAR CREEK



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

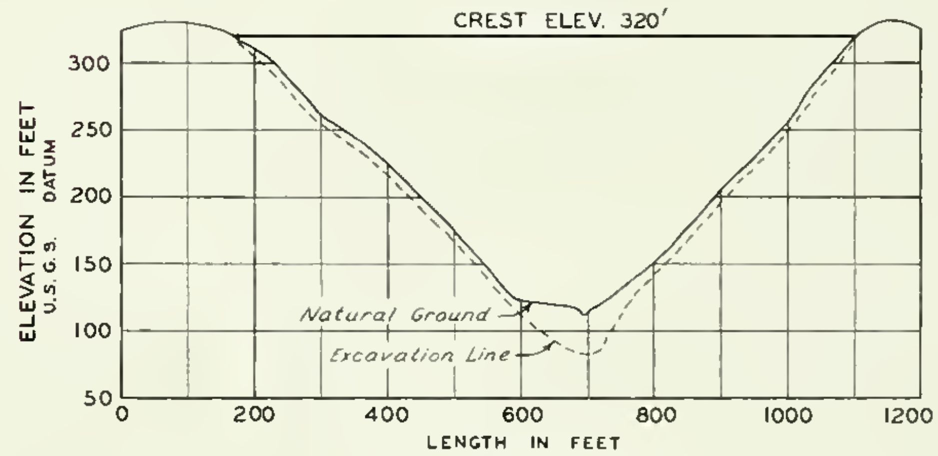
JAMISON DAM
ON
BOULDER CREEK


Newell Creek
360
400
500
600
24" STEEL PIPE, CONCRETE ENCASED
CONTROL HOUSE
ELEV. 510'
CONTROL BOX
GENERAL PLAN
SCALE OF FEET
0 100 200
SPILLWAY CREST ELEV. 510'
CREST ELEV. 520'
ELEVATION IN FEET U.S.G.S. DATUM
300
400
500
Excavation Line
Natural Ground
0 100 200 300 400 500 600 700 800 900 1000 1100 1200
LENGTH IN FEET
PROFILE OF DAM
LOOKING UPSTREAM
28'
15'
W.S. ELEV. 510'
CREST ELEV. 520'
3' RIPRAP
SLOPE 2.5:1
PERVIOUS
SLOPE 0.75:1
IMPERVIOUS
SLOPE 0.75:1
PERVIOUS
SLOPE 2.5:1
Excavation Line
SECTION OF DAM
SCALE OF FEET
0 100 200
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
NEWELL CREEK DAM
ON
NEWELL CREEK



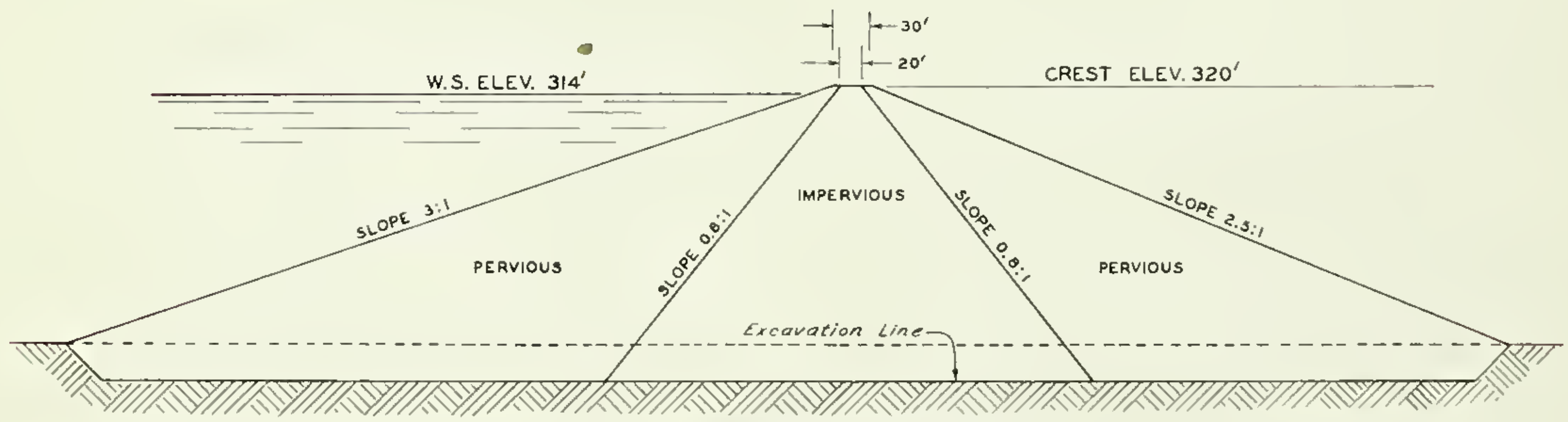
GENERAL PLAN

SCALE OF FEET
0 200 400



PROFILE OF DAM

LOOKING UPSTREAM



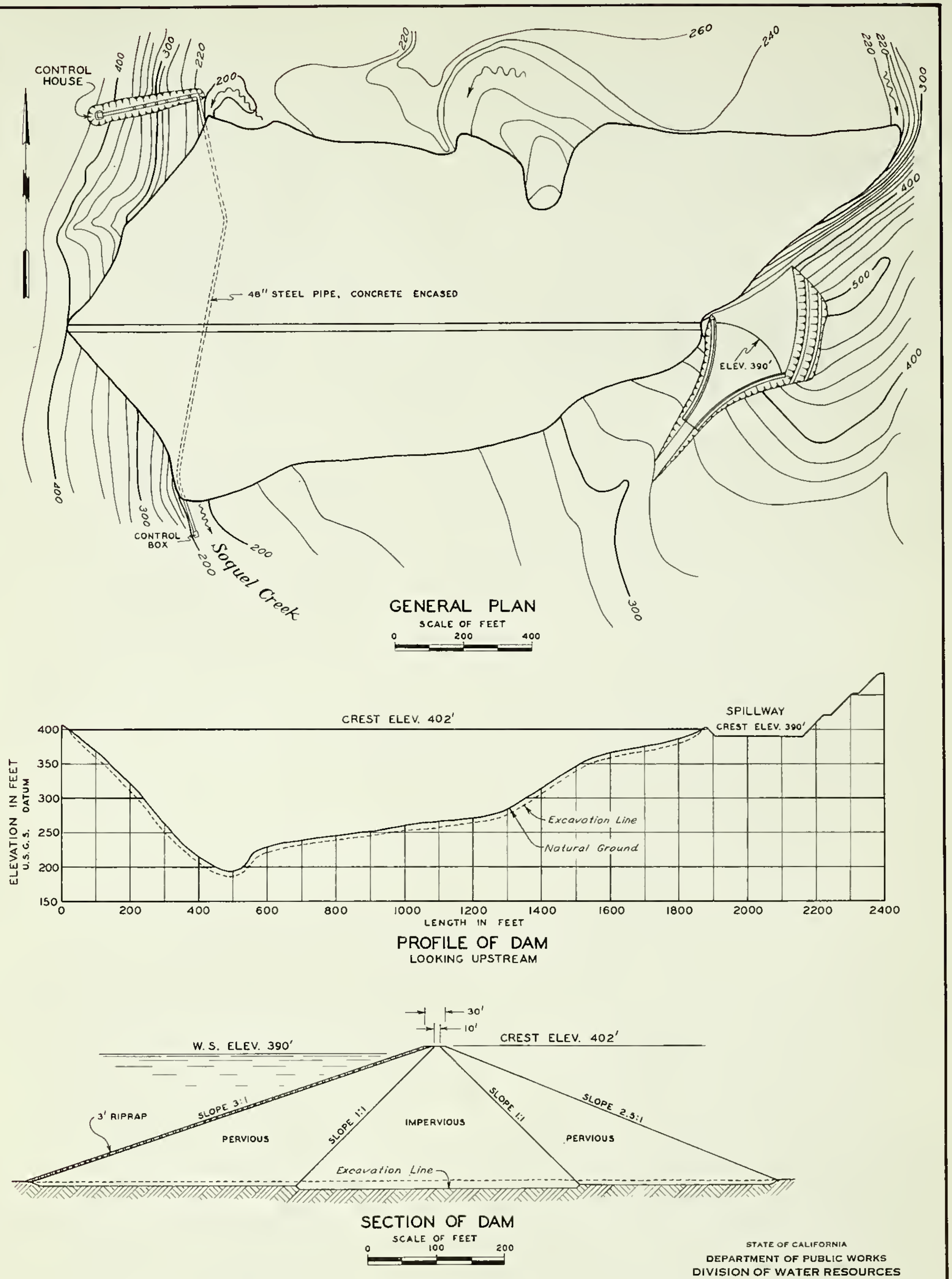
SECTION OF DAM

SCALE OF FEET
0 100 200

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

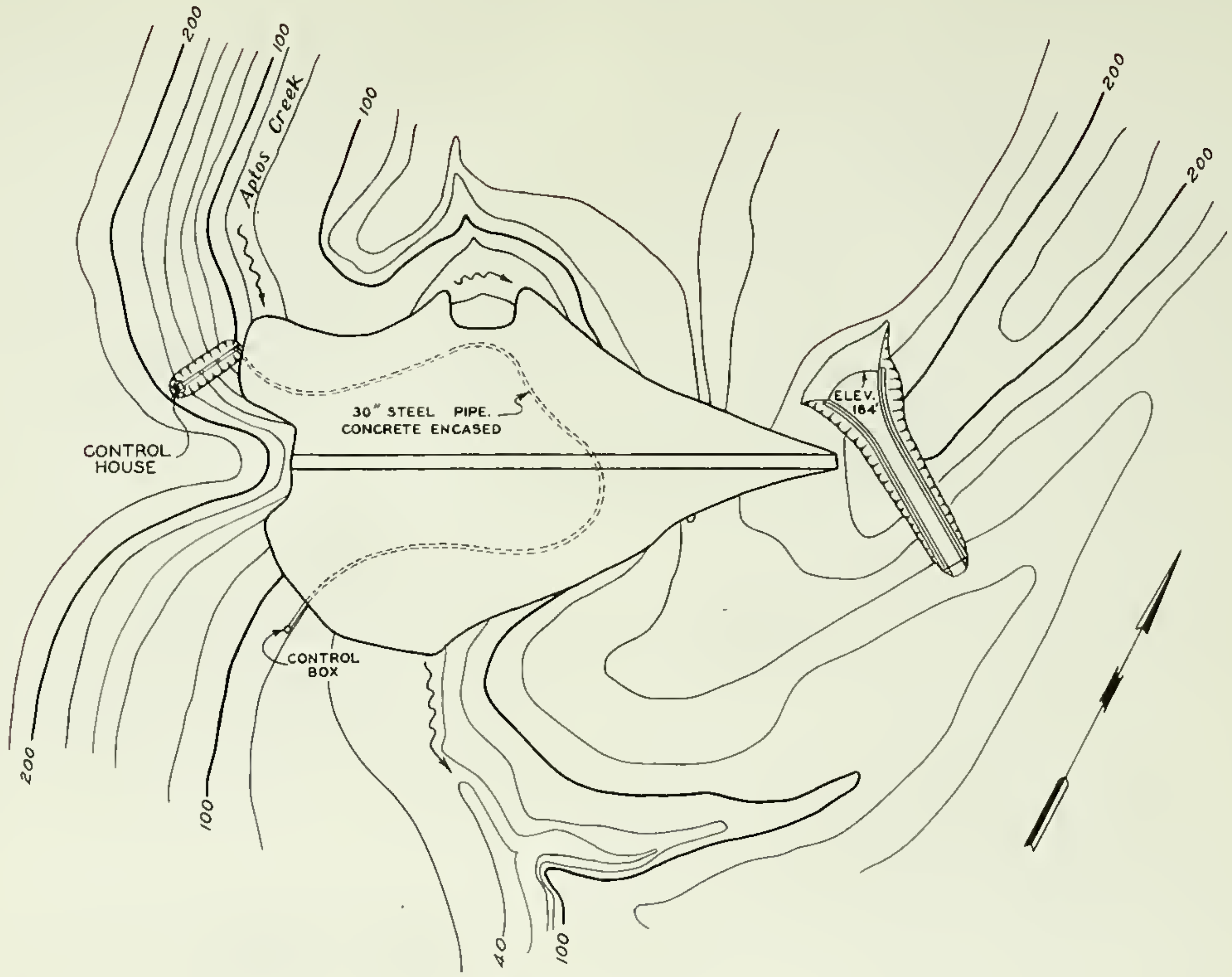
DOYLE GULCH DAM
IN
DOYLE GULCH

RESERVOIR STORAGE CAPACITY OF 14,500 ACRE-FEET



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

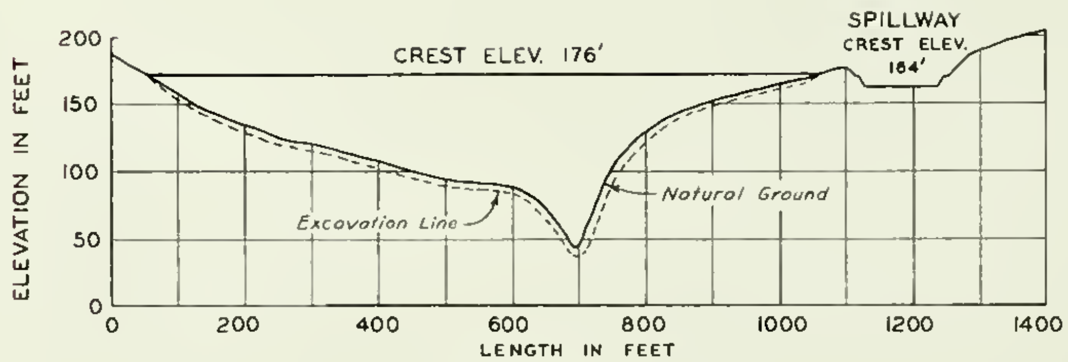
SOQUEL CREEK DAM
ON
SOQUEL CREEK



GENERAL PLAN

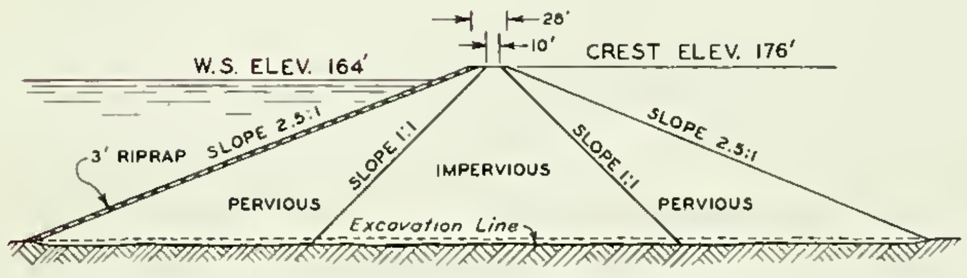
SCALE OF FEET

0 200 400



PROFILE OF DAM

LOOKING UPSTREAM



SECTION OF DAM

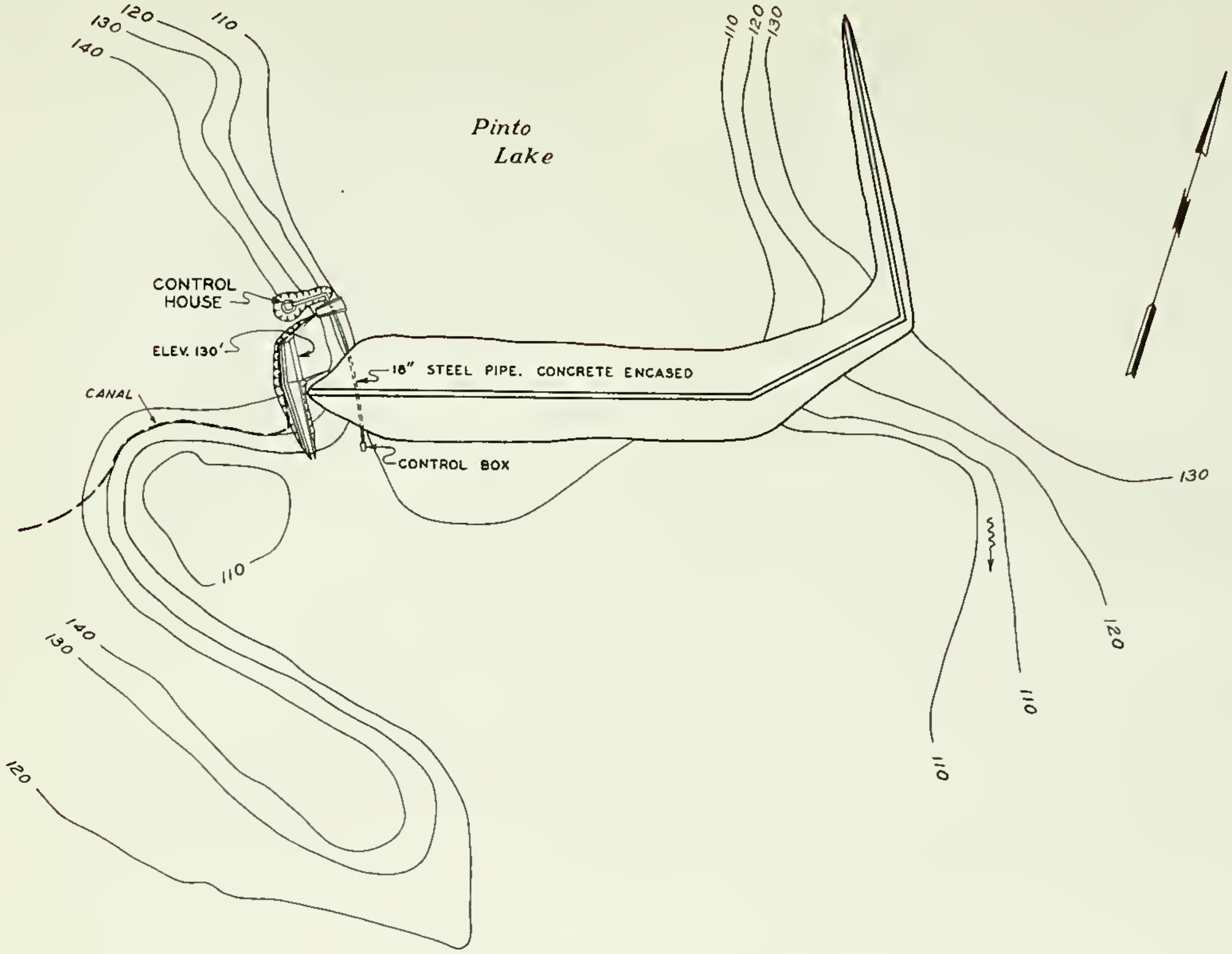
SCALE OF FEET

0 100 200

NOTE:
TO OBTAIN ELEVATIONS ON U.S.G.S. DATUM SUBTRACT SIX FEET FROM ELEVATIONS SHOWN.

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

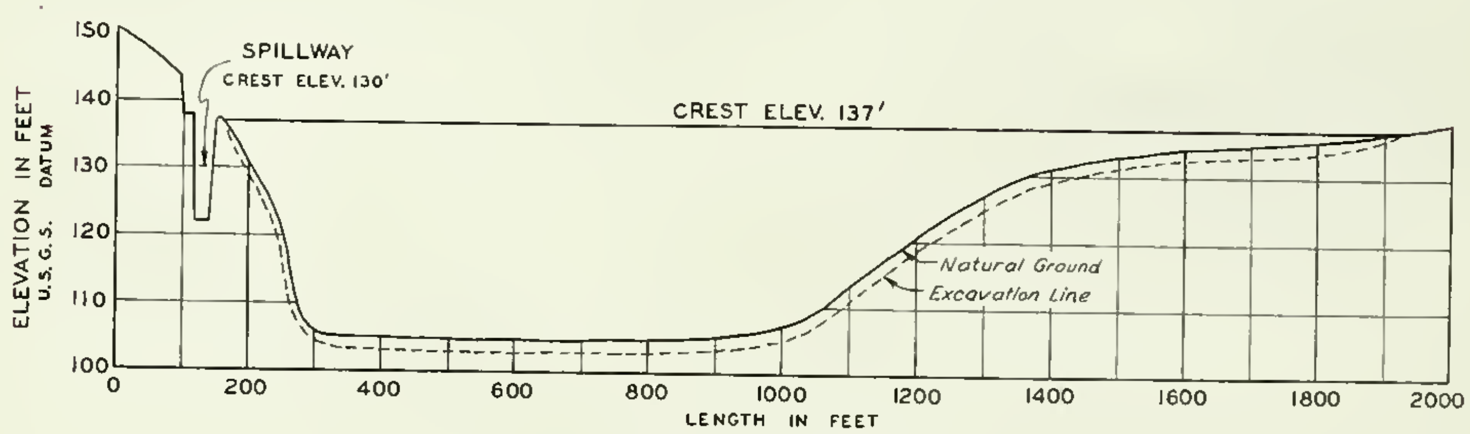
APTOS CREEK DAM
ON
APTOS CREEK



GENERAL PLAN

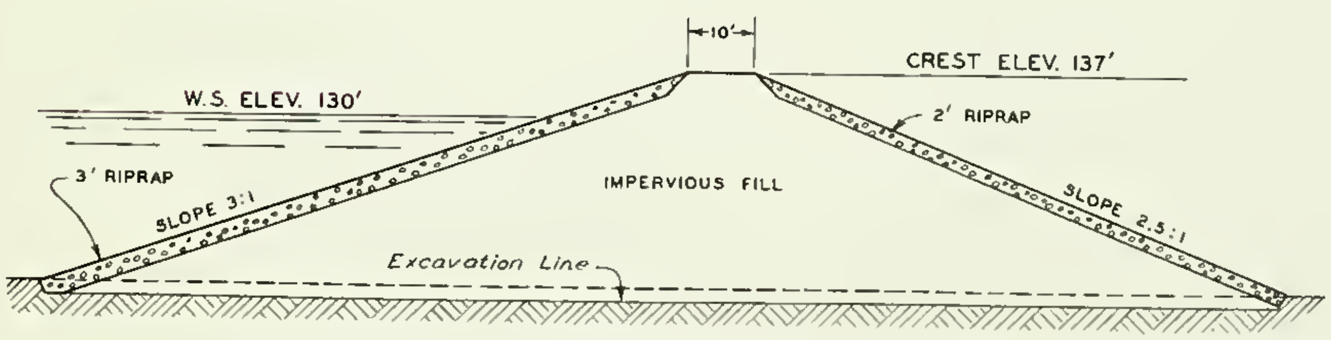
SCALE OF FEET

0 200 400



PROFILE OF DAM

LOOKING UPSTREAM



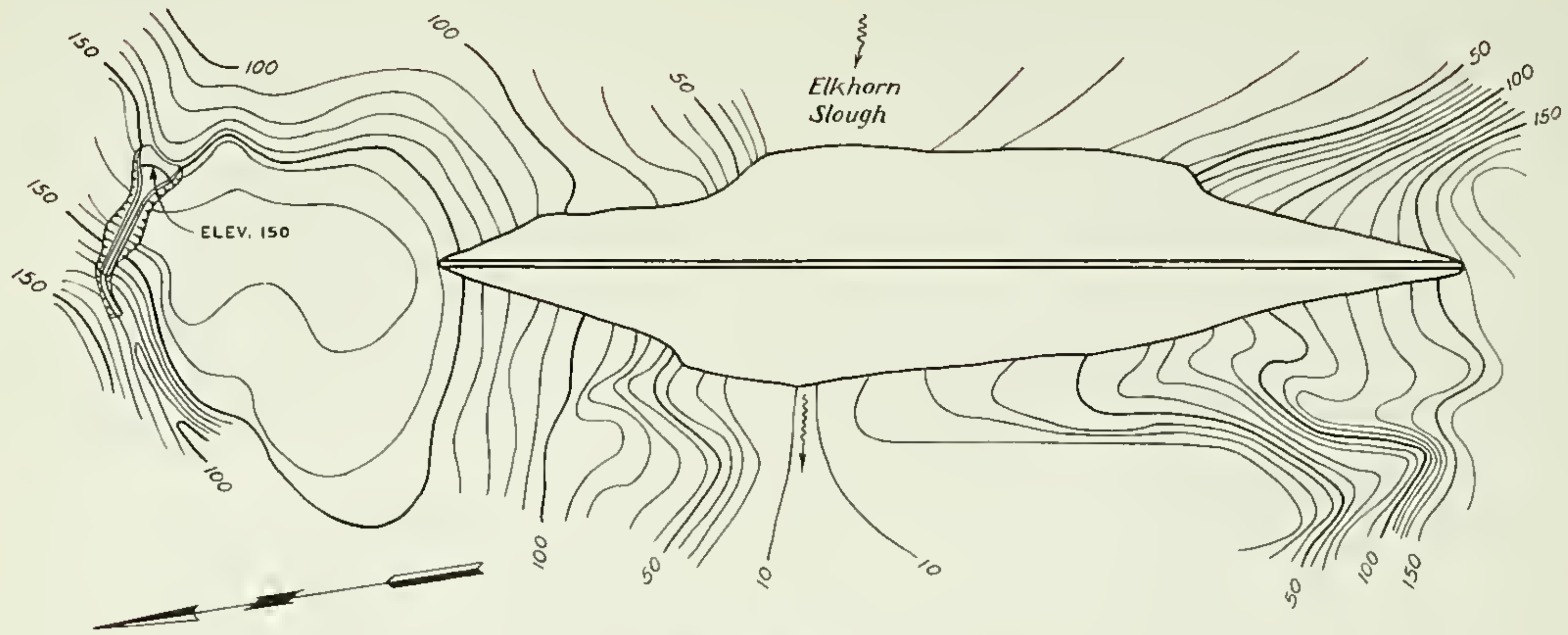
SECTION OF DAM

SCALE OF FEET

0 20 40

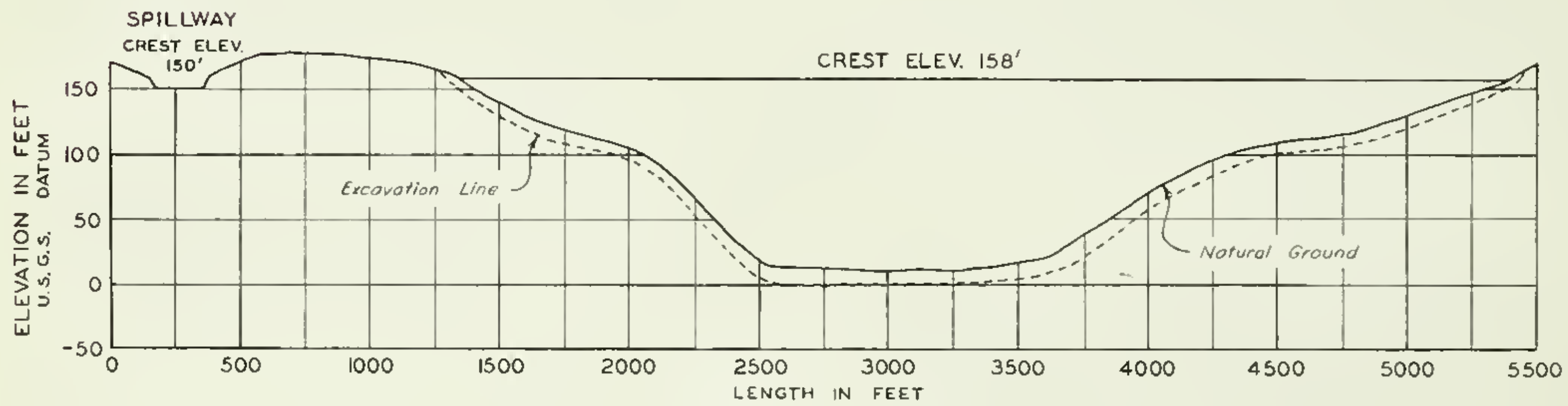
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

PINTO LAKE DAM

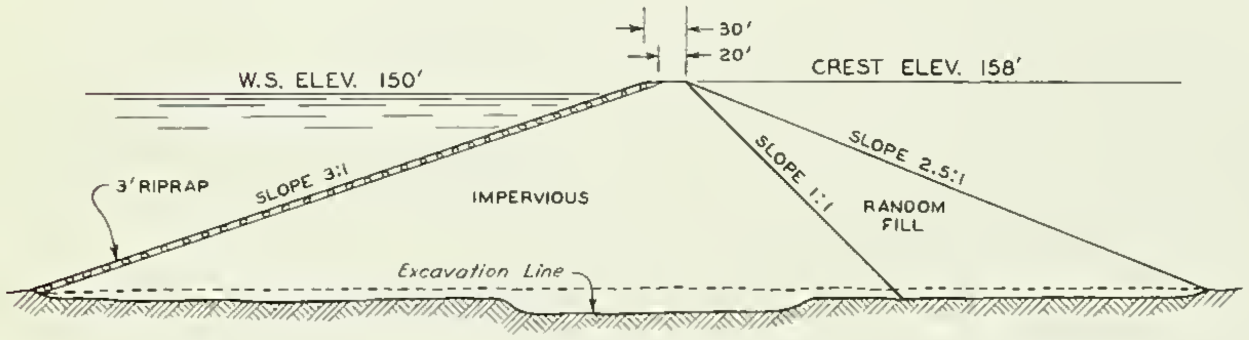


GENERAL PLAN

SCALE OF FEET
0 500 1000



PROFILE OF DAM
LOOKING UPSTREAM



SECTION OF DAM

SCALE OF FEET
0 100 200

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

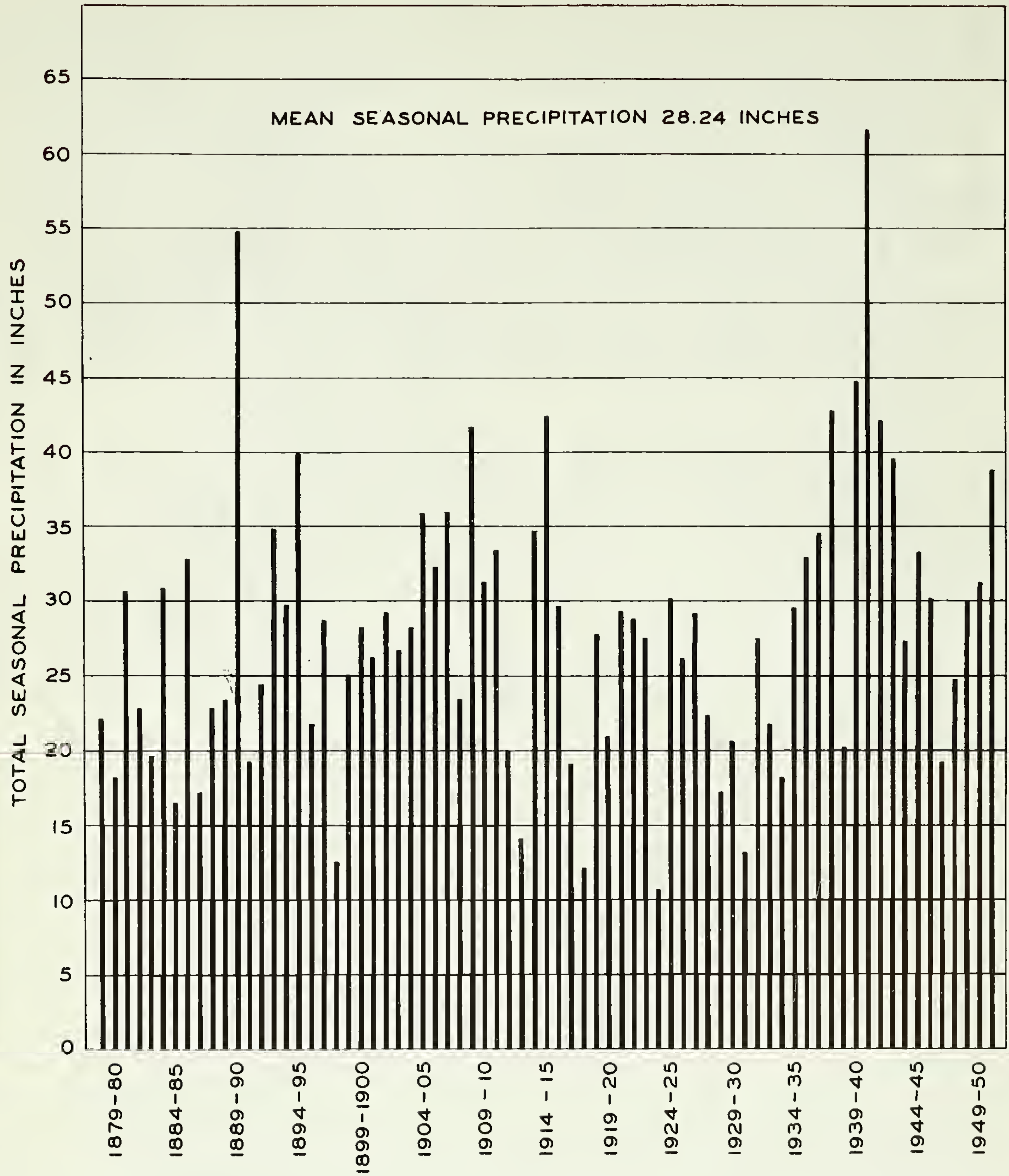
ELKHORN SLOUGH DAM
ON
ELKHORN SLOUGH

PLATE 1

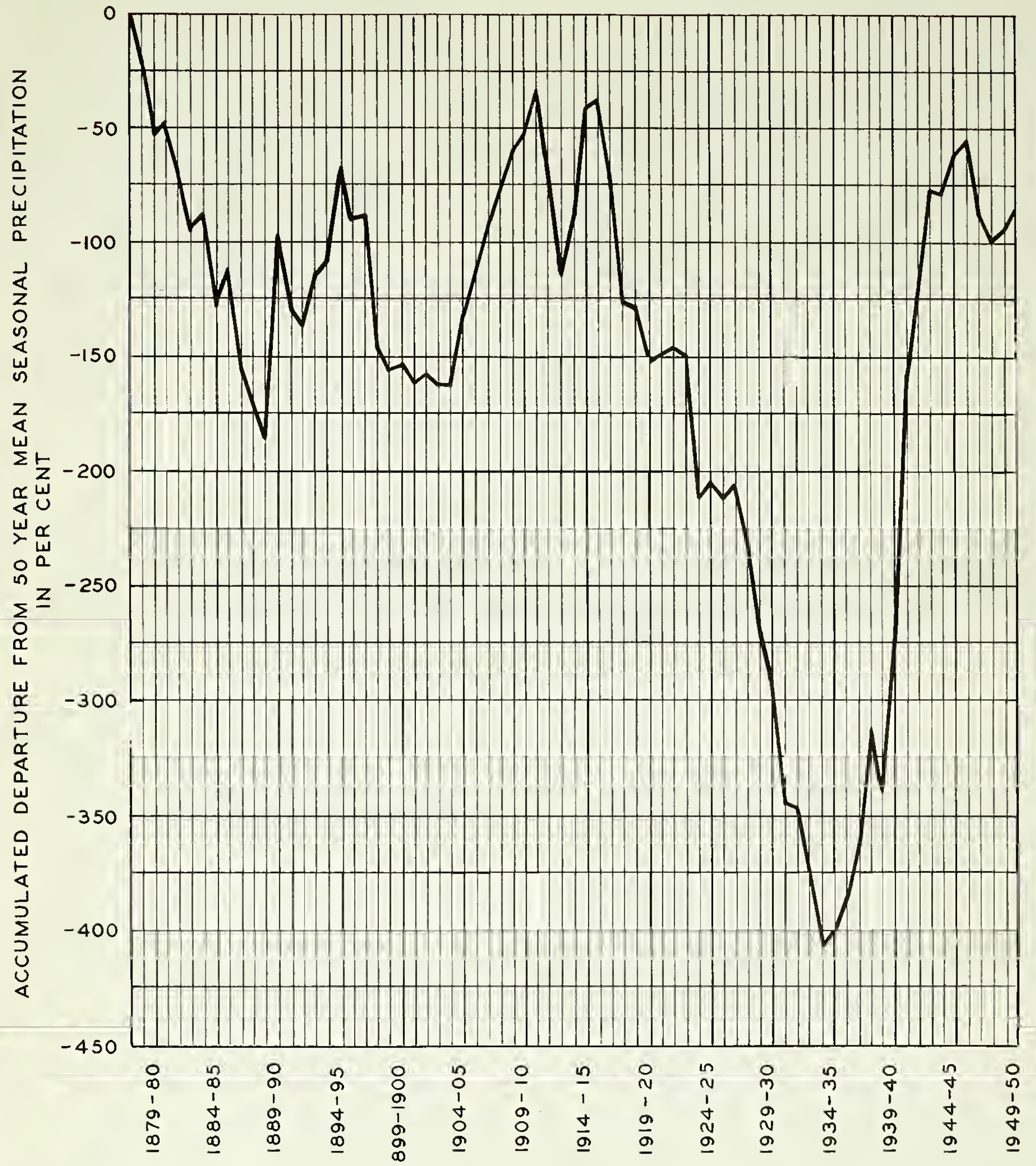

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION
LOCATION
OF
SANTA CRUZ - MONTEREY AREA
SCALE OF MILES
10 0 10 20 30 40 50
1952
OREGON
NEVADA
MEXICO
ARIZONA
PACIFIC OCEAN
SISKIYOU
MODOC
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
LAKE
COLUSA
SONOMA
YOLO
ALPINE
MARIN
CONTRA COSTA
ALAMEDA
SAN FRANCISCO
SANTA CLARA
MONO
MARIPOSA
SAN BENITO
MONTEREY
INYO
KINGS
TULARE
SAN LUIS OBISPO
KERN
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
ORANGE
SAN DIEGO
IMPERIAL
Lake Tahoe
Lake Mead
Boulder Dam


SANTA CRUZ MOUNTAINS
NORTH COASTAL UNIT
SAN LORENZO UNIT
SOQUEL UNIT
PAJARO UNIT
PACIFIC OCEAN
MONTEREY BAY
BIG BASIN REDWOODS STATE PARK
SAN LORENZO VALLEY COUNTY WATER DISTRICT
RIVERSIDE GROVE WATER CO. INC.
CITIZEN'S UTILITY CO. OF CALIFORNIA
LOMPICO COOPERATIVE WATER ASSOCIATION
MONTEREY BAY WATER CO.
MOUNT HERMAN ASSOCIATION
MISSION SPRINGS WATER CO.
FOREST SPRINGS MUTUAL WATER CO.
LORENZO WATER WORKS
BEN LOMOND REDWOOD PARK WATER CO.
FELTON WATER CO.
FOREST LAKES MUTUAL WATER CO.
PARADISE PARK WATER CO.
CITY OF SANTA CRUZ WATER DEPARTMENT
BELTZ WATER CO.
SEACLIFF WATER WORKS
WATSONVILLE MUNICIPAL WATER DEPARTMENT
SANTA CRUZ
WATSONVILLE
NATURAL BRIDGES BEACH STATE PARK
NEW BRIGHTON BEACH STATE PARK
SEACLIFF BEACH STATE PARK
MANRESA BEACH STATE PARK
SUNSET BEACH STATE PARK
PAJARO RIVER BEACH STATE PARK
LEGEND
BOUNDARY OF SANTA CRUZ - MONTEREY AREA
BOUNDARY OF UNIT
APPROXIMATE 500-FOOT CONTOUR
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION
HYDROGRAPHIC UNITS
AND
PRINCIPAL ORGANIZED WATER AGENCIES
SCALE OF MILES

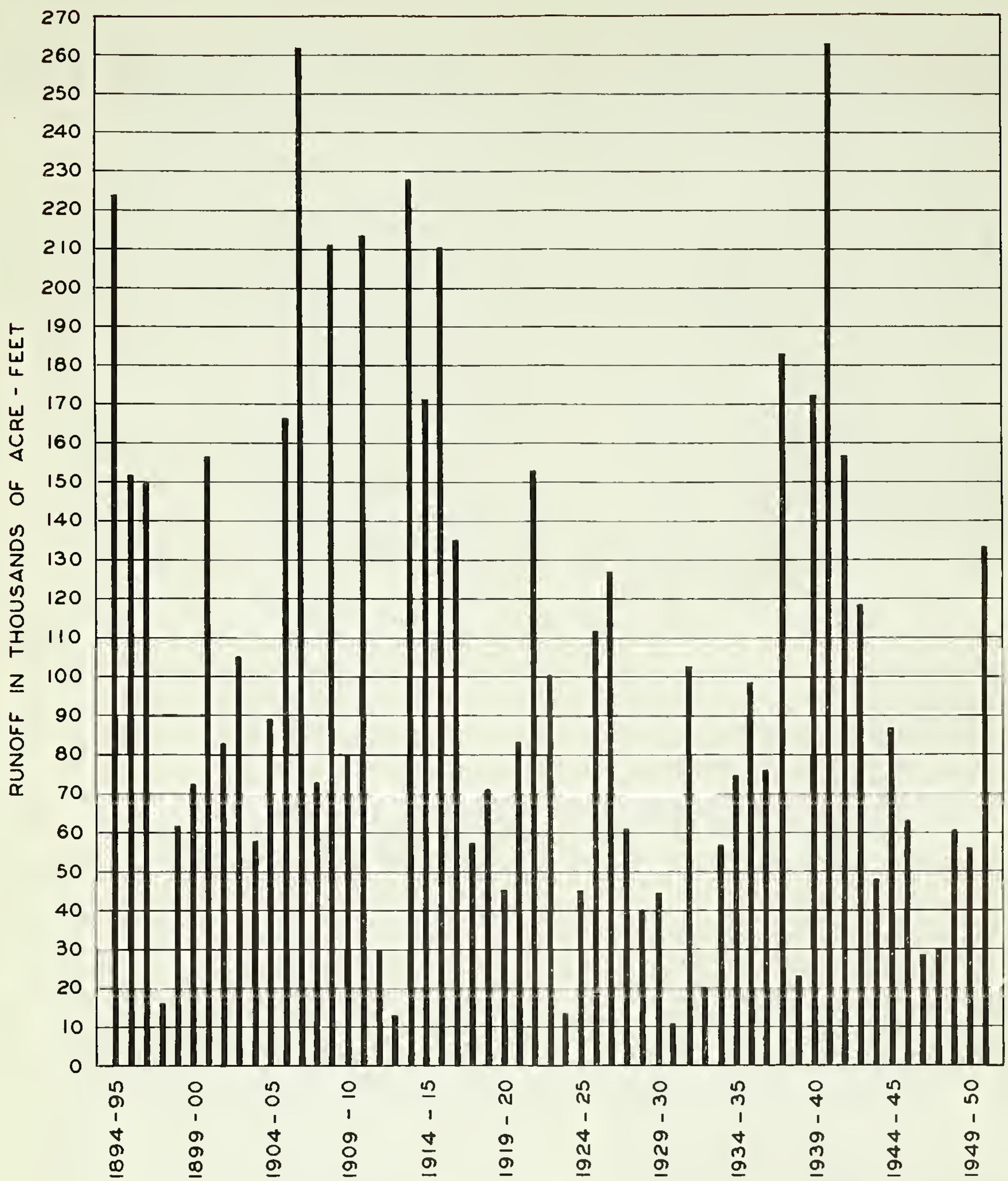

SANTA CRUZ MOUNTAINS
SAN LORENZO UNIT
SOQUEL UNIT
PAJARO UNIT
NORTH COASTAL UNIT
BEN LOMOND MOUNTAIN
BIG BASIN REDWOODS STATE PARK
SANTA CRUZ
WATSONVILLE
MONTEREY BAY
PACIFIC OCEAN
LEGEND
STREAM GAGING STATIONS
PRECIPITATION STATIONS
LINES OF EQUAL PRECIPITATION IN INCHES
BOUNDARY OF SANTA CRUZ - MONTEREY AREA
BOUNDARY OF UNIT
APPROXIMATE 500-FOOT CONTOUR
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION
LINES OF EQUAL MEAN SEASONAL PRECIPITATION
SCALE OF MILES



RECORDED SEASONAL PRECIPITATION AT SANTA CRUZ



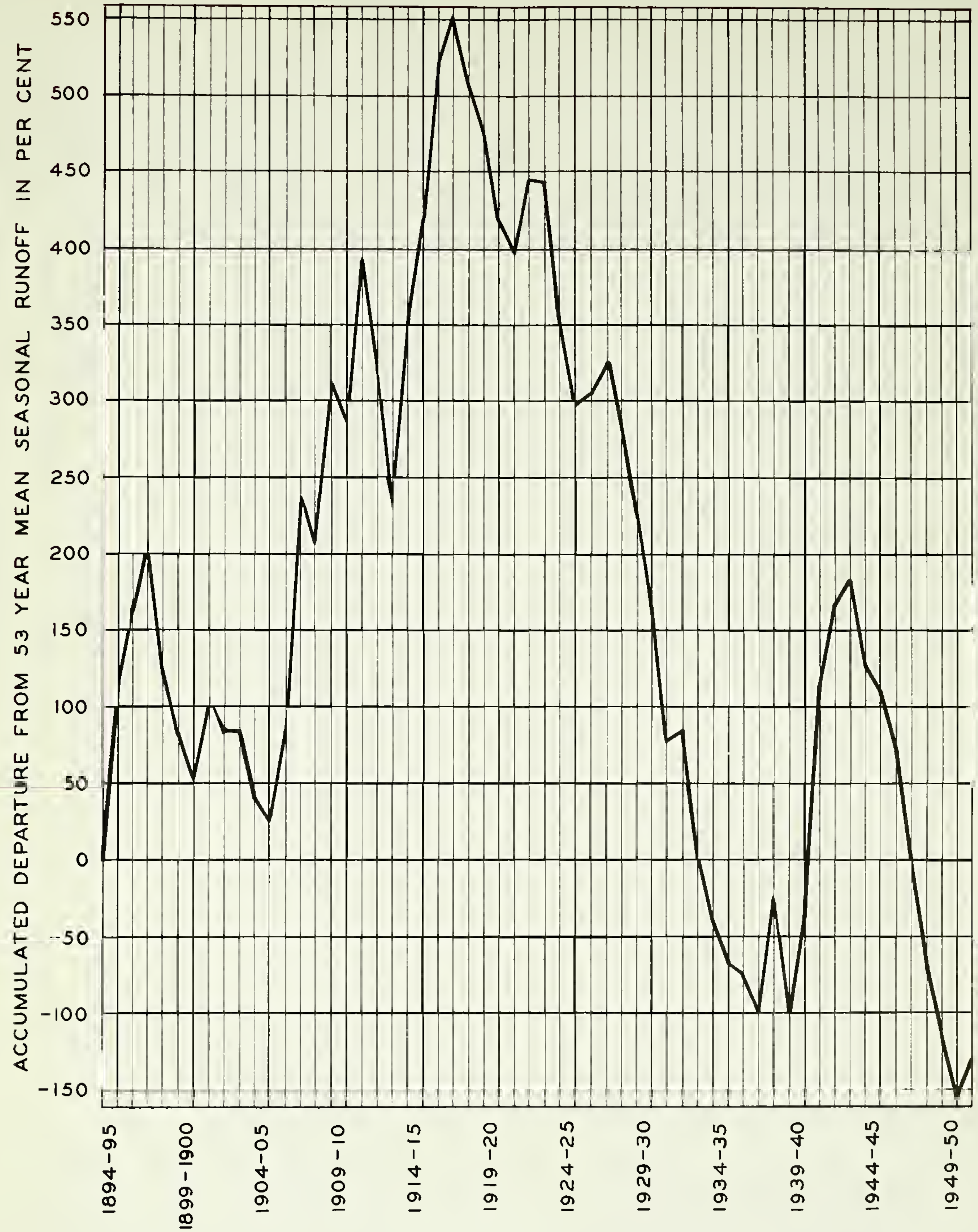
ACCUMULATED DEPARTURE FROM MEAN SEASONAL PRECIPITATION AT SANTA CRUZ



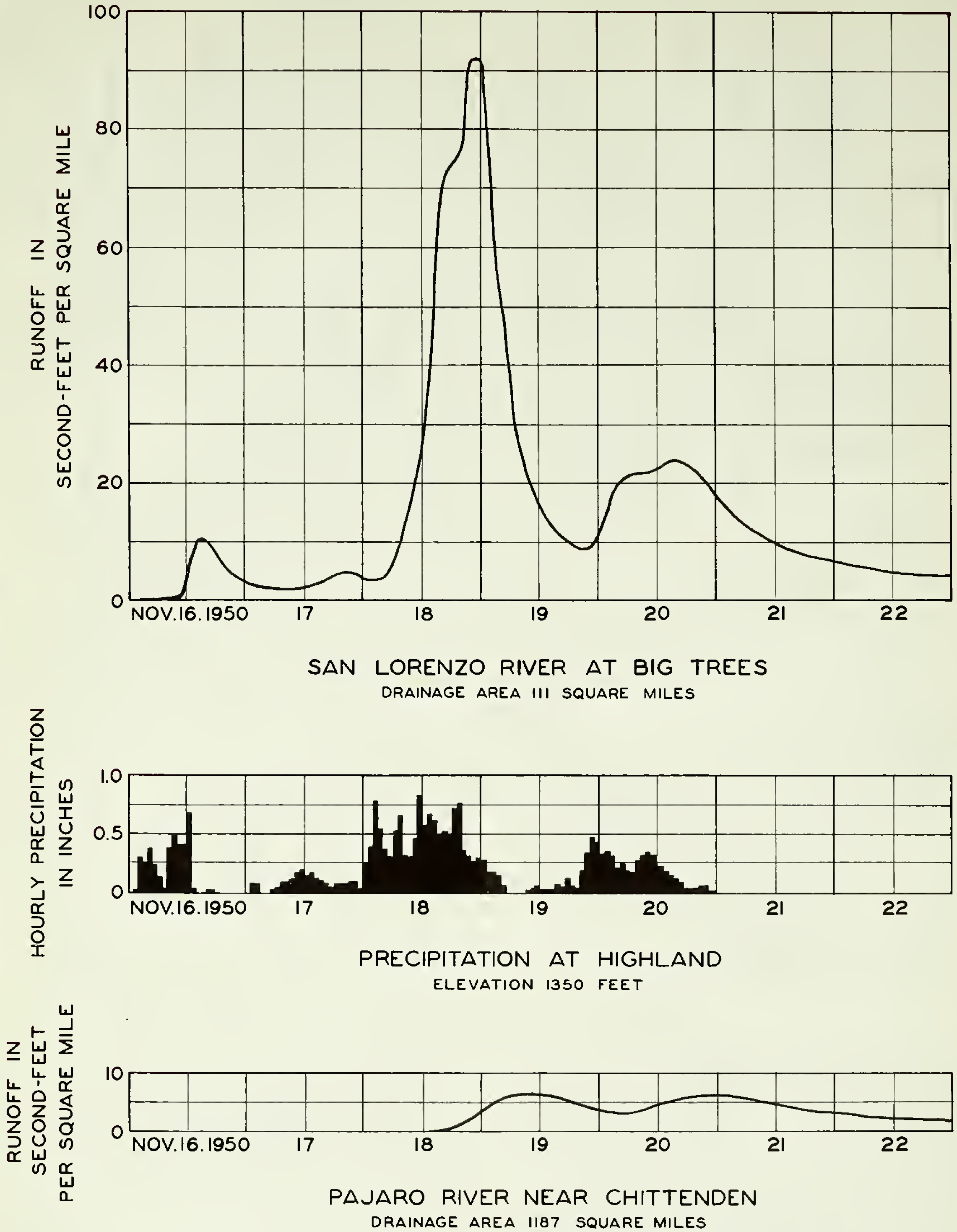
RECORDED AND ESTIMATED SEASONAL RUNOFF

OF

SAN LORENZO RIVER AT BIG TREES

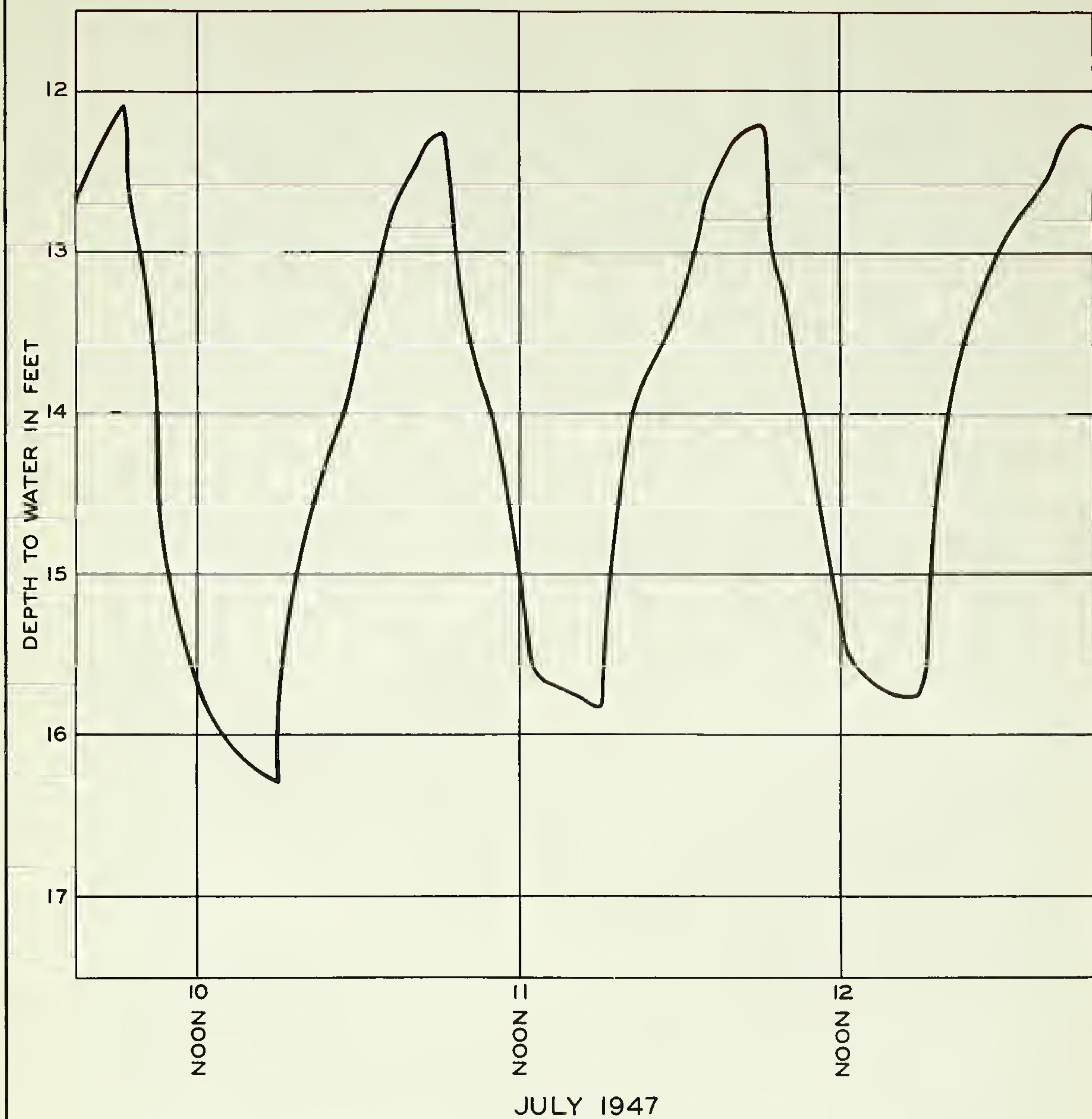


ACCUMULATED DEPARTURE FROM MEAN SEASONAL RUNOFF
OF
SAN LORENZO RIVER AT BIG TREES



RUNOFF CHARACTERISTICS OF SAN LORENZO AND PAJARO RIVERS AS RELATED TO PRECIPITATION AT HIGHLAND

FLOOD OF NOVEMBER 1950



FLUCTUATION OF PIEZOMETRIC SURFACE OF CONFINED AQUIFERS
AT WELL 12S/1E-25A3

LEGEND

+2 — LINES OF EQUAL CHANGE IN GROUND WATER ELEVATIONS IN FEET

BOUNDARY OF PAJARO UNIT

APPROXIMATE 500-FOOT CONTOUR

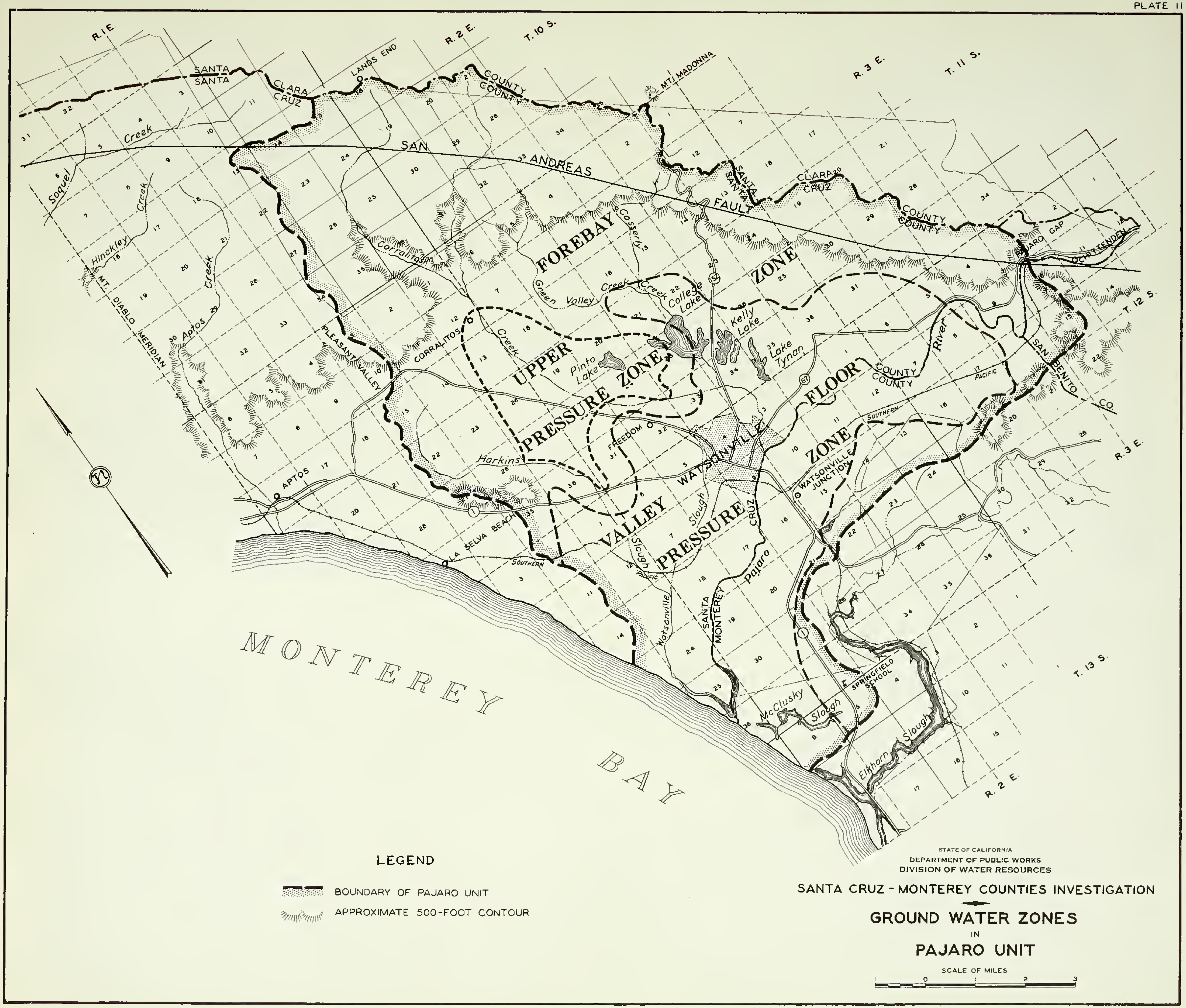
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION

LINES OF EQUAL CHANGE IN GROUND WATER ELEVATIONS IN PAJARO UNIT

SUMMER OF 1947 TO FALL OF 1947

SCALE OF MILES
1 0 1 2 3



LEGEND

BOUNDARY OF PAJARO UNIT

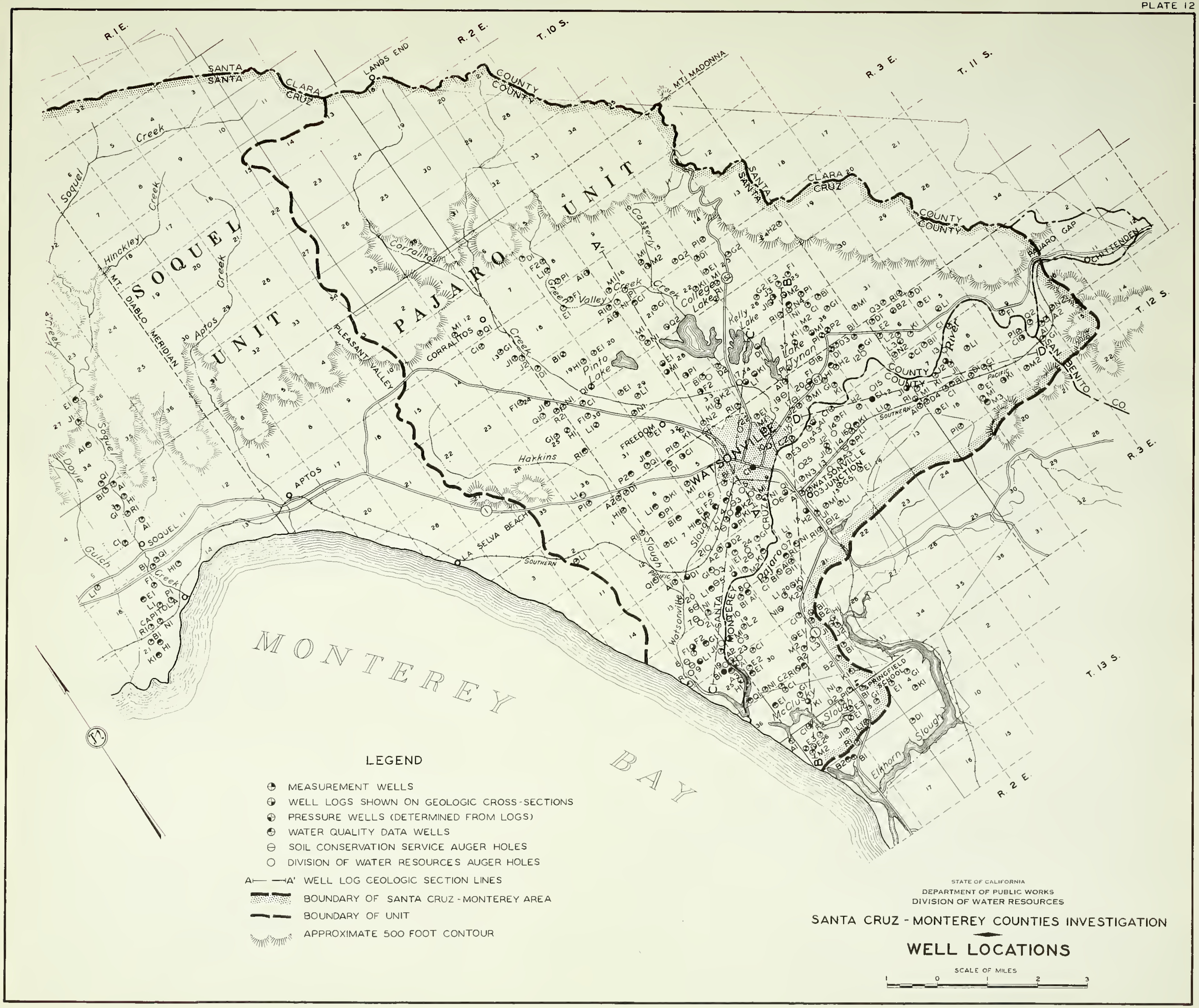
APPROXIMATE 500-FOOT CONTOUR

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION

GROUND WATER ZONES IN PAJARO UNIT

SCALE OF MILES
0 1 2 3


SOQUEL UNIT
PAJARO UNIT
MONTEREY BAY
WATSONVILLE
APTOS
SOQUEL
CAPITOLA
LA SELVA BEACH
FREEDOM
CORRALITOS
WATSONVILLE JUNCTION
LANDS END
MT. MADONNA
PAJARO GAP
CHITTENDEN
PLEASANT VALLEY
MT. DIABLO MERIDIAN
SANTA CLARA COUNTY
SANTA CRUZ COUNTY
SAN BENITO CO.
Pajaro River
Pinto Lake
Kelly Lake
College Lake
Tynan Lake
Soquel Creek
Aptos Creek
Corralitos Creek
Casserly Creek
Green Valley Creek
Hinckley Creek
Valencia Creek
Harkins Slough
Watsonville Slough
McClusky Slough
Elkhorn Slough
Springfield School
R. 1 E.
R. 2 E.
R. 3 E.
T. 10 S.
T. 11 S.
T. 12 S.
T. 13 S.
LEGEND
MEASUREMENT WELLS
WELL LOGS SHOWN ON GEOLOGIC CROSS-SECTIONS
PRESSURE WELLS (DETERMINED FROM LOGS)
WATER QUALITY DATA WELLS
SOIL CONSERVATION SERVICE AUGER HOLES
DIVISION OF WATER RESOURCES AUGER HOLES
A— —A' WELL LOG GEOLOGIC SECTION LINES
BOUNDARY OF SANTA CRUZ-MONTEREY AREA
BOUNDARY OF UNIT
APPROXIMATE 500 FOOT CONTOUR
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION
WELL LOCATIONS
SCALE OF MILES
1 0 1 2 3

LEGEND

- 50 — LINES OF EQUAL DEPTH TO GROUND WATER IN FEET
- BOUNDARY OF PAJARO UNIT
- APPROXIMATE 500-FOOT CONTOUR

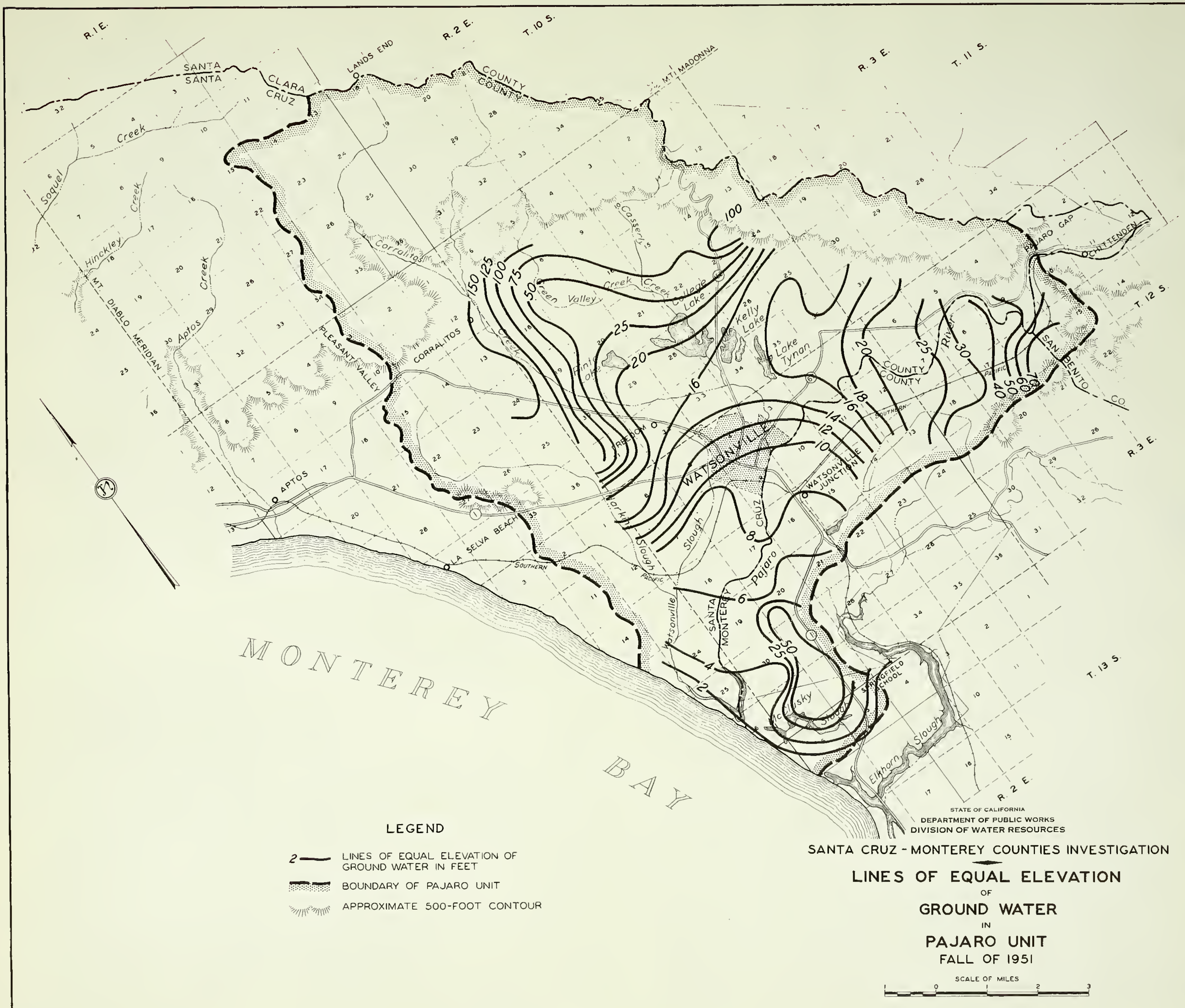
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION

LINES OF EQUAL DEPTH TO GROUND WATER IN PAJARO UNIT

FALL OF 1951

SCALE OF MILES
1 0 1 2 3



LEGEND

- 2 — LINES OF EQUAL ELEVATION OF GROUND WATER IN FEET
- BOUNDARY OF PAJARO UNIT
- APPROXIMATE 500-FOOT CONTOUR

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION

LINES OF EQUAL ELEVATION OF GROUND WATER IN PAJARO UNIT

FALL OF 1951

SCALE OF MILES
1 0 1 2 3

LEGEND

- Lines of equal change in ground water elevations in feet
- Boundary of Pajaro Unit
- Approximate 500-foot contour

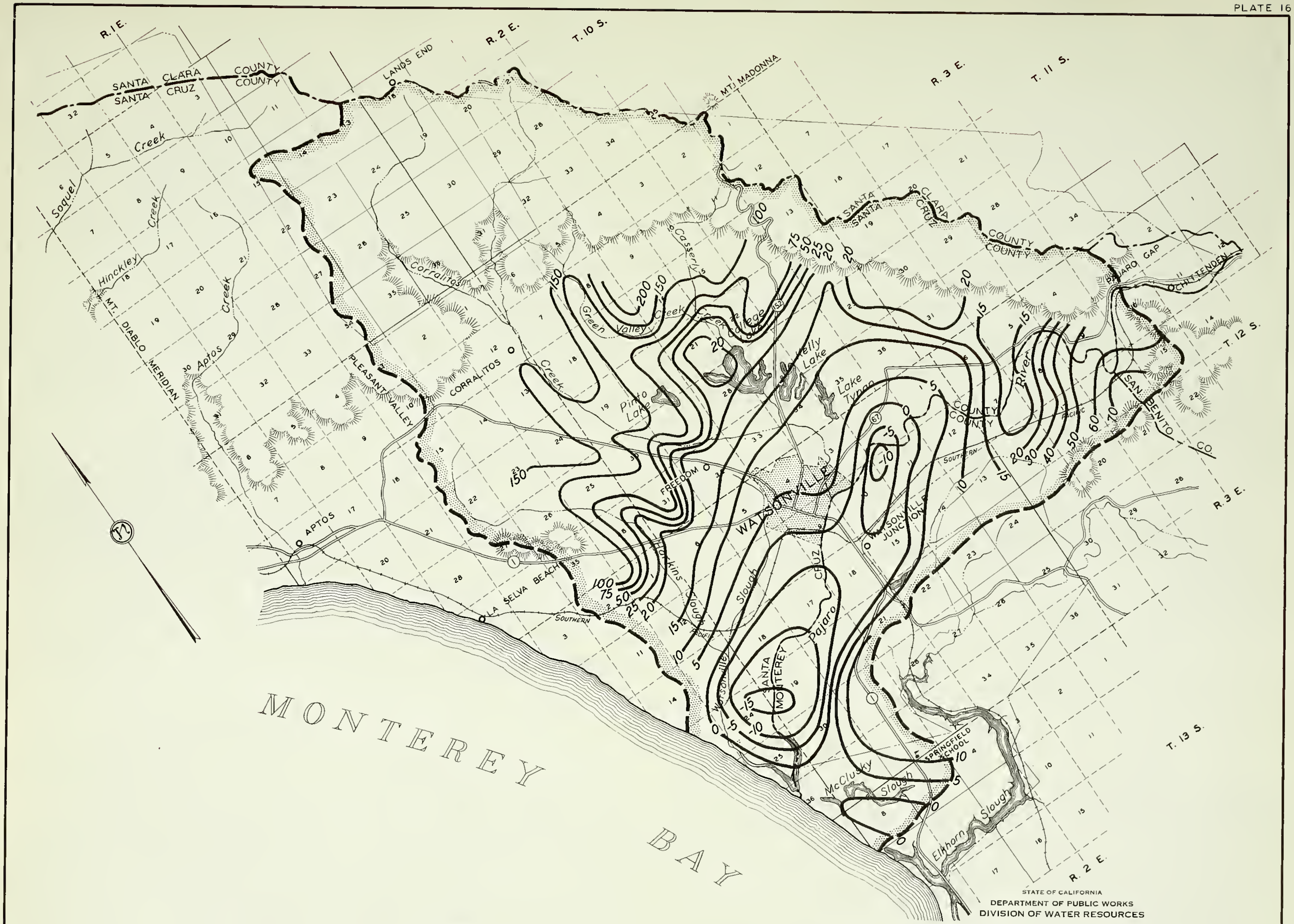
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION

LINES OF EQUAL CHANGE IN GROUND WATER ELEVATIONS IN PAJARO UNIT

FALL OF 1947 TO FALL OF 1951

SCALE OF MILES
1 0 1 2 3



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION

LINES OF EQUAL ELEVATION OF GROUND WATER IN PAJARO UNIT

JULY OF 1947

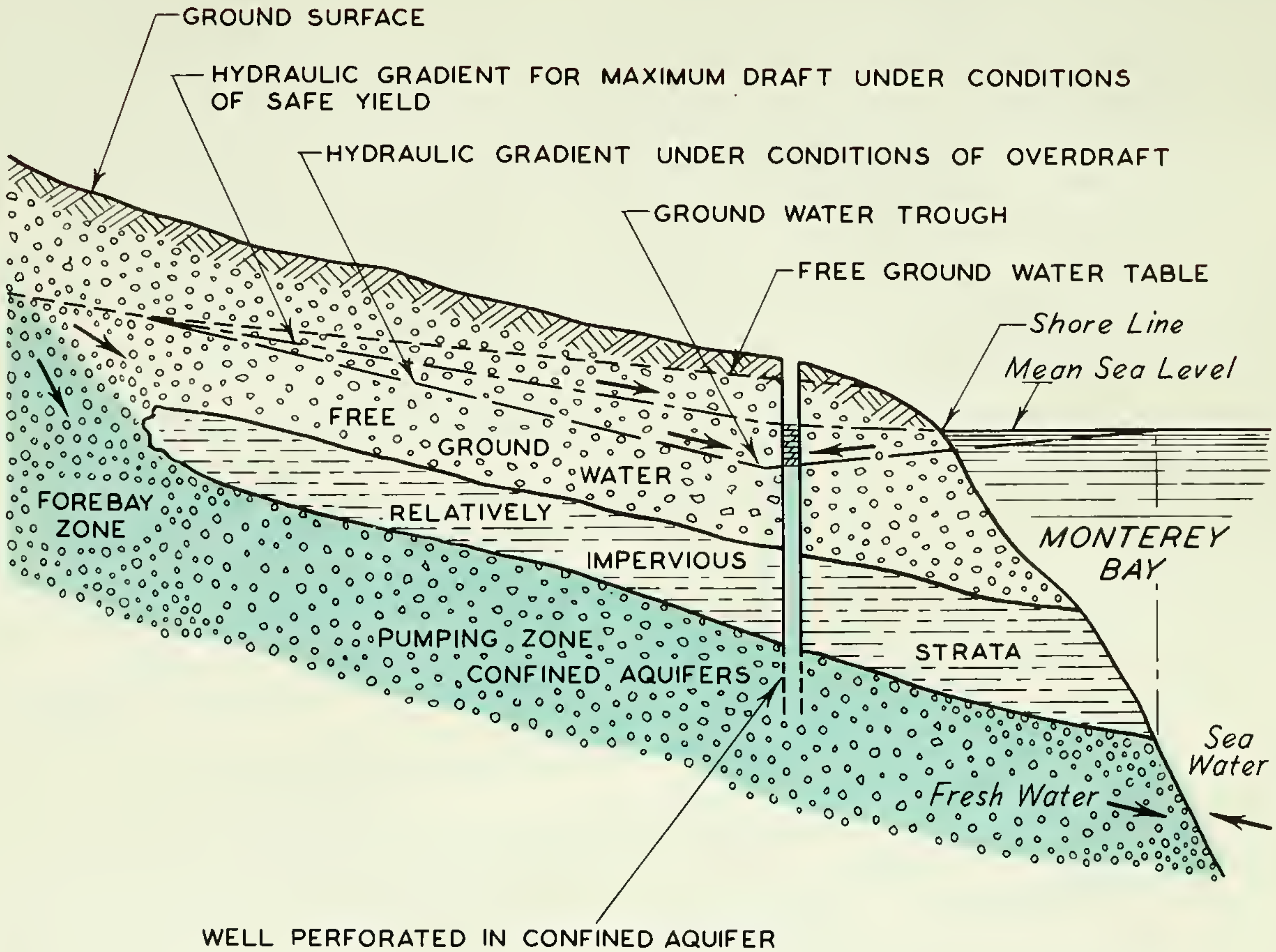
SCALE OF MILES
1 0 1 2 3

LEGEND

5 — LINES OF EQUAL ELEVATION OF GROUND WATER IN FEET

BOUNDARY OF PAJARO UNIT

APPROXIMATE 500-FOOT CONTOUR



DIAGRAMMATIC CROSS SECTION OF PAJARO UNIT

HYDRAULIC GRADIENTS OF CONFINED AQUIFERS
UNDER CONDITIONS OF SAFE YIELD AND OVERDRAFT


LEGEND
PRESENT IRRIGATED AREA
PRESENT URBAN AREA
PRESENT RECREATIONAL AREA
PROBABLE ULTIMATE WATER SERVICE AREA
BOUNDARY OF UNIT
BOUNDARY OF SANTA CRUZ - MONTEREY AREA
APPROXIMATE 500-FOOT CONTOUR
41 LOCATION OF PLOT STUDIES
NORTH COASTAL UNIT
SAN LORENZO UNIT
SOQUEL UNIT
PAJARO UNIT
MONTEREY BAY
PACIFIC OCEAN
SANTA CRUZ
WATSONVILLE
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SANTA CRUZ-MONTEREY COUNTIES INVESTIGATION
PRESENT AND PROBABLE ULTIMATE WATER SERVICE AREAS
SCALE OF MILES


STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION
EXISTING WATER CONSERVATION WORKS
AND
WORKS CONSIDERED FOR FUTURE DEVELOPMENT
SCALE OF MILES
1 0 1 2 3
LEGEND
POTENTIAL DAM AND RESERVOIR
POTENTIAL CONDUIT
EXISTING DAM AND RESERVOIR
EXISTING CONDUIT
BOUNDARY OF SANTA CRUZ - MONTEREY AREA
BOUNDARY OF UNIT
APPROXIMATE 500-FOOT CONTOUR
PACIFIC OCEAN
MONTEREY BAY
NORTH COASTAL UNIT
SAN LORENZO UNIT
SOQUEL UNIT
PAJARO UNIT
WATERMAN SWITCH RESERVOIR
BEAR CREEK RESERVOIR
JAMISON RESERVOIR
NEWELL CREEK RESERVOIR
ZAYANTE CREEK RESERVOIR
GLENWOOD RESERVOIR
UPPER SOQUEL RESERVOIR
SOQUEL CREEK RESERVOIR
APTOS CREEK RESERVOIR
DOYLE GULCH RESERVOIR
PINTO LAKE RESERVOIR
WATSONVILLE RESERVOIR
ELKHORN SLOUGH RESERVOIR
EL OSO RESERVOIR
ARCHIBALD RESERVOIRS
LAGUNA CREEK RESERVOIR
BALD MT. SCHOOL RESERVOIR
SANTA CRUZ
WATSONVILLE
CAPITOLA
SOQUEL
APTOS
FELTON
BEN LOMOND
BOULDER CREEK
SCOTT VALLEY
DAVENPORT
LA SELVA BEACH
BIG TREES PARK
PARADISE PARK
MT. MADONNA
LAND'S END
HECKER PASS
CORRALITOS
WATERMAN GAP
SANTA CLARA COUNTY
SANTA CRUZ COUNTY
SAN MATEO COUNTY
MONTEREY COUNTY
SAN BENITO COUNTY
R. 4 W.
R. 3 W.
R. 2 W.
R. 1 W.
R. 1 E.
R. 2 E.
R. 3 E.
T. 8 S.
T. 9 S.
T. 10 S.
T. 11 S.
T. 12 S.
T. 13 S.
MT. DIABLO MERIDIAN
San Lorenzo River
Soquel Creek
Aptos Creek
Pajaro River
Corralitos Creek
Green Valley Creek
College Lake
Kelly Lake
Tynan Lake
Pinto Lake
McClusky Slough
Elkhorn Slough
Watsonville Slough
Harkins Slough
Struve Slough
BROWN CREEK DIVERSION
CORRALITOS CR. DIVERSION
DIVERSION WEIR
CANAL
PIPE LINE
PUMPING PLANT NO. 2
PUMPING PLANTS
LAGUNA CR. DIVERSION
LIDDELL CR. DIVERSION
MAJORS CR. DIVERSION
MILL CREEK RES.
COWELL RES.
BAY ST. RES.
SEMPERVIRENS RES.
FREEDOM RES.
WATSONVILLE JUNCTION
SPRINGFIELD SCHOOL

STATE OF CALIFORNIA
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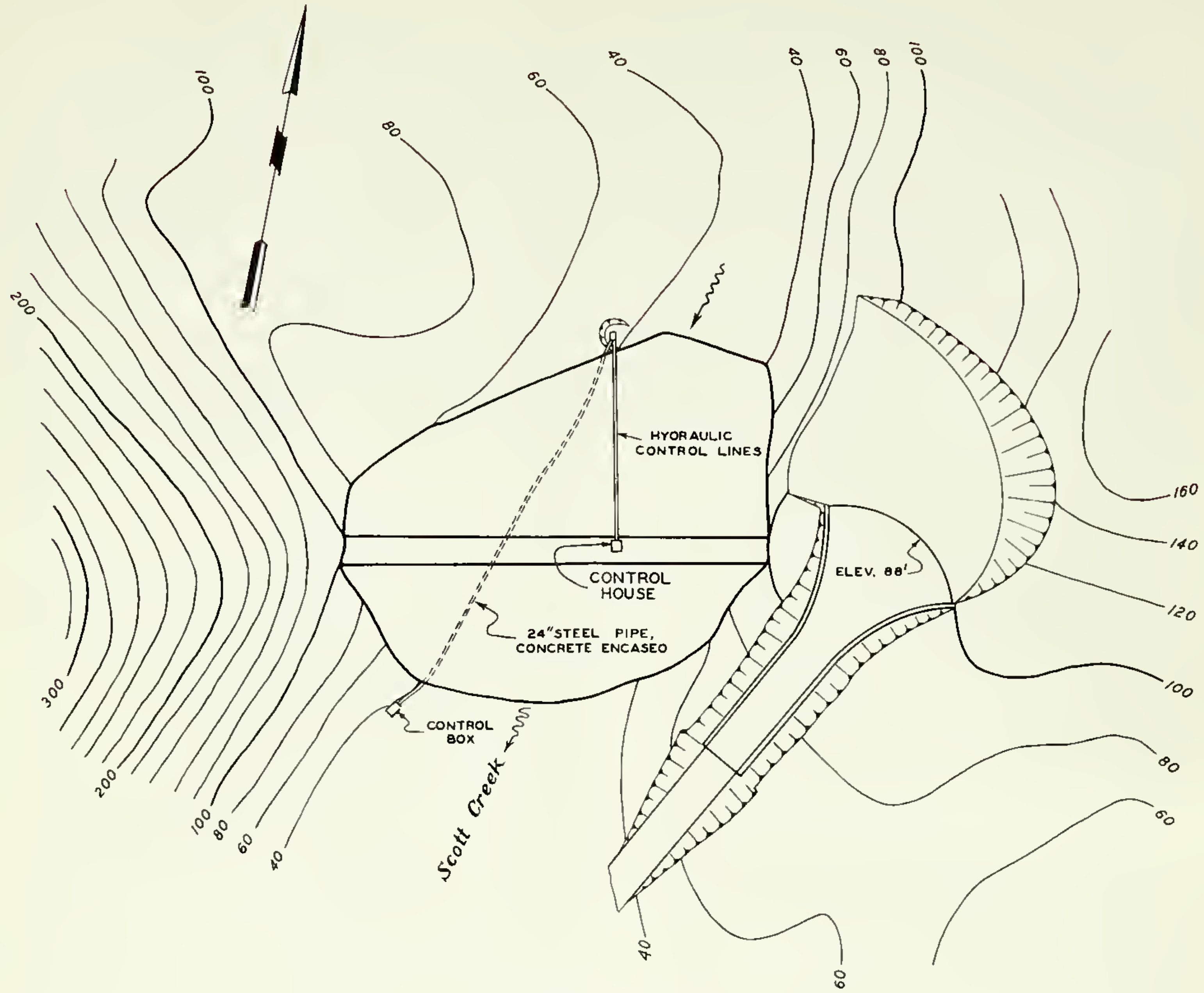
DIVISION OF WATER RESOURCES

SANTA CRUZ - MONTEREY COUNTIES INVESTIGATION

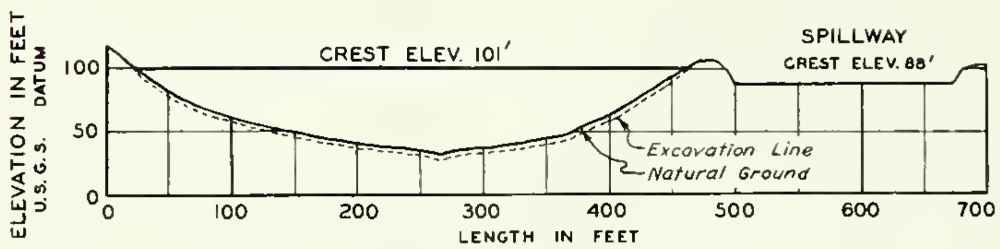
POSSIBLE WATER CONSERVATION WORKS AND SERVICE AREAS UNDER INITIAL DEVELOPMENT



GENERAL PLAN

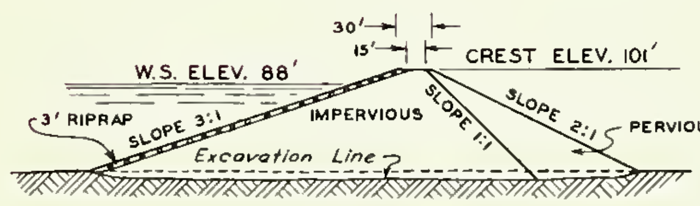
SCALE OF FEET

0 100 200



PROFILE OF DAM

LOOKING UPSTREAM



SECTION OF DAM

SCALE OF FEET

0 100 200

STATE OF CALIFORNIA

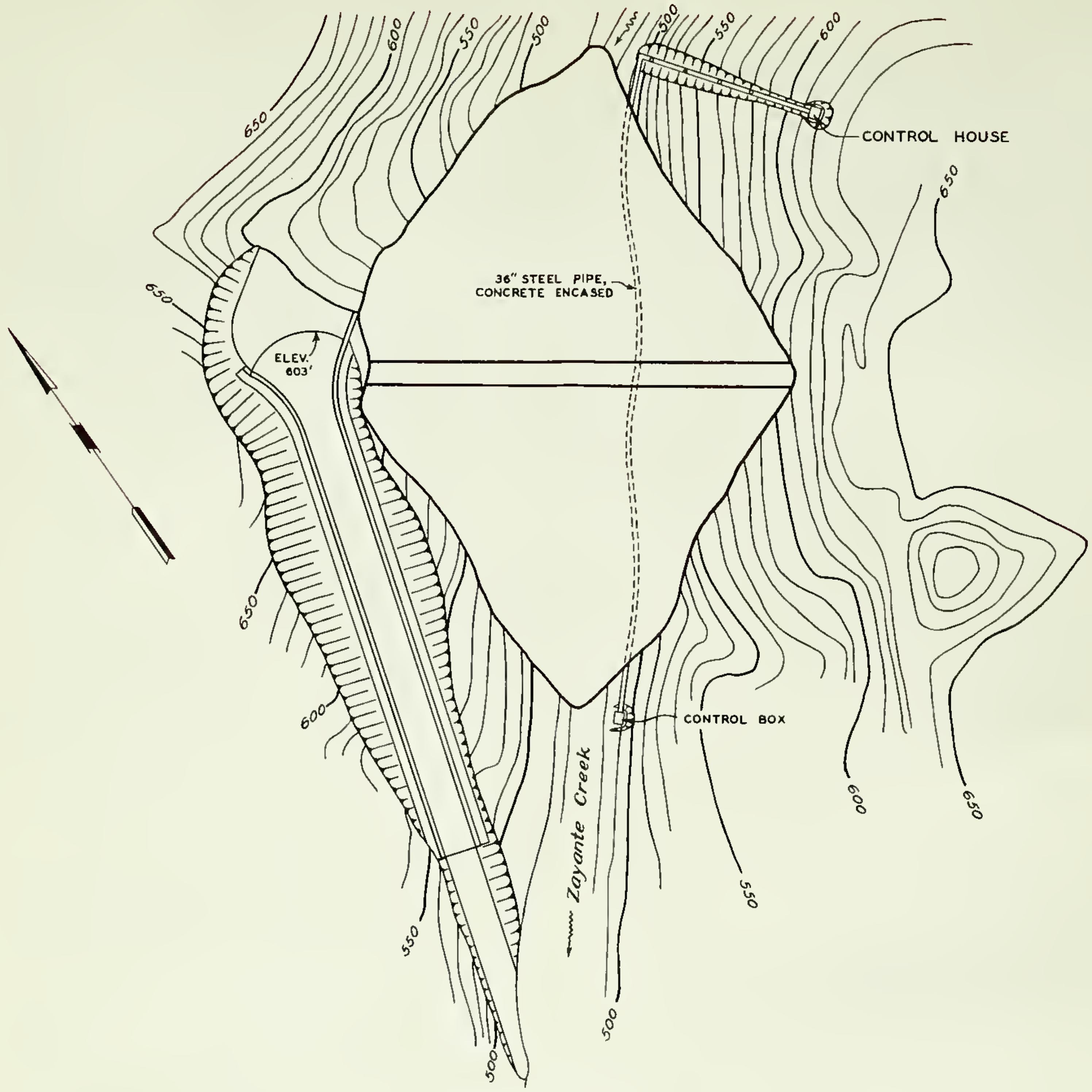
DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES

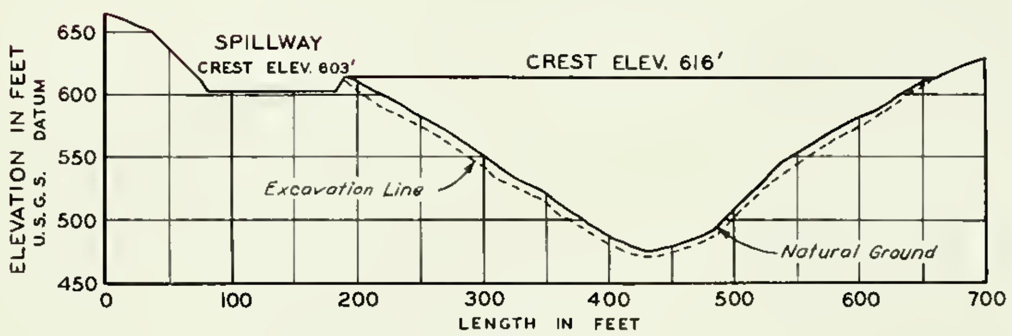
ARCHIBALD DAM

ON

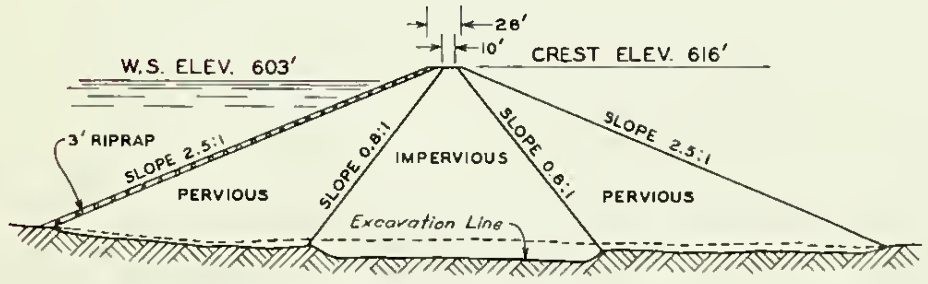
SCOTT CREEK



GENERAL PLAN
SCALE OF FEET
0 100 200



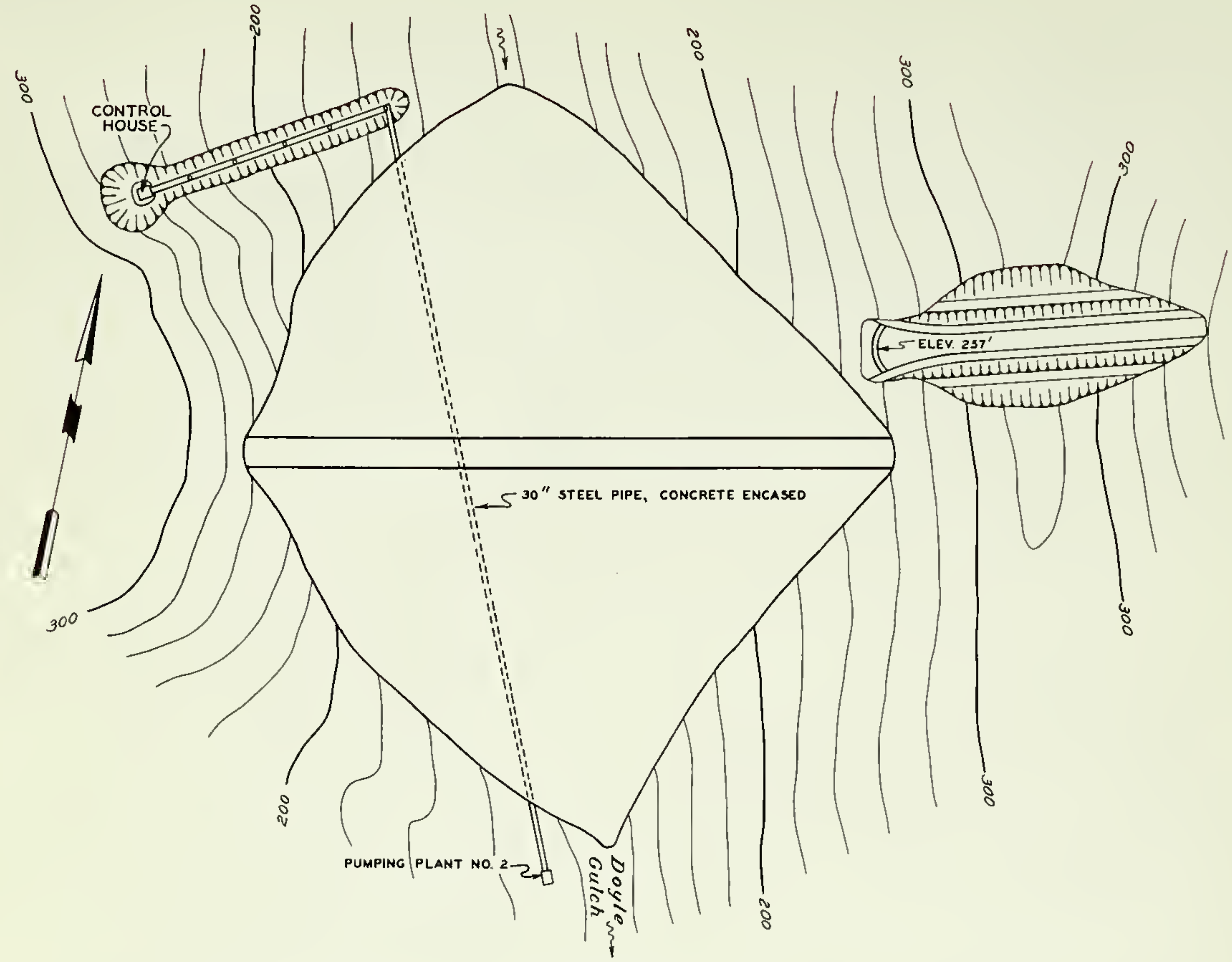
PROFILE OF DAM
LOOKING UPSTREAM



SECTION OF DAM
SCALE OF FEET
0 100 200

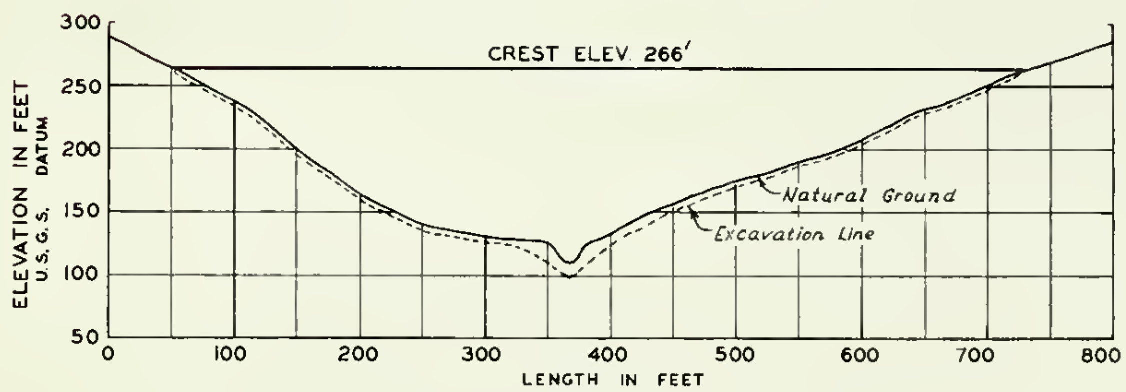
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

ZAYANTE CREEK DAM
ON
ZAYANTE CREEK



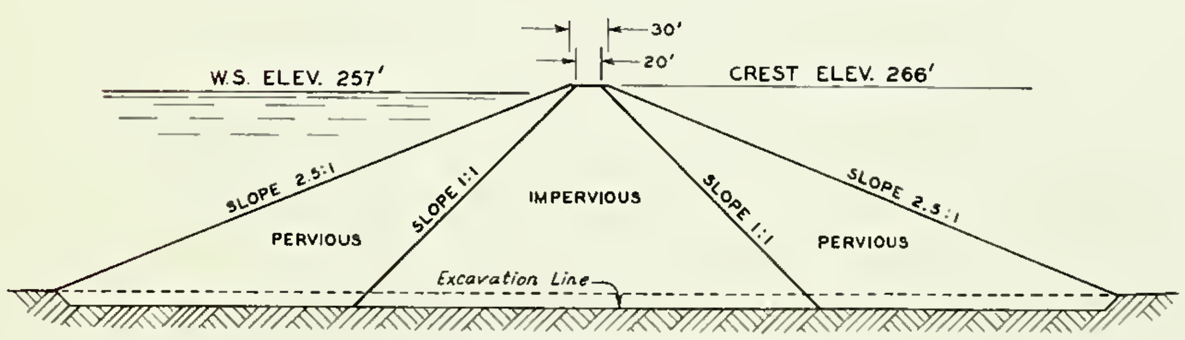
GENERAL PLAN

SCALE OF FEET
0 100 200



PROFILE OF DAM

LOOKING UPSTREAM

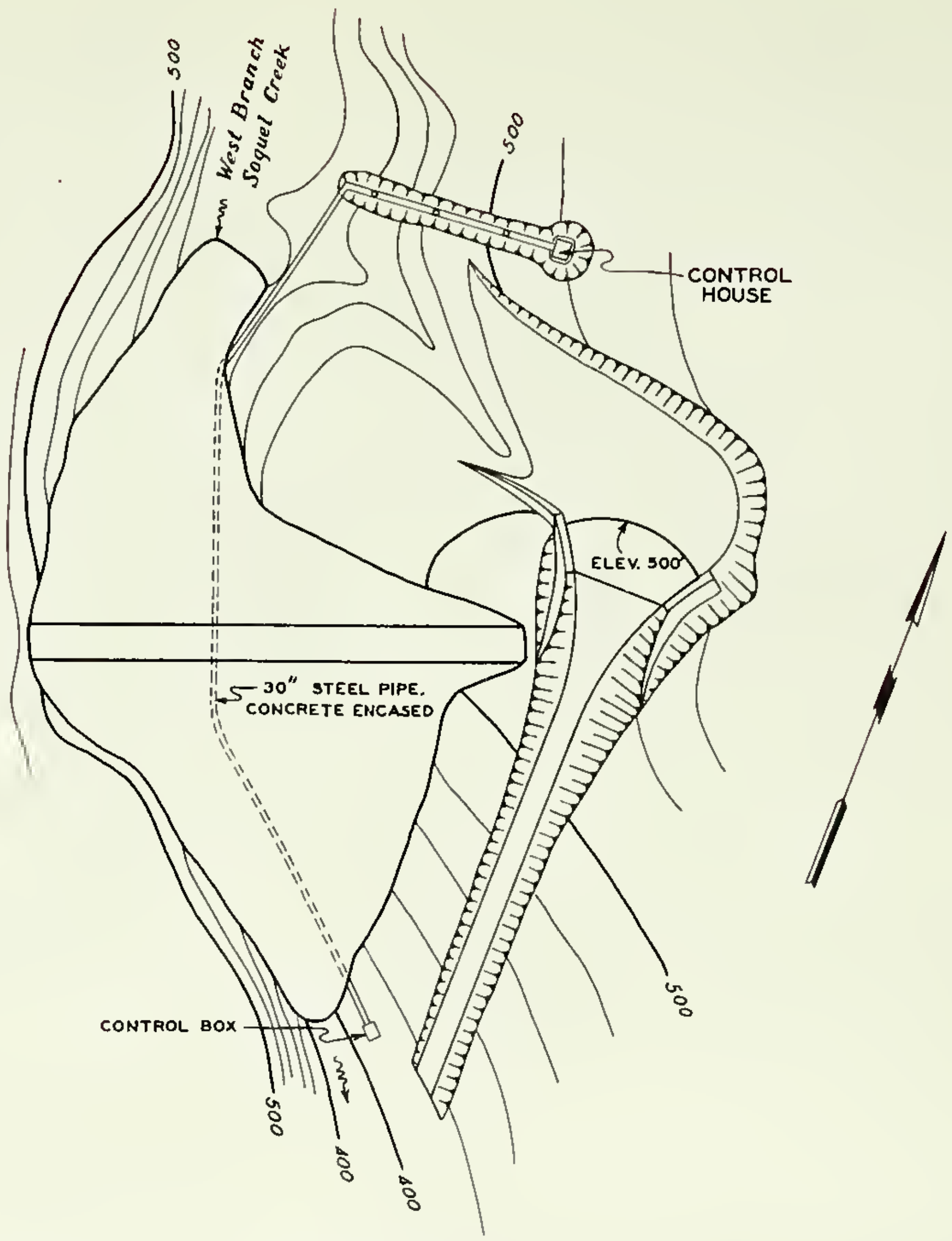


SECTION OF DAM

SCALE OF FEET
0 100 200

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

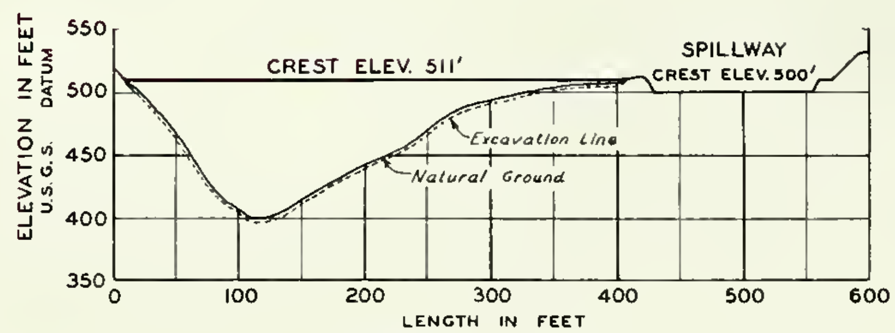
DOYLE GULCH DAM
IN
DOYLE GULCH



GENERAL PLAN

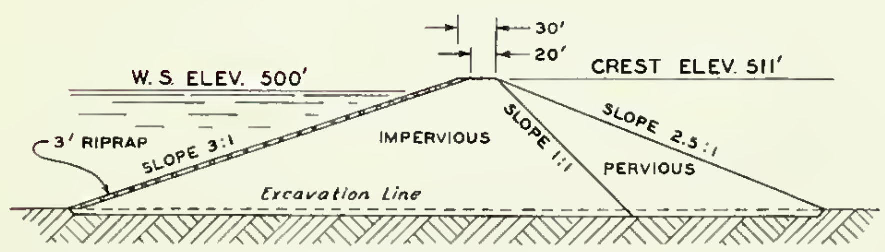
SCALE OF FEET

0 100 200



PROFILE OF DAM

LOOKING UPSTREAM



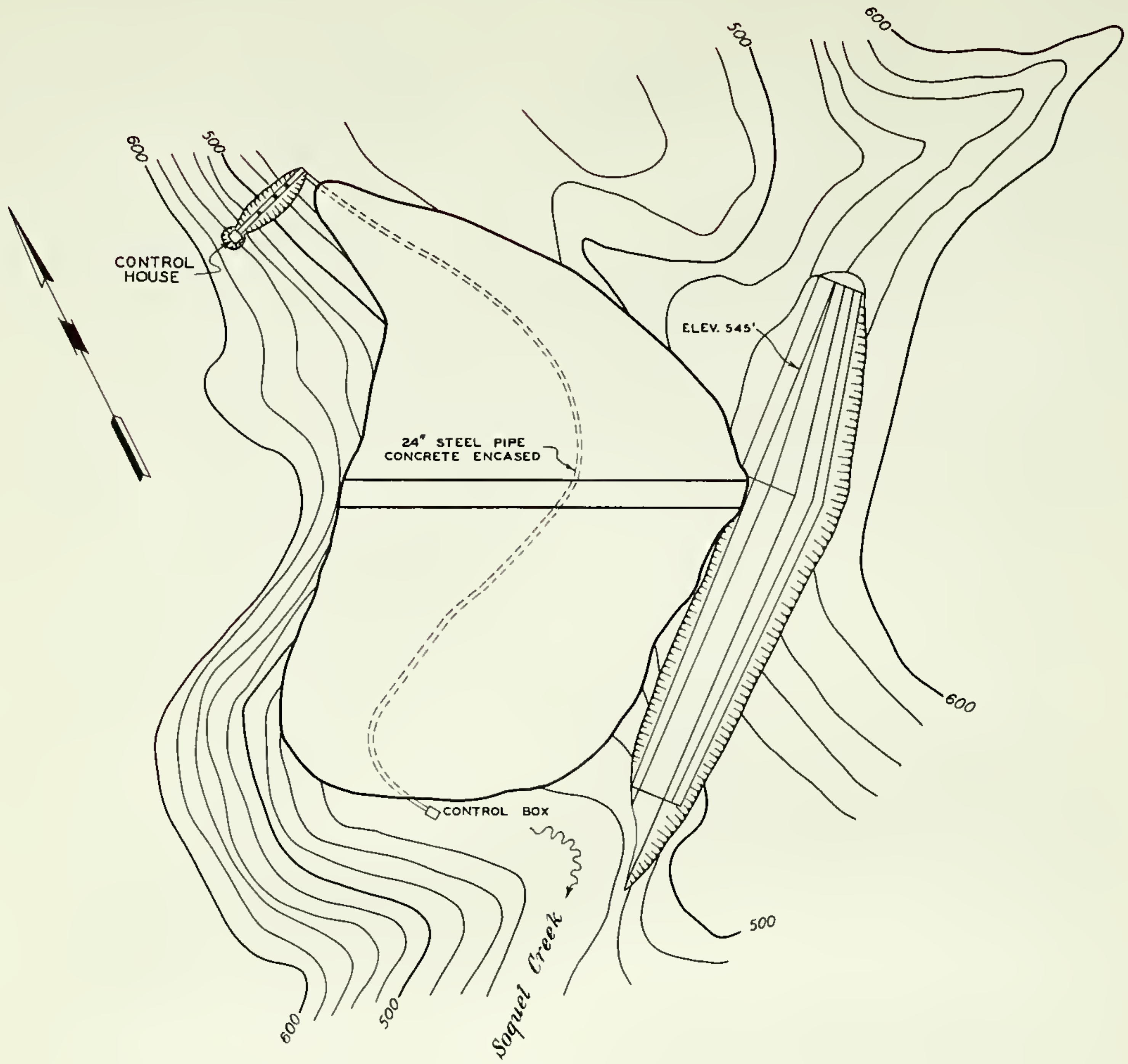
SECTION OF DAM

SCALE OF FEET

0 100 200

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

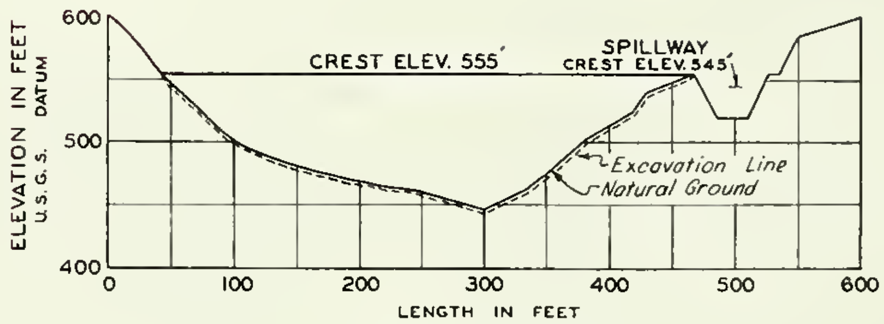
GLENWOOD DAM
ON
WEST BRANCH SOQUEL CREEK



GENERAL PLAN

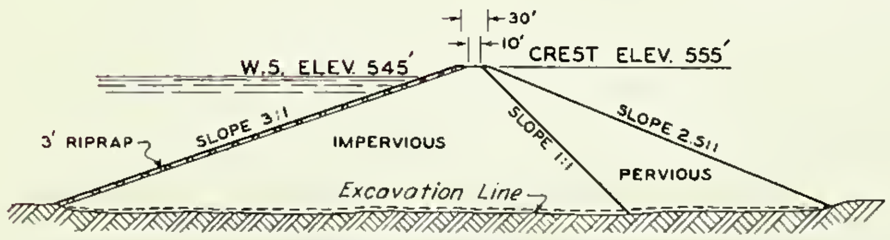
SCALE OF FEET

0 100 200



PROFILE OF DAM

LOOKING UPSTREAM



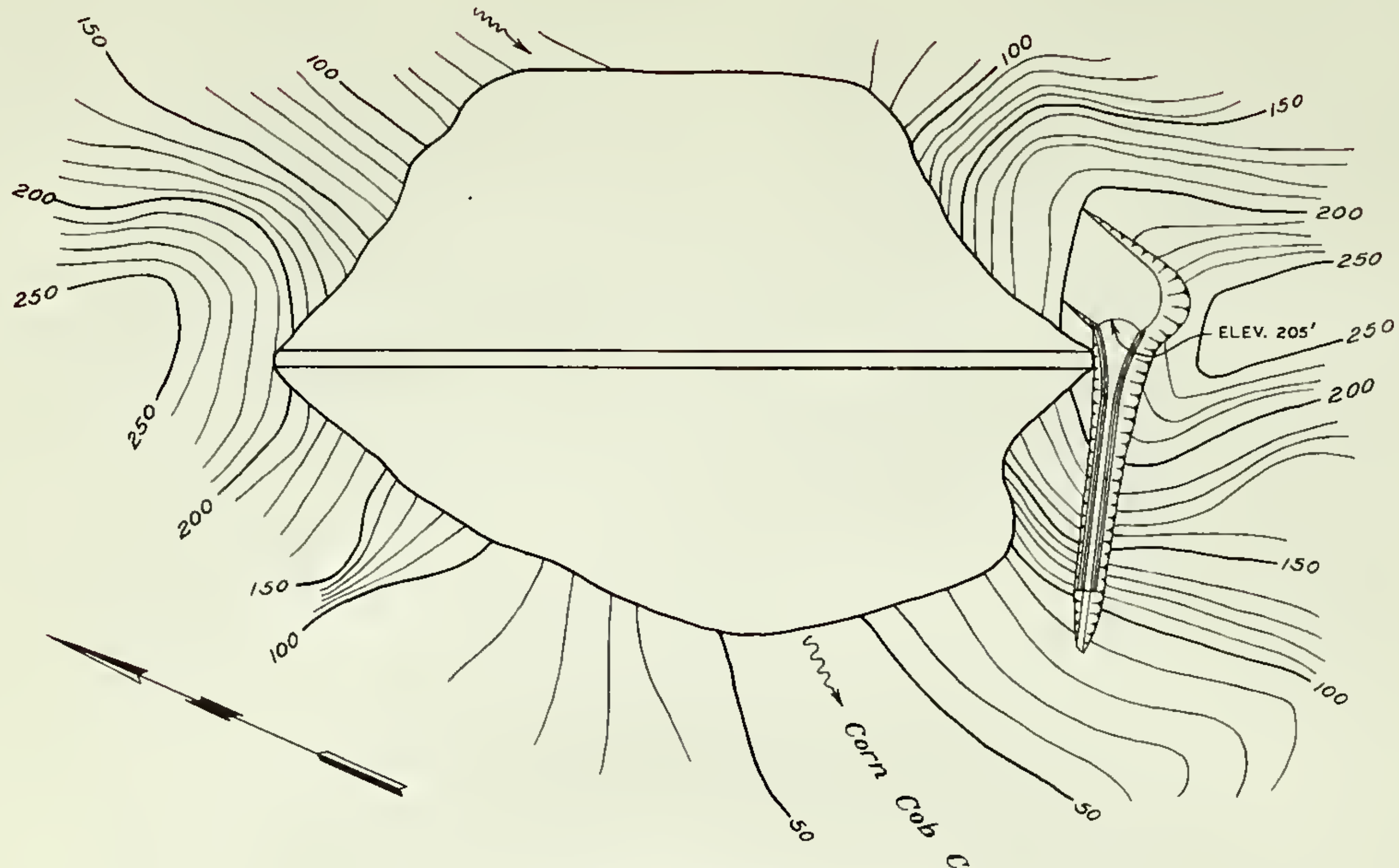
SECTION OF DAM

SCALE OF FEET

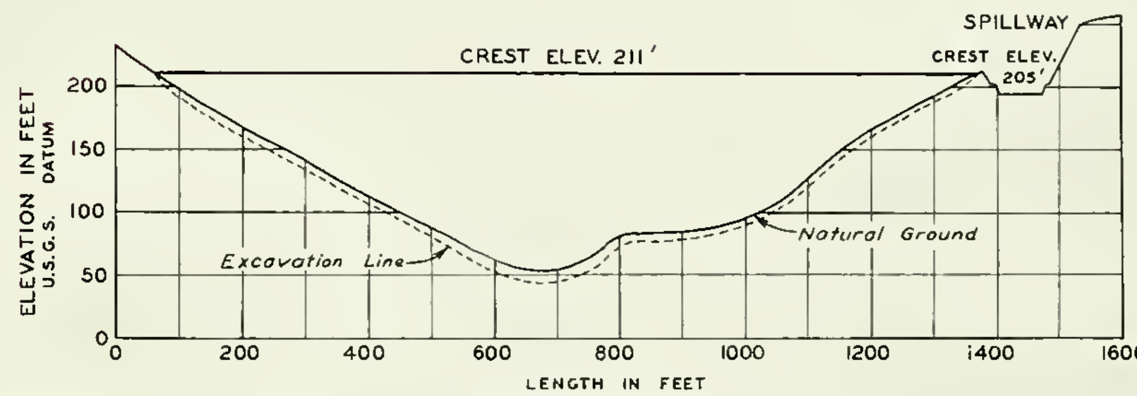
0 100 200

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

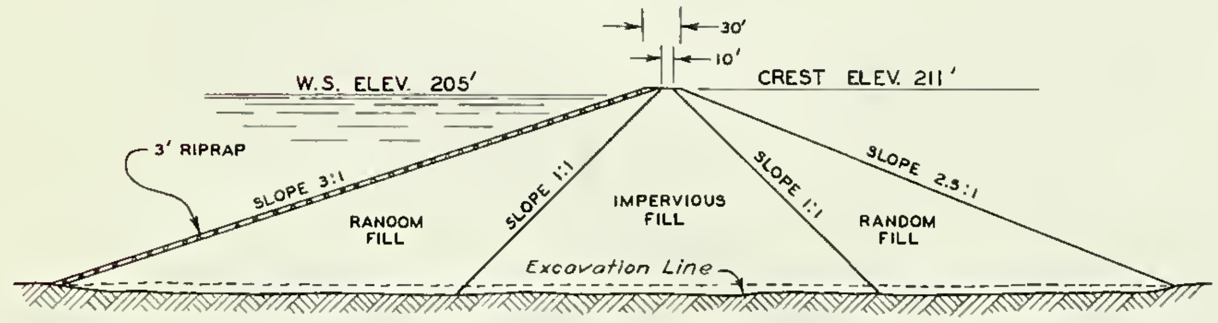
UPPER SOQUEL DAM
ON
SOQUEL CREEK



GENERAL PLAN
SCALE OF FEET 0 200 400



PROFILE OF DAM
LOOKING UPSTREAM



SECTION OF DAM
SCALE OF FEET 0 100 200

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

WATSONVILLE DAM
IN
CORN COB CANYON