Study of

WATER SUPPLY SITUATION IN THE SAN JACINTO RIVER BASIN

Made by H.W. Goodhue

Dept. of Civil Engineering

Calif. Inst. of Technology

Pasadena, Calif., June 13, 1924

B.S. THESIS

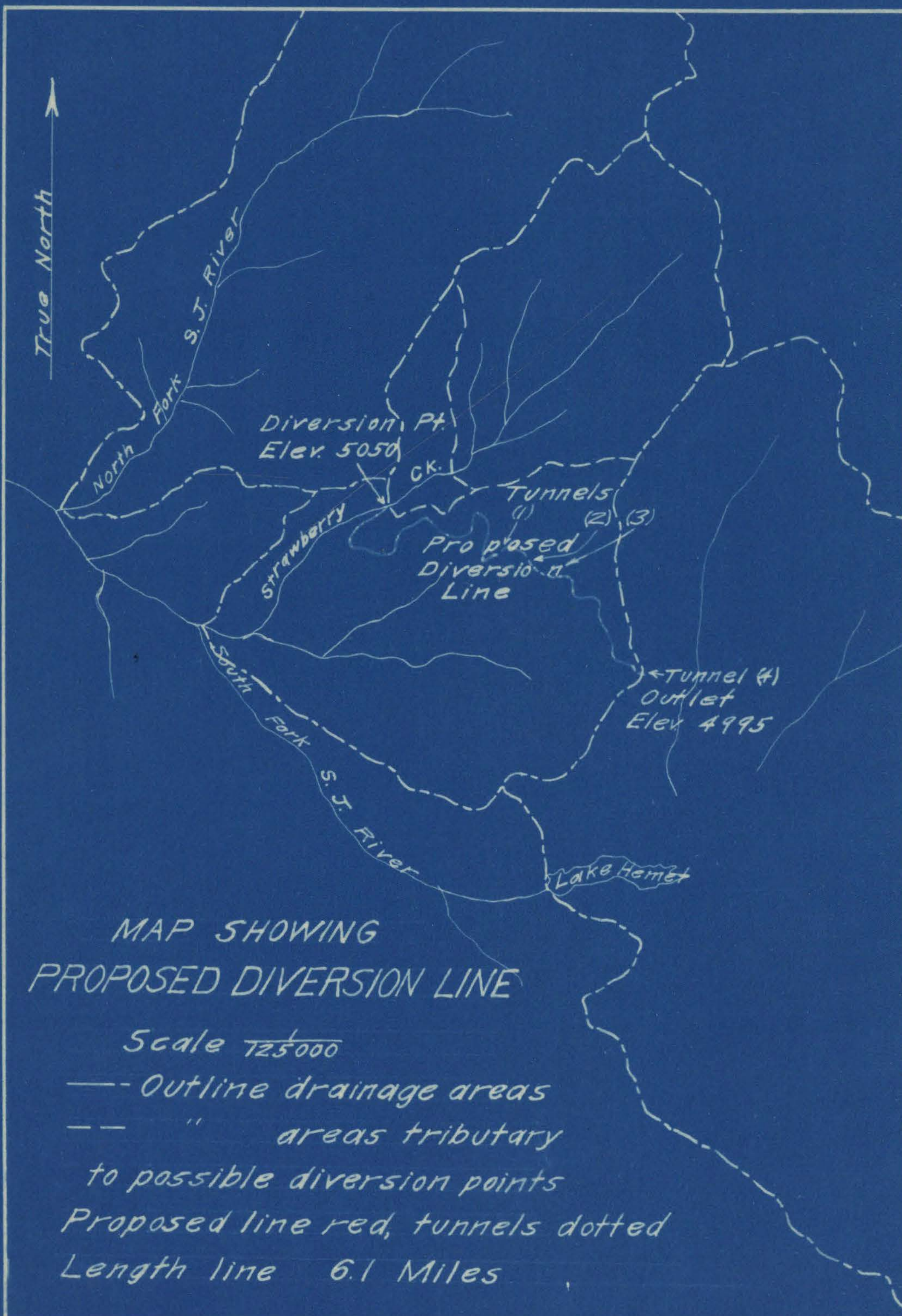
TABLE OF CONTENTS

INDEX TO TABLES

INTRODUCTION AND PROCEDURE

The San Jacinto Basin drains the west slope of the San Jacinto Mountains in Riverside County. The San Jacinto River, which originates in the junction of the North Fork South Fork, and Strawberry Creek near the same at the base of these mountains, flows eventually into Elsinore Lake. Here it stays and evaporates except in years of extreme flood when it has overflowed in the past into the Santa Ana River thru Temescal Canyon.

The object of this report is to determine, if possible, the amount of water still available for agricultural use, if any, and to study means of making this water useful. The first portion consists of estimates of the stream flow and run-off of the basin from available records. These estimates, so far as the stream flow of Strawberry Creek, South Fork, and North Fork is concerned, are also used in the latter part in the study of possible storage, where actual measurements are lacking. The second portion shows the requirements for various uses in the basin, including maintenance of Lake Elsinore, ground water, and surface water, in relation to the estimated run-off. The third part is a consideration of the duty of water in the basin. The final part is a study of the proposed increase in the surface water use by the diversion of a portion of the flow of Strawberry Creek into Lake Hemet Reservoir.



MAP SHOWING
PROPOSED DIVERSION LINE

Scale $\frac{1}{125000}$

—- Outline drainage areas
— — " areas tributary to possible diversion points
Proposed line red, tunnels dotted
Length line 6.1 Miles

T A B L E I

ANNUAL PRECIPITATION AT LAKE HEMET

(From records of Lake Hemet Water Co.)

Season	Rainfall in.	Snowfall in.	Equivalent Rrec. in.
I899-I900	I4.80	30.0#	I7.8
I900-0I	I7.87	30.0#	20.9
I90I-02	I3.43	30.0#	I6.4
I902-03	I7.9I	30.0#	20.9
I903-04	I2.34	30.0#	I5.3
I904-05	23.20	30.0#	26.2
I905-06	26.26	30.0#	29.3
I906-07	24.7I	32.5	27.9
I907-08	23.76	I7.0	25.5
I908-09	23.25	I5.9	23.8
I909-I0	I425	44.4	I8.6
I9I0-II	I8.75	I0.5	I9.8
I9II-I2	II.65	49.8	I6.6
I9I2-I3	II.33	30.0#	I4.3
I9I3-I4	22.55	2.0	22.8
I9I4-I5	23.06	38.5	26.8
I9I5-I6	I5.95	46.0	20.7
I9I6-I7	II.8I	5I.5	I7.0
I9I7-I8	I3.59	30.0#	I6.6
I9I8-I9	II.I9	30.0#	I4.2
I922-23	I3.05	25.5	I5.6

Equivalent precipitation includes snowfall at one tenth its depth of rainfall

# indicates that snowfall is assumed as the average for years of record

TABLE II

ANNUAL PRECIPITATION AT HEMET, CAL.

(From records of Lake Hemet Water Co.)

Season	Precipitation in.	Season	Prec. in.
I9I0-II	I4.84	I9I7-I8	I3.46
I9II-I2	I2.96	I9I8-I9	8.96
I9I2-I3	I0.75	I9I9-20	I3.74
I9I3-I4	20.73	I920-2I	8.77
I9I4-I5	24.I6	I92I-22	25.80
I9I5- I6	I9.50	I922-23	8.65
I9I6-I7	I5.07		

Rainfall records at other points in the basin are taken from U.S.G.S. Water Supply Paper 429

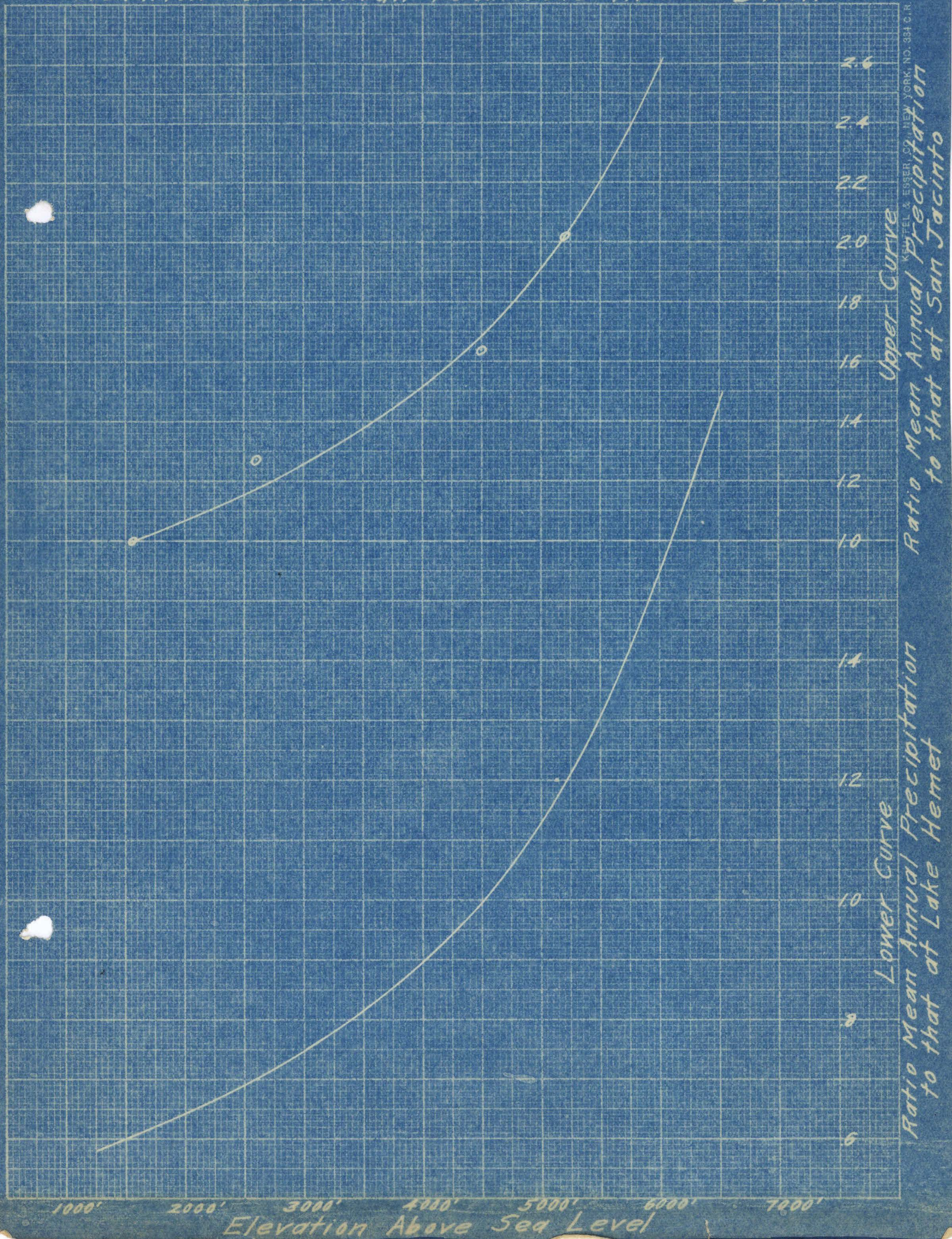
T A B L E III

ELEVATION AND MEAN ANNUAL PRECIPITATION AT DIFFERENT POINTS IN BASIN

	Elevation	Mean Precipitation in.		Ratio to That At San Jacinto For Same Period
		I892-I902	I90I-II	
Lake Hemet	4500		22.5	I.64
Idyllwild	5200		27.8	2.02
Beaumont	2600	I4.33		I.27
San Jacinto	I550	II.3I	I3.76	I.00

From the above table the curve entitled "Curve Showing Relation of Precipitation to Elevation" was plotted.

Curve Showing
Relation of Rainfall to Altitude in S.J. Basin



ESTIMATION OF DISCHARGE SOUTH FORK AT LAKE HEMET
(INFLOW INTO LAKE HEMET)

Records of the heights of water in Lake Hemet at intervals of one month, as well as the maximum and minimum heights for each year which indicated the heights at the beginning and end of irrigation draft, were secured over the period from 1909 to 1922, from records of the Lake Hemet Water Co.

The inflow during the winter months when the lake was closed was estimated by taking the difference in the capacities, from the capacity curve for the lake, corresponding to the heights of water at the beginning and the end of each month. These monthly flows were ~~not~~ corrected for estimated evaporation, which is slight during the rainy season, and are therefore estimates only instead of actual values. In months in which there was spill over the crest of the dam the amount of this spill as taken from records of the company was added to the above inflow corresponding to an increase in water level.

The monthly depth of evaporation in inches assumed for the corrections were as follows:

March	2	August	8
April	3	September	7
May	5	October	5
June	8	November	2
July	8		

For the months in which the lake was under draft a different method had to be pursued as water was flowing in and out at the same time. For the year s from I909 tb I9I4 records of the total draft on the lake are available. For these years the difference in capacities corresponding to the water levels at the beginning and end of draft, corrected for evaporation, gives the apparent draft. The difference between this and the measured draft, which is always larger gives the inflow into the lake during the period.

For years since I9I4 records of draft were not accessible, but records of total water deliveries are available for all years. For these years, therefore, the monthly inflow into Lake Hemet, as well as the flow in Strawberry and North Fork, was estimated for the season of draft as follows. The monthly water delivery was increased by I5 % to allow for losses. This amount is reasonable as it was assumed for the Riverside system of similar canals, concrete and wood. Some actual fragmentary measurements made on the Lake Hemet system indicate a loss of about I0 %. This monthly diversion is derived from three sources during the season of draft:

(I) Total flow of North Fork

(2) Total flow of Strawberry

(3) Draft on Lake Hemet

Therefore the difference between the estimated diversion and the apparent draft on the lake as determined above will give the combined discharge for the month of North Fork, Strawberry, and inflow into Lake Hemet. As this is small during the season of draft and since it is all available for irrigation use, it is not material how it is distributed among the three. It will therefore be divided equally.

For months in which draft does not start sufficiently near the first or last of a month to be so considered, the flow has been estimated partly by the first method and partly by the second or third. An example of this type will be given to show the method for other months as this will involve all the steps.

Example: November, 1921

(1) Total water delivery 10340 M. I. D.

Total diversion, increase 15 % 11900 M.I.D.

Ht. lake at beginning of month 81' 6"

Less evap. for half period ½" 81' 5½"

(period ½ mo. to end draft)

Ht. lake at end draft (Nov. 18) 78'

Plus evap. allowance ½" 78' ½"

Difference in capacities at beginning and end of period 8560 M.I.D.

Example, cont:

Combined discharge three streams (to Nov. I8)

3340 M.I.D.

Portion assumed for Lake Hemet IIIO M.I.D.

(2) Ht. water Nov. I8 78'

~~Plus~~ Less $\frac{1}{2}$ evap. for period $\frac{1}{2}$" ~~78' $\frac{1}{2}$"~~ 77' 11$\frac{1}{2}$"

Ht. water Nov. 30 78' 9$\frac{1}{4}$"

Plus $\frac{1}{2}$ evap. for period $\frac{1}{2}$" 78' 9$\frac{3}{4}$"

Difference in corresponding capacities

2020 M.I.D.

Total estimated inflow for month

3I30 M.I.D.

As the above method of estimating total diversions is necessarily inaccurate, the combined discharge in some months comes out negative. In such cases it is assumed to be zero.

TABLE IV

MONTHLY DISCHARGE SOUTH FORK AT LAKE HEMET

(From gage heights and drafts at Lake Hemet)

In Miners Inch Days

Month	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
Jan.	43600	67100	15890	6050	0	39850	27480		22920	5040	4540	7310	10840	49100
Feb.	68300	16710	30770	3030	12360	71900	132470		41570	8060	10080	28250	6050	206420
March	49200	13510	44100	29000	24200	22690	70430		31110	72350	15630	70800	14120	126710
April	25840	13370	11100	40100	12100	16900	40970		19200'	12610	4790	42600	6550	34050
May	13850	32010	6300	15630	4790	11350	119010		10000'	9050	6470	16140	8070	27500
June	3860	29510#	22220#	32090#	24000#	3780	22210		4600'	4300	1620	7560	6040	4790
July	27520#					250#	8570		2480	2620	0	5970	2070	7260
August							1210		0	1800	0	750	1350	3280
Sept.							1080		0	0	650	1380	550	280
Oct.							640	3500	580	2050	670	1780	2780	
Nov.					3030	2520	4550	4190	1500	3910	5930	5800	3130	
Dec.	20680	5290	6300	14380	7810	8820	7300	10800	3080	8820	9070	6550	114700	
Total (year)	252850	177500	136680	140280	88290	178060	435830		137040	130410	59450	194890	176250	
Season Total (Oct.-Sept.)	238000	192890	135670	132200	91830	177560	434870		150370	120790	58560	196430	69770	579000

Discharge beginning this month and including that of subsequent months until the next figure

' Interpolated from hydrograph for year

Record for most of 1916 is uncertain because most of it came in a short time and spilled over the dam. Accurate records of spill could not be obtained. The data is therefore not included.

ESTIMATION OF DISCHARGE OF NORTH FORK AND STRAWBERRY CREEK FOR MISSING MONTHS

Because of incomplete and uncertain discharge records since the flood of 1916 washed out many of the company's works, it was necessary to estimate as well as possible the discharge of North Fork and Strawberry Creek for many months by comparison with the inflow into Lake Hemet obtained above. This was done by obtaining the ratio of the monthly discharge of each of these streams for all months in the years from 1909 to 1915 and for 1922 (these records being complete) to the inflow into Lake Hemet in the corresponding months. The ratio for each stream of the average discharge for each month thruout the period of years to the corresponding average discharge of ~~Lake-Hemet~~ South Fork was also obtained. These ratios are shown in Table VII. Although there is a wide variation in the ratios, for Strawberry for example, for the same month of different years, there is a more or less definite tendency for the ratio to rise in certain months and fall in others. The ratio for a given month of the average discharge thruout the period of years is used to estimate the discharge of Strawberry and North Fork for that month in the years in which the record is missing. The inflow into Lake Hemet for a given month of the closed season is multiplied by this ratio for the given month for either stream to get estimated discharge of that stream for that month.

This method was used only for the closed season, that in which there is no draft from the Lake and the inflow can be fairly accurately estimated from the difference in water levels. For months in the open season the method used above in estimating the inflow into Lake Hemet for the same period was used. This consisted in dividing the combined discharge, estimated by taking the difference between the assumed diversions and the apparent draft on the lake, equally among the three streams, Strawberry Creek, North Fork and South Fork or Lake Hemet.

Only three months of North fork for the several years were estimated ~~because~~ by the first method because the record was not needed before March at least in order to determine the possible use of natural flow for irrigation, as the season does not commence until later.

T A B L E V

MONTHLY DISCHARGE OF STRAWBERRY CREEK

(Observed and Estimated)

In Miners Inch Days

Month	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
Jan.	19130	33600	27750	2450	5000	39400	11940		16850'	3710'	3340'	5370'	7980'	44380
Feb.	24560	19380	43230	1860	10500	83200	85880		26600'	5150'	6450'	18060'	3870'	77060
March	28150	19030	52480	34720	33600	51180	59830		30200'	70200'	15150'	56460	13640'	89150
April	35550	21000	28710	50730	26010	35220	53730		27570	20800'	10470	55820	10810'	69460
May	24890	9420	17170	33570	12060	33880	121550		24930	9050'	6470'	37070	13200	42240
June	7230	3960	6710	12840	5940	11010	37070		12560	4300'	1620'	12890	10730	19520
July	3720	1020	2600	4150	2200	2910	10960		2480'	2620'	600	4400	4310	8310
August	2820	60	620	810	900	960	3410		0'	1800'	50	1480	1440	3990
September	1980	0	0	270	540	270	1830		0'	0'	80	370	220	1020
Oct.	1360	250	460	2170	500	1180	1110	3500'	580'	2050'	440	1650	1840	
Nov.	4410	1140	990	1950	2100	1260	2270	3150'	1500'	2700'	3500'	2650	1630	
Dec.	26470	1150	1460	2140	3530	4440	6180	4280'	2080'	3490'	3590'	4100	28830	
Season Total (Oct.-~~Nov.~~ Sept.)	218540	139730	181820	143500	102510	264170	393060		174120	121790	52470	199450	74600	387430

' indicates estimated flow

Remaining flow from records of L. H. W. Co.

Most of 1916 omitted because flood in January washed out most of company's works and subsequent records are uncertain

TABLE VI

MONTHLY DISCHARGE OF NORTH FORK

(From records of L. H. W. Co. and estimated)

In Miners Inch Days

Month	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
Jan.	23250	43880	39640	4150	6040	66900	17870					5000		68560
Feb.	29960	28750	44870	3220	12670	107530	111980							125300
March	34750	29160	73010	60480	31920	99500	102300		44900'	104500'	22600'	116430	20400'	117200
April	35320	26730	42980	87090	41600	66360	102610		12660	31100'	32370	113210	16180'	78300
May	24020	25560	35860	60050	22850	64800	159330		59630	9050'	6470'	56020	16950'	91620
June	9470	11060	4910	25880	32080	34950	53460		9390	4300'	1620'	19030	20040	53740
July	8730	2350	6750	7090	3440	9240	10720		2480'	2620'	1780	12050	6960	22600
August	5220	240	1500	0	2050	2780	6930		0'	1800'	590	4760	5440	5060
Sept.	2840	160	760	590	1220	820	4030		0'	5920	570	7800	5010	2000
Oct.	1810	1360	1530	4710	780	2220	2670	3500'	580'	2050'	1680	7400	5290	
Nov.	5400	2640	1880	3960	3400	2870	4910	2040'	1500'	1390'	8500	8330	5100	
Dec.	7000	29440	1980	2830	4500	4710	13650		3080'		14000		52540	
Season Total (Oct.-Sept.)	188050	204550	256260	254800	167030	461780	580310							627400

indicates estimated flow

Record for most of 1916 omitted because of uncertain records as in case of other streams

T A B L E VII

RATIO OF MONTHLY DISCHARGES OF STRAWBERRY CREEK AND NORTH FORK TO INFLOW INTO LAKE HEMET

A. STRAWBERRY CREEK

Month	I909	I9I0	I9II	I9I2	I9I3	I9I4	I9I5	I922	Ratio Aver.
Jan.	.44	.50	I.75	.40		.99	.44	.90	.74
Feb.	.34	I.I6	I.40	.6I	.85	I.I6	.65	.38	.64
March	.57	I.4I	I.I9	I.20	I.39	2.26	.85	.70	.97
April	I.38	I.57	2.59	I.26	2.I6	2.08	I.3I	2.I4	I.65
May	I.80	.29	2.73	2.I5	2.52	2.98	I.02	I.54	I.28
June-Nov.	.68	.22	.5I	.69	.45				.52
Dec.	I.28	.22	.23	.I5	.45	.50	.25		.40

B. NORTH FORK

March	.7I	2.I6	I.66	2.08	I.32	4.38	I.45	.92	I.44
April	I.37	2.00	3.87	2.I7	3.46	3.93	2.5I	2.85	2.47
May	I.73	.80	5.7	3.84	4.76	5.7I	I.34	3.33	2.I0

RELATION OF RUN-OFF TO RAINFALL

To determine the relation existing between rainfall and run-off on the three areas above for which satisfactory records are available, the areas of the portions tributary to the respective streams as well as the areas of all other portions of the basin (used later) were obtained. ~~These are shown in the plate in the back of this report.~~

The seasonal run-off (Oct.-Sept.) of the three streams for all years of satisfactory record since 1909 was then converted into acre feet. The intensity of run-off for each year for each stream was then obtained by dividing these figures by the respective areas tributary to each. This gave the result in acre feet per square mile. It was also expressed as depth in inches over the drainage area.

The Rainfall Run-off Curves for the three streams were plotted using the rainfall at Lake Hemet as the abscissa. This is merely a common base and does not truly represent the rainfall on any of the stream areas without correction for elevation which will be made later. The data for the curve are shown in Table VIII.

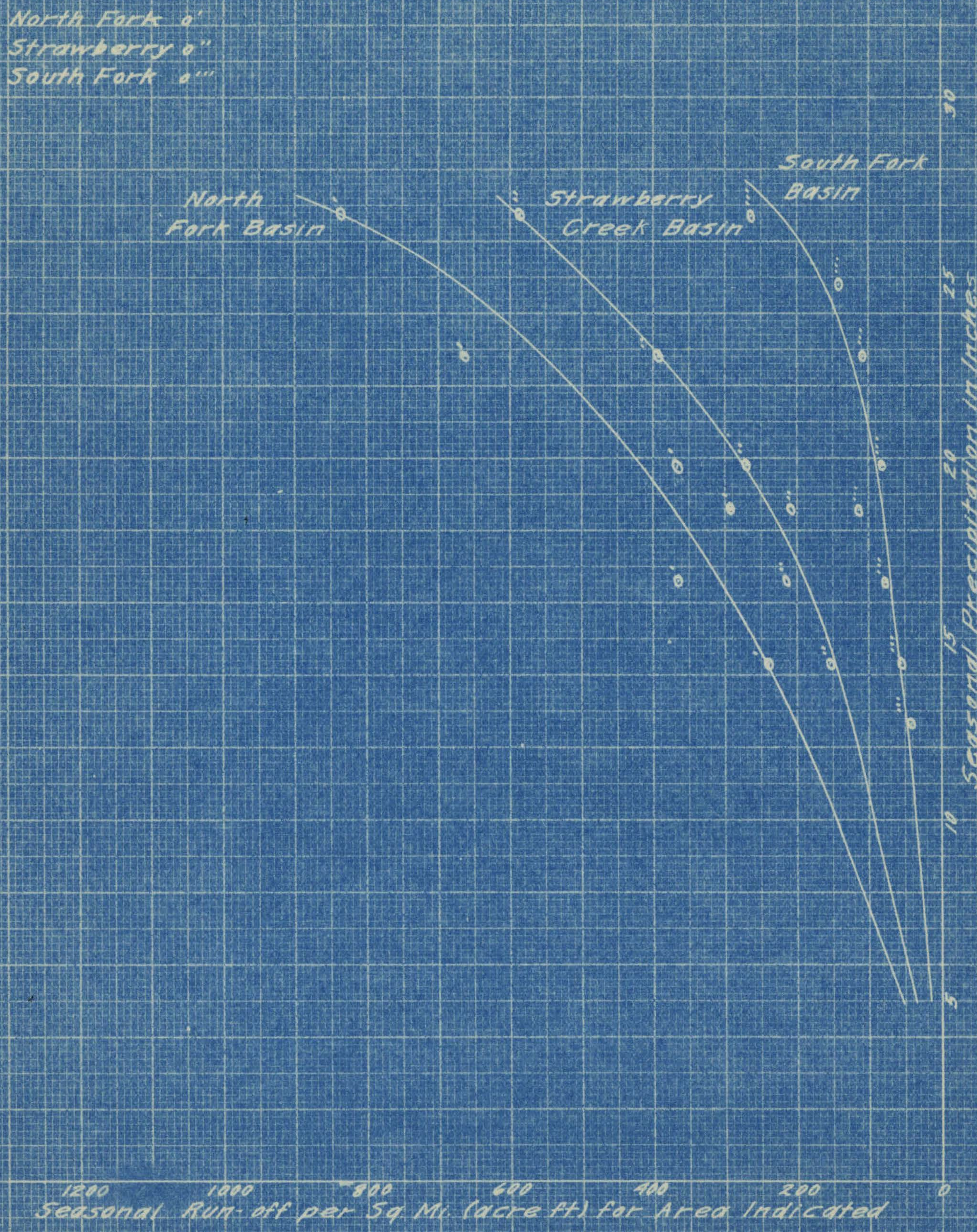
T A B L E VIII

RELATION OF SEASONAL RUN-OFF OF STREAMS TO SEASONAL RAINFALL AT LAKE HEMET

(Actual rainfall at mean elevation of each area is greater)

Year	Prec. at L. H.	Run-off North Fork Drainage Area 27.5 sq. mi.			Run-off Strawberry Creek Drainage Area 26.4 sq. mi.			Run-off South Fork Drainage Area 66.2 sq. mi		
		Acre Ft	Acre Ft /sq. mi.	Depth in.	Acre Ft	Acre Ft /sq. mi.	Depth in.	Acre Ft.	Acre Ft /sq. mi.	Depth in.
I908-09	24.8	7470	272	5.I0	8685	329	6.I7	9450	I43	2.68
I909-I0	I8.6	8I25	295	5.53	5550	2I0	3.94	7660	II6	2.I7
I9I0-II	I9.8	I0I80	370	6.94	7220	273	5.I2	5390	8I.4	I.53
I9II-I2	I6.6	I0I20	368	6.90	5700	2I6	4.05	5250	79.4	I.49
I9I2-I3	I4.3	6630	24I	4.52	4070	I54	2.89	3650	55.I	I.03
I9I3-I4	22.8	I8340	667	I2.5I	I0490	397	7.45	7250	I09.8	2.06
I9I4-I5	26.8	23040	838	I5.72	I56I0	59I	II.09	I74I0	263	4.93
I9I7-I8	I6.6							5I70	78.I	I.46
I9I8-I9	I2.7							2724	4I.2	.77
I9I9-20								8020	I2I.2	2.27
I920-2I								2675	40.4	.76
I92I-22		24920	907	I7.02	I5380	582	I0.92	I96I0	296	5.55
Mean 8 yr.		I3600			9090			9450		

Curves Showing Relation of Seasonal Run-off per Sq Mi. to Seasonal Rainfall on San Jacinto Basin



T A B L E IX

SEASONAL INFLOW INTO LAKE HEMET I895 TO I908

(From estimates of Division of Water Rights, Calif.)

Season	Annual Run-off Acre Ft.	Annual Run-off M. I. D.
I895- 96	2455	6I800
I896- 97	6070	I52800
I897- 98	2508	60600
I898- 99	I822	45900
I899- I900	2052	5I700
I900- 0I	4675	II7700
I90I- 02	29II	73300
I902- 03	5030	I26600
I903-04	2240	56400
I904- 05	6425	I6I800
I905- 06	I8090	455200
I906- 07	Io890	274I00
I907- 08	4I50	I04400

These estimates by the Division of Water Rights of the State of California Department of Public Works were made in the same essential manner as the estimates prepared above for Lake Hemet since I909, using the heights and discharges from the lake.

ESTIMATION OF SEASONAL RUN-OFF FOR WHOLE BASIN

The estimation of the run-off for those portions of the basin for which no records are available was made, except in the case of the agricultural area, by comparison with the run-off of the three streams for which reasonable records are obtainable, North Fork, Strawberry Creek and South Fork. This was done by using the run-off curves. The average elevation of each portion into which the basin was divided for purposes of comparison and the area of each was determined from U.S.G.S. sheets. The rainfall at San Jacinto, for which records were obtained from I892 to I915 from U.S.G.S. Water Supply Paper 429, was taken as the basis in obtaining the value of precipitation to use on the run-off curves.

This precipitation had to be corrected for each area depending upon its approximate average elevation. The correction used is called the precipitation factor. This precipitation factor was obtained by the use of the precipitation- elevation curve. Since the basic precipitation is that at San Jacinto, the precipitation at any point at a higher elevation will be approximately that multiplied by the ratio of precipitation at the higher elevation to that at San Jacinto as shown on the curve. This, however, does not give the precipitation value to use on the curveas it was constructed, not with the precipitation actually occurring at the average elevation of the stream whose flow was plotted, but with the precipitation at Lake Hemet. Therefore the above ratio must be divided by the ratio shown on the curve for the precipitation at the average elevation of the stream basin used for comparison, to that at Lake Hemet. As the curve for ratios on Lake Hemet was constructed with the precipitation for that point indicated on the precipitation elevation curve first drawn (on San Jacinto as base) instead of the actual value, which is somewhat lower, the factor resulting above must be further corrected by multiplying it by the ratio of the actual precipitation factor of Lake Hemet on San Jacinto to that indicated as the average for that elevation on the first curve. The resulting factor is the precipitation factor for the area in question.

All areas in the basin were compared with either Strawberry Creek or South Fork, according to which seemed to be more nearly like the area in question. The precipitation factor was then determined as above and multiplied by the annual precipitation at San Jacinto to obtain the annual precipitation to be used on the run-off curve of the area selected for comparison. The following annual or seasonal precipitations were thus obtained: (I) mean annual from I892 to I9I5; (2) maximum for the period; (3) minimum; (4) maximum five-year mean; and (5) minimum five year mean. The corresponding run-offs per sq. mi. from the curve were multiplied by a correction factor for run-off. This factor was so chosen as to represent the probable ratio of run-off on the area being estimated to that of the stream used for the comparison if both were at the same average elevation. A reasonable value for this factor was judged from a consideration of the characteristics of the areas involved, such as slope, character of soil and vegetation.The precipitation factor times the precipitation at San Jacinto thus gave the value to use on the run-off curve to obtain the rate of run-off per sq. mi. on an area similar in characteristics to the comparison stream, but at the elevation of the area to be estimated. The correction factor for run-off then corrected for the different character of the area and gave the probable rate of run-off on the area desired. By multiplying this value in each case by the area in sq. mi. the estimated seasonal runoff for each section was obtained,(mean, maximum, minimum, maximum 5-year mean, and minimum 5-year mean).

For the relatively flat agricultural area this method is obviously not satisfactory. In this case the surface run-off is negligible as well the under ground percolation due to rain falling on the area. The only factor of importance here is the ground flow due to percolation of irrigation waters, which is a matter of uncertainty. Ordinarily about 25% of the water applied as irrigation may be expected to seep away even when no over irrigation is practiced. In the San Jacinto Basin much of the water used is for cattle ranches, etc., where little loss is expected. Also some of the irrigated land seems to be under irrigated. It is therefore unlikely that more than 20% of the irrigation water applied finds its way back to the underground flow, although ranches which have plenty of well water do not skipm on its use. This assumption is therefore made in the estimate of the run-off.

Included in the estimates for different sections of the basin are of course figures for the three major streams, Strawberry, North Fork and South Fork. These, however, were obtained in a different manner. The figures for Lake Hemet or South Fork, which cover the period from 1895 to 1922, except 1916 and 1917, were used as estimated before in this report. Strawberry and North Fork were proportioned form these figures on the basis of the ratios, respectively, of their average discharges for the 8 years of complete record to that of South Fork. This was done for all values except the maximum, which was taken as that of 1921-22. As the flood year of 1915-16 would give tha max-the maximum value has little significance. These figures for the three streams go from 1895 to 1922 with the exception of 1915-16 and 1916-17, whereas those estimated for other portions run from 1892 to 1915. But with the ommission of these two years of high run-off there is probably little difference in the periods.

The estimates for the whole basin are shown in Table X. For the return irrigation water 20% of the irrigation in 1922 was used thruout as this represents the most recent use and may be expected to continue if not to increase. The estimate therefore shows the conditions which would have occurred if this volume had been used in the past.

For purposes of comparison an estimate of the run-off of the basin for the year 1921-22 was made and compared with the measured discharges of the San Jacinto River above San Jacinto and at Elsinore and as made by the U.S.G.S. As the rainfall at San Jacinto was not obtainable for this year, a different method of estimating was employed. This was comparison with the similar year 1914-15. The ratios of the discharges of Strawberry, North Fork and South Fork in the latter year to that in the former are shown below. The average ratio of the three streams was multiplied by the estimated run-off of each of the other areas, except the agricultural, to obtain the estimate for I92I-22.

Comparison of Run-Off for Two Years

Stream	Run-off I9I4-I5	Run-off I92I-22	Ratio Latter to Former
South Fork	I74I0	I96I0	I.I3
Strawberry	I56I0	I5380	.99
North Fork	23040	24920	I.08
Average			I.06

Table XI shows the estimate for the season I92I-22. The draft on ground water was obtained from data obtained by the Division of Water Rights for the season I92I-22. As this year was one of large run-off and there was consequently an average rise in the ground water level of several feet, the ground water flow was in excess of the draft. An allowance for this was arbitrarily taken at I0% of the ground water draft.

TABLE X

ANNUAL RUN-OFF OF PORTIONS OF SAN JACINTO BASIN, OBSERVED

AND ESTIMATED

(Including Underground Flow)

1892 TO 1915

Locality or Portion	Basic Stream for estimate	Elev. Est. Area	Prec. Factor	Annual Precipitation to use				...on Curve	Corresponding Run-off per Sq. Mi. Acre Ft.					Correction Factor (Runoff)	Estimated Run-Off Acre Ft. per Sq. Mi.					Total Area Sq.Mi.	Total Estimated Seasonal Run-Off Acre Ft.				
				Mean	Max.	Min.	Max. 5-yr.Mean	Min. 5-yr.Mean	Mean	Max.	Min.	Max. 5-yr.Mean	Min. 5 yr.Mean		Mean	Max.	Min.	Max. 5-yr.Mean	Min.5-yr.		Mean	Max.	Min.	Max. 5-yr.Mean	Min. 5-yr.Mean
*Lake Hemet	Observed	5200																		66.2	6550'	19610'	1820'	10040'	2795'
*Strawberry	S. Fork	5200																		26.4	6300	15380	1750	9660	2690
*North Fork	"	6000																		27.5	9420	24920	2620	14450	4020
Other above U.S.G.S. Sta. (S.J.)	Straw.	3500	.938	12.31	17.69	6.84	14.60	9.20	120	214	56	152	84	1.10	132	235	61.5	167	92.4	20.6	2720	4840	1270	3440	1900
North Ridge to Potrero	"	3500	.938	12.31	17.69	6.84	14.60	9.20	120	214	56	152	84	1.10	132	235	61.5	167	92.4	55.6	7340	13080	3420	9290	5140
Potrero Ck.	"	2800	.828	10.87	15.62	6.04	12.89	8.13	103	169	48	128	72	.75	77.3	127	36	96.8	54	31.4	2425	3985	1130	3035	1695
North Ridge beyond Pot.	S. Fork	2100	.739	9.71	13.95	5.31	11.50	7.26	33	55	16	42	23	.75	24.8	41.2	12	31.5	17.2	39.8	987	1640	478	1250	685
Bautista	Straw.	4000	1.03	13.57	19.52	7.54	16.10	10.15	137	267	65	178	95	.75	103	200	48.7	134	71.3	56.1	5780	11220	2735	7520	4000
Diamond Hills	S. Fork	2500	.788	10.34	14.86	5.74	12.26	7.72	37	60	16	46	25	1.50	55.5	90	24	69	37.5	38.0	2110	3420	912	2620	1425
Other Hills above Els.	"	1800	.705	9.26	13.31	5.15	10.99	6.92	32	51	15	40	20	1.00	32	51	15	40	20	102	3265	5205	1530	4080	2040
Agricultural		1550																		248.5	8870	8870	8870	8870	8870
Below Els. U.S.G.S. Station	"	1700	.699	9.16	13.18	5.10	10.88	6.85	31	50	15	40	20	1.20	37.2	60	18	48	24	69.6	2590	4175	1250	3340	1670
San Jacinto (Base)		1550	1.00	13.12	18.87	7.29	15.56	9.81										*Total*		781.7	56360	116340	27880	77600	36930
Total																									

' indicates actual figures estimated above

* *1895-1922 with 1915-16 & 1916-17 omitted*

T A B L E XI

ESTIMATION OF RUN-OFF OF BASIN FOR I92I-22

		Volume Acre Ft.
Observed discharge Strawberry	I5380	
Observed discharge North Fork	24920	
Observed overflow L. H. Dam	I0980	
Estimated run-off below dam and		
above U. S. G. S. Station	5I30	
		564I0
Total water delivery of L.H.W. Co.		
plus I5% losses = diversions	8900	
Less draft on Lake Hemet	4050	
Net stream diversions		4850
Discharge at U.S.G.S. Station from above		5I560
Observed discharge at U.S.G.S. Station		
(San Jacinto)		55500
Estimated run-off between S.J. Station		
and Elsinore Station:		
North Ridge to Potrero	I3860	
Potrero Creek Area	4225	
North Ridge beyond Potrero	I740	
Bautista Creek	II900	
Diamond Hills	3625	
Other Hills above Els. Station	55I5	
Agricultural Area	8870	
		49740

			Volume Acre Ft.
Sum of two above items			I05240
Less diversions and well draft:			
	Diversions by Fruitvale Mutual Water Co.	6240	
	Well draft above Els. Sta.	29200	
	Add I0% of this to allow for elevation of ground water level	2920	
	Diversions by Temescal Water Company	2500	
			40860
Net flow at Elsinore Station on above basis			64380
Observed discharge at Elsinore Station			65800

The above figures show a fair correspondence between the estimated values of run-off and the records of the U.S.G.S. stations where they can be compared at a common point.

RUN-OFF REQUIRED TO MAINTAIN LAKE ELSINORE

One requirement of water in the basin outside use for agricultural purposes is for the maintenance of Lake Elsinore at a reasonable elevation. This is necessary because of the riparian law which allows any person on or adjacent to a river to demand a reasonable flow past him even for purely pleasure purposes. This is the case with Lake Elsinore which is situated at the lower end of the basin and catches all the excess water of the San Jacinto River. It has no outlet except when it overflows in flood years, which it will probably not do more than once in a lifetime now that so much water is used for irrigation. The Lake is used for boating and pleasure purposes only. The water which must be allowed to flow into Lake Elsinore to take care of these rights will, however, probably not be any considerable loss to the agricultural interests as a whole, because this flow will insure a reasonable percolation of water to help maintain the ground water level in the agricultural area. If only enough water were to be allowed to flow into the river in low years so that it would all be absorbed, there would not be enough absorbed to prevent excessive lowering of the ground water level.

In order to take care of the rights of the pleasure interests around Lake Elsinore, which are rather powerful, it is thought that the allowance of enough water to maintain the Lake at about its present level of about I225 ft. above sea level with a lowering of possibly IO or I5 ft. below this in a dry period is reasonable. Enough water is therefore needed to replenish evaporation losses to this extent. The surface area of the lake at elevation I225 is about 6.6 sq. mi. If evaporation is assumed at 5 ft. depth annually, which is apparently reasonable as the climate is very hot in summer, the average annual inflow into Lake Elsinore required to supply this loss is

5 x 6.6 x 640 = 2II00 acre feet

The average annual inflow required during the minimum 5 years to prevent a lowering of more than IO ft. during the period is

(5 - 2) x 6.6 x 640 = I2700 acre ft.

Although the minimum period would be likely to last more than 5 years, the flow would not be so low and several feet more of lowering of the lake would probably be allowable.

GROUND WATER SITUATION

In considering the ground water situation the basin can be divided into two major divisions. The upper division is that of all land above Lakeview where there is a sort of dike underground which holds the water near the surface at this point. The lower or Perris area is that below Lakeview and above the hills separating it from the area around Elsinore Lake. The latter really forms a third division, but the ground water problem there is not so acute. Being adjacent to the lake the lowering of the water table to any great extent is not possible. All that is necessary is that there be enough water passed to maintain the Lake ~~in excess of that needed for irrigation.~~ The run-off of the adjacent hills is the only factor which holds the ground water level above the level of the lake, and this cannot be affected by inflow into it from above. The facts given below on the ground water level in the upper and Perris areas is representative of that contained in U.S.G.S. Water Supply Paper 429 and in the report mentioned above made by the Division of Water Rights of the State Dept. of Public Works.

The recession in the water table in the Perris area has been serious and practically continuous from I905 to I922. The average drop in this section from I905 to I9I6 was around 20 ft. in most places, reaching a maximum of 30 and over. Since I9I6 the drop has been even greater reaching as much as 40 ft.This has been due to greatly increased development in recent years.

In the upper area there has on the whole been comparatively little change. There was only a slight drop in the water table from 1905 to 1915, but since that time there has been appreciable drop even here because of the dry period.

As the years prior to 1915 were about normal in run-off, it is seen from the above that with the development existing in that year the ground water level would be fairly well maintained in normal years.in the Upper area. In dry spells excessive lowering occur. Since 1916 the area under irrigation has been materially increased, possibly by 5000 acres or more. As an offset to this increased use, however, the Fruitvale Mutual Water Co. has adopted the practice of spreading which more than compensates for its own increased use.

In 1921 and 1922, from January to June about 1100 to 2400 miners inches on the average were diverted for spreading. As the spreading in other months is negligible because of insufficient water, this represents an average diversion for the six months of 1750 miners inches. Some of this, however, flowed back into the river without be- absorbed, so that about 1500 miners inches is thought to be a reasonable value for the amount absorbed. This means a total absorption due to spreading in each of the above years of about 9000 acre ft. The year 1921 was one of ~~fair~~ low run-off while 1922 was one of excessive run-off. Therefore if the water is available, it is reasonable to suppose that its flow will be so distributed as to enable this amount to be absorbed by the spreading operations now carried on.

This spreading has undoubtedly taken care of much of the increased use of water in the basin since 1916, with the result that there has been little serious drop in the water table in the upper basin even during the period of drought. The drop in level in the Perris area could probably be stopped by increased spreading operations if this were found feasible, as there is additional area available for spreading. With such increased spreading it would be possible to insure the percolation of enough water if available to keep the ground water level at a reasonable point with at least the present use and possibly with an increased.use.

The next point to consider, therefore, is how much water must be available to replenish the ground water level.The amount needed to maintain the ground water level on the average is the amount of draft. This is taken as the draft in 1922 (from the data of the Division of Water Rights). This represents the most recent use, but there was undoubtedly some waste in that year because of an abundant supply due to excessive run-off.

The question now arises as to how much water is needed to keep the ground water within reasonable limits during droughts. Some drop is of course allowable, probably from 10 to 20 feet. In order to determine approximately what per cent of the average requirement should be assumed for periods of drought, the records of fluctuation in ground water level for 1922 are used. The rise in the ground water level thruout the Upper area from Nov. 1921 to the high point of 1922 (about May) was 5 to 6 feet on the average. This is about the point where appreciable draft commences, so that this rise may represent the total flow during the period, which may be in the Neighborhood of one-half the total for the season, as the water table rises but slowly. The average drop from this month to the end of the season (Nov. 1922) was about 3 ft. The latter one-half of the ground flow was therefore sufficient to supply only about two-thirds of the draft. About $\frac{3}{4}$ of the season's flow of ground water was therefore consumed in draft, about $\frac{1}{4}$ raising the water table from 2 to 3 ft. from Nov. 1921 to Nov. 1922. A continuance of an excess draft of the above amount of one-third the present requirement for a period of 5 years, say thru the minimum 5-year period of run-off, would cause a total lowering during the period of from I0 to I5 feet. This is probably reasonable, but would be likely to be exceeded as the minimum period would probably last longer than 5 years. The flow in these other years, however, would not be so low and a more careful use of water might be expected than in the flood year of I92I-22. Therefore two-thirds of the present use of ground water is taken as that which must be available even during the minimum 5-year period.

T A B L E XII

SUMMARY OF WAT_R REQUIREMENTS AND POSSIBLE USE

A summary of the present use of water and the requirements to maintain the ground water level, Lake Elsinore, and the present surface use is given below, including the estimated available supply.

	Quantity in Acre Ft.
<u>Present Use</u>	
L. H. W. Co. diversions	9060
Fruitvale Mutual surface diversions	4930
Temescal Water Co. diversions	<u>I250</u>
Total surface use	I5,240
Friutvale Co. well draft	I2I0
Temescal Co. well draft (Div. of Water Rights)	I250
Other well draft (Div. of Water Rights)	<u>30,540</u>
Total well draft	33,000

<u>Run-off Required to Maintain this Use</u>

	Quantity in Acre Ft.	
	<u>Average</u>	<u>Min. 5-year Mean</u>
Maintenance of Lake Elsinore	2II00	I2700
Maintenance of Water Table	33000	22000
Surface Diversions	<u>I5240</u>	<u>I2I90</u>
Total Requirement	69300	46900
<u>Present Estimated Run-off</u>	56360	36930

The water required to provide for surface diversions accompanied by storage, as they are in the case of the Lake Hemet Water Co., as shown above for the minimum 5-year period was taken as 80 % of the average requirement, since some would be held over from periods of greater run-off. These requirements for surface use were not increased for probable evaporation from the reservoir surface, but this loss would not be very large in comparison with the total requirements of the basin.

The above table indicates that there would be a deficit in the supply on the average of nearly I5000 acre ft. per year and for the minimum 5- year period of about I0000 acre ft. per year. This is assuming the use of the year I922 to continue. This is probably desirable so far as the surface supply is concerned because the orchards irrigated from this have been under rather than over irrigated, because of the limited supply and high cost of extra water under the Lake Hemet system. Ground water use could probably be safely cut down below that for this year, in which there was an abundance due to rise in the water table.

In addition, the estimates of run-off are necessarily uncertain. Therefore there may be an actual surplus, although not a large one. The studies following are made on the possibility that there may be shown to be water still available for use if properly controlled.

DUTY OF WATER FOR THE BASIN

The average duty of water applied to the land for the past few years on the Lake Hemet system has been about I.I5 acre ft. per acre per year as shown by the company's records of deliveries and the area irrigated by the system. In addition to this some of the lands under system are supplied with additional water, making the total average about I.30 acre ft. per acre.

Records of deliveries by the Fruitvale Mutual Water Co. for the years I92I-I923 show an average net duty of about 2.00 acre ft. per acre per year.

In order to judge whether or not thse values are reasonable or should be changed if possible, a comparison with the use in other places is desirable. In Riverside, which has an almost identical climate, the use for citrus has been around 2.25 acre ft. per acre, while in cooler portions of the Citrus Belt it drops as low as I.5 acre ft. per acre and less.

The desirable duty of water for ordinary orchards as shown by experiments in similar climates such as at Davis and on irrigation projects in Idaho is about I.5 acre ft. per acre. For citrus it runs around 2.0 acre ft. per acre and for deciduous trees about I.0 acre ft. per acre. Although much of the land under the two major irrigation systems of the basin, Lake Hemet and

Fruitvale, is in deciduous trees, many of these are walnuts which have been demonstrated to require possibly as much water as citrus.

Inasmuch as the experience of the past few years has shown the desirability of a greater use than is at present practiced on the Lake Hemet system, the figure of I.5 acre ft. per acre is considered reasonable.

The use under would be expected to somewhat greater as about one-half the acreage is planted to alfalfa and field crops which require more than an area composed almost entirely of orchards as is the Lake Hemet Service Area. The past use of about 2.0 acre ft. per acre is therefore not excessive, but sufficient.

Of the I.5 acre ft. per acre desirable use under the Lake Hemet system supplementary wells may be expected to supply as in recent years about .25 acre ft. This leaves an average of I.25 acre ft. per acre to be supplied by the company. In determining the value of any development, however, only the amount actually supplied by the system is considered. The full duty must therefore be taken. The net duty assumed above is increased I5 % to allow for losses in transmission, making a gross duty of I.72 acre ft. per acre.

The distribution of this thruout the year as assumed for convenience to correspond to percentage of average use on Lake Hemet and Fruitvale systems is shown in Table XIII.

T A B L E XIII

MONTHLY DUTY OF WATER IN PERCENTAGE

Month	Average on L. H. System	Average on Fruitvale Sys.	Assumed
April	I0.0	I2.8	I0.0
May	I7.2	I4.9	I5.0
June	I6.5	I6.5	I5.0
July	I4.0	I5.4	I5.0
August	I4.9	I5.6	I5.0
Sept.	I3.4	I3.7	I5.0
Oct.	9.5	8.3	II.7
Nov.	4.6	2.6	3.3 (ending Nov. I5)

Any requirements in other months are slight and will be assumed to be supplied by the natural stream flow.

HYDROGRAPHS AND MASS CURVES OF FLOW FOR STORAGE DEVELOPMENT

There is already the Lake Hemet reservoir in the San Jacinto Mountains for the purpose of storing a portion of the run-off of South Fork. It was desired, however, to ascertain the possibility of increasing the supply by catching more of the run-off of that stream and also by diverting water from Strawberry Creek, which has no suitable reservoir site, to Lake Hemet.

Accordingly hydrographs of the flow of Strawberry Creek were constructed by plotting the mean rate of flow for each month at the middle of that month. All other hydrographs were constructed in the same manner.

As a large portion of the Strawberry drainage area is below any possible diversion point, the elevation of which must be at least 5000ft., it was necessary to determine what portion of the discharge of the stream ~~ab~~ might be expected at the diversion point. There were two diversion points close together considered. The area tributary to each as well as that of the entire Strawberry area, and the average elevation of each are given below.

	Tributary Area	Average Elev.
Entire Strawberry	26.4	5200
Above Lower Div. Pt.	II.9	6500
Above Upper Div. Pt.	IO.2	6500

The lower diversion point was selected because of greater tributary area and because the line from the upper point would either have to be longer or go thru a ridge at the start with a tunnel probably 3/8 mile long.

The portion of the precipitation of the whole Strawberry Area probably occurring above this point was found by taking the precipitation factors at both average elevations from the precipitation elevation curve. The equivalent area tributary to the diversion point which would give the same volume of precipitation taking the depth of precipitation on the whole area was then equal to the actual area multiplied by the ratio of precipitation factors for the diversion area to that of the whole. (II.9 x I.83/I.2 = I8.I sq.mi.) Therefore about two-thirds (I8.I/26.4 = .69) of the volume of precipitation on the whole area occurs above the proposed diversion point. Conditions of run-off are not very different in the two cases, as the steepness and barrenness of the extreme upper portions is offset by uniformly less covering on the portion below the diversion point. Therefore it is considered safe to assume two-thirds the run-off of the Strawberry Area as available at the diversion point.

Although this run-off will not be distributed thruout the year the same as that of the whole area, it is considered sufficiently so to plot two-thirds the flow of Strawberry as the hydrograph of flow available for diversion. This hydrograph indicated the reasonableness of a diversion capacity of 500 miners inches or IO sec. ft. The line representing the maximum diversion above was drawn on the hydrograph, all flow below it being divertible, and all flow above not divertible.

Hydrographs of North Fork, North Fork plus Strawberry (representing available natural stream flow without the diversion), and North Fork plus undivertable flow of Strawberry (representing available stream flow naturally with the diversion0 were plotted in the same manner as above. For years of incomplete record the estimated flow from that of South Fork was used as obtained in the early part of this study. No attempt was made to estimate flow for I9I6 as satisfactory records are absent.

Two mass curves of flow were then plotted, one for the flow of South Fork alone and the other for the flow of South Fork plus the Divertable flow of Strawberry taken each month from the hydrograph and added to the first. The year I9I6 is omitted because of unsatisfactory records. I9I7 is plotted on from the end of I9I5. This is reasonable as the stage of any reservoir at the end of I9I7 would be substantially the same as that at the end of I9I6 because of excess run-off and overflow in both years.

REQUIRED RESERVOIR CAPACITIES

On the mass curves of flow trial demand lines for uniform flow were. Two were drawn on each curve, one of maximum possible slope, allowing spill only in I9I6 (o-mitted) and the last year of I922, and one of less slope. As the Hemet Dam was originally designed for a height of I50 ft. and built up to full width as high as II0 ft., it would undoubtedly be desirable to take the line of greater slope in each case because the additional cost of constructing an additional narrow top strip would not be great. Until recently the height of the dam has been I22 ft., but last fall it was raised to I38 ft.

From the trial mass curves and uniform flow lines the reservoir capacities required were easily obtainable as the maximum intervals. As the water has to be stored each season until practically all the seasonal flow has occurred, the natural stream flow taking care of the de-mand it drops excessively in the other two streams as well as this, the reservoir capacities necessary to do this were taken as approximately the interval between the point where the trial flow line crossed the end of the preceding season, about Nov. I5, to the maximum of the year in question.

These capacities and the heights of dam required to give them are shown in the following table as well as the regulated flow available under each.

T A B L E XIV

RESERVOIR CAPACITIES AND REGULATED FLOWS

	Lower Demand Line	Higher Demand Line
South Fork alone		
Res. Cap. Uniform Flow	I65000 M.I.D.	330000 M.I.D.
Res. Cap. Irrigation Demand	220000	420000
Ht. for Latter	II7.5 ft.	I36 ft.
Surface Area	308 A.	556 A.
Annual Evap.(3' on ¾ surface area)	I7500 M.I.D.	3I500 M.I.D.
Gross Reg. Flow	I38000 M.I.D.	I73000 M.I.D.
Net Flow	I20000	I42000
South Fork plus Strawberry Diversion		
Res. Cap. Uniform Flow	252000 M.I.D.	4I0000 M.I.D.
Res. Cap. Irrigation Demand	350000	525000
Ht. for Latter	I3I ft.	I43 ft.
Surface Area	500 A.	630 A.
Annual Evap.	28400 M.I.D.	35800 M.I.D.
Gross Reg. Flow	208000	242000
Net Flow	I80000	206000

IRRIGATION DEMAND

The possible irrigation use with the larger reservoir in each case above is of course greater than that shown because of the use of the natural stream flow of North Fork and Strawberry. The probable amount of this use was found by increasing the average use above as a guessand taking I5 % of this as that required in each, which is about true for most months. By studying the hydrographs to see for how many months this use would be supplied by the natural stream flow, the additional amount available from this source was arrived at more or less roughly. The original regulated flow was then increased by this amount and distributed monthly as shown before. In using the hydrographs the available flow without the diversion is of course that shown on the hydrograph of North Fork plus Strawberry total, while that with the diversion is shown on the hydrograph of North Fork plus undivertable flow of Strawberry.

The demands assumed above for trial and the corresponding irrigated areas, taking a duty of I.5 acre ft. per acre net or I.72 gross, are shown for the two possibilities in the table below.

In constructing the mass curves of demand on this basis the available natural flow shown on the proper hydrograph was subtracted each month up to irrigation requirement for that month, and the cumulation made.

TABLE XV

ASSUMED MONTHLY IRRIGATION DEMAND

Month	South Fork alone 5260 Acres		S. Fork plus Straw. 6920 Acres	
	Acre Ft.	M.I.D.	Acre Ft.	M.I.D.
April	905	22800	II90	30000
May	I360	34250	I790	45000
June	I360	34250	I790	45000
July	I360	34250	I790	45000
August	I360	34250	I790	45000
Sept.	I360	34250	I790	45000
Oct.	I050	26500	I390	35000
Nov. (before Nov. I5)	300	7550	395	I0000
Total	9045	227500	II930	300000
Evap. (3' depth on $\frac{3}{4}$ surface area)		3I500		35800

With the mass curves of demand drawn, starting with reservoir stage in each as estimated from the estimation of inflow into Lake Hemet preceding the period of this investigation made by the Division of Water Rights, they were found to utilize the possibilities of the flow very satisfactorily. With the control of South Fork alone by the reservoir chosen there is no shortage, but an excess in the lowest point of nearly 50000 M.I.D. The capacity of the reservoir for comparative purposes should be reduced about 50000 M.I.D. The slight shortages then resulting under both developments are shown below;

South Fork alone		Reservoir Capacity		370000 M.I.D.
	Shortage in 1921	10000 M.I.D.	or	4.5%
	" " 1919	5000		2.3%
South Fork plus Straw.		Res. Capacity		525000 M.I.D.
	Shortage in 1921	30000 M.I.D.	or	10%

It is not thought desirable to allow further shortages as the period from 1895 to 1905 shows greater drought than period which has followed 1916.

The present reservoir height is slightly more than sufficient to maintain the above control of South Fork alone so that further raising of the height of the dam for that purpose alone would not be justifiable.

The increased acreage which could be irrigated by making the proposed Strawberry diversion is shown above as I660 acres, assuming a use of I.5 acre ft. per acre per year. The increased value of good orchard land ~~add~~ resulting from this would be I00 to I50 dollars per acre as a conservative figure, the value not being as great as land in a climate more conducive to citrus culture. Taking the lower figure above the increased value of land would total at least $I66,000. As the water supplied by this plan is not sufficient to supply the present acreage with I.5 acre ft. per acre without the use of auxiliary wells to just about the present amount, it would be inadvisable to encourage further land development. The present area irrigated under the system is about 7800 acres, of which supply enough to care for about I000 acres. The increased supply could be used to advantage and would undoubtedly be just as valuable if applied to the present lands, many of which have been under-irrigated with resulting under size of fruits.

DIVERSION PIPE LINE

Elevation at upper end	5050 ft.
Length of line as draen on map	6.I mi.
Capacity required	IO sec. ft.- 500 m.i.
Diameter pipe	24 in.

Concrete pipe used

The available drop in order that the line may be carried thru a ridge at its lower end without excessive tunneling is only about 50 ft, making a slope of about .00I7

n .0I2

r .50

Therefore c = II6

$V = II6 \sqrt{.5 \times .00I7} = 3.38$ ft./sec.

Q = 3.38 x = I0.6 sec. ft. or 530 miners inches

Total drop .00I7 x 5280 x 6.I = 54.8 ft.

Elevation outlet 4995 ft.

The above line is considered satisfactory. Time was lacking to make a detailed study or design.

SUMMARY AND CONCLUSIONS

(I) The water available as estimated in the first part of the report appears to be hardly sufficient to supply the present irrigated area in the basin, about 23000 acres for all purposes, with sufficient water to replenish the ground water table, Lake Elsinore, and supply the present surface diversion and storage requirements. The estimated average annual run-off of the basin is only 60000 acre ft.

(2) The percolation of such water as is available seems to be assured.

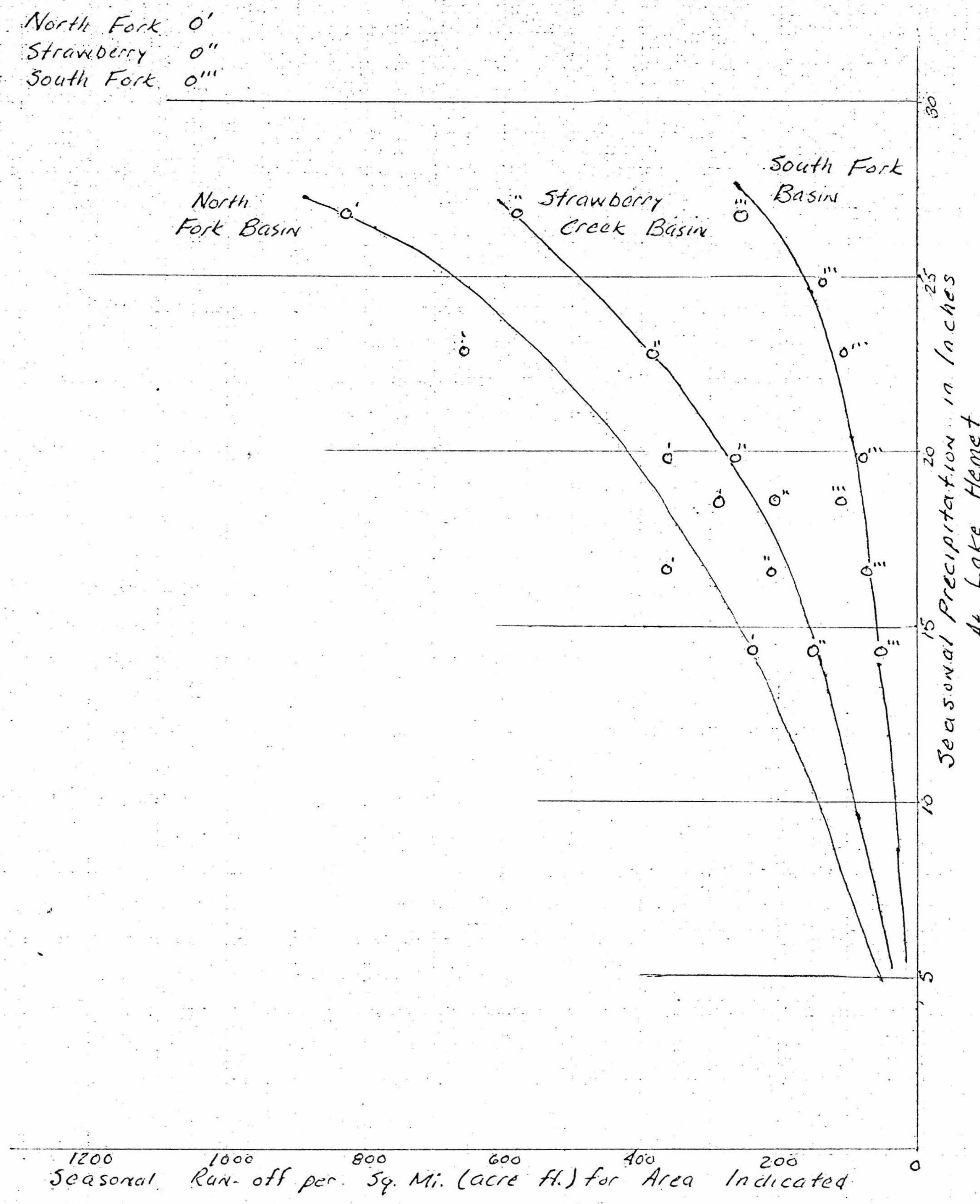
(3) If additional water is shown to be available, there are facilities for storing it, either in the ground or by the diversion of Strawberry Creek to Lake Hemet.

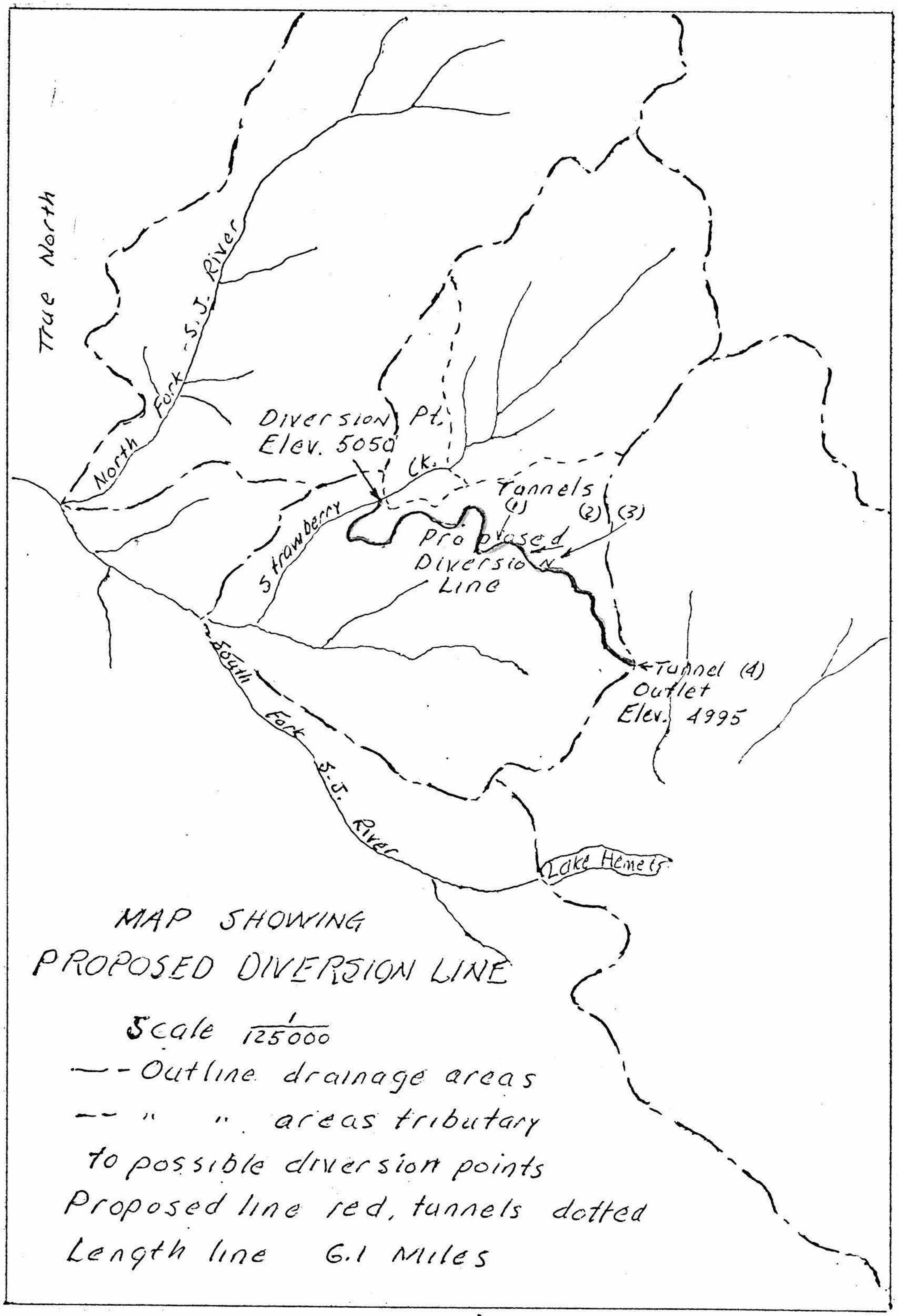
(4) Probably the spreading byt the Fruitvale Mutual Water Co. could be doubled as there is more land available for spreading and more care can be taken in its control.

(5) The diversion from Strawberry to Lake Hemet would justify an expenditure of at$I60000 for pipe line and raising of the dam.

(6) There appears to little use attempting to raise or possibly even maintain the ground water level in the Perris Area by spreading, as a large amount of water would be required for this.

Curves Showing Relation of Seasonal Run-off per Sq. Mi. to Seasonal Rainfall on San Jacinto Basin





MAP SHOWING
PROPOSED DIVERSION LINE

Scale 1/125000

— - Outline drainage areas
-- " " areas tributary
to possible diversion points
Proposed line red, tunnels dotted
Length line 6.1 Miles

Curve Showing
Relation of Rainfall to Altitude in S.J Basin