February 24, 1917.

Mr. Wm. G. Henshaw,
Mills Building,
San Francisco, Cal.

Sir:-

On December 5th, 1916, the undersigned Board of Engineers received the following communication:

"At Mr. Henshaw's request you have been asked to meet as a Board and report findings on the water supply of the Volcan Land and Water Company.

The streams to be considered are the San Luis Rey at Warner's Dam and the Santa Ysabel at Sutherland and Pamo, including San Clemente Reservoir. The findings desired are:

(a) The net safe domestic yield and the proper heights of dams necessary to secure it.

(b) The net safe irrigation yield and the corresponding proper heights of dams.

In determining the net safe yield of the San Luis Rey at Warner's Dam, you will only take into consideration the demand of the Escondido Mutual Water Co. as per our agreement. On the Santa Ysabel River we would like the report of the net safe yield, without consideration of the needs of the riparian owners below Pamo; also a separate statement giving estimate of the amount of water necessary to take care of the riparian owners below Pamo and above Carroll, whose riparian rights we have not yet secured. Mr. Post can give you full data as to rights heretofore acquired between Pamo and Carroll.

All riparian rights from Carroll to the ocean have been acquired and no deductions will be made on this account.

(signed) Ed Fletcher,"

In compliance with these instructions, the Board has held several meetings at which all available data has been examined, and analyzed. A preliminary report relating to the San Luis Rey was submitted to Mr. Fletcher on January 16, 1917.

After exhaustive study of the matters submitted, the Board has arrived at the following conclusions.

San Luis Rey River

The net safe yield, after deducting for Escondido priorities, will be for domestic use, 24,750 acre feet annually, equivalent to about 22,000,000 gallons daily.

The net safe yield for irrigation purposes, assuming that a 50% supply is allowable for two consecutive years is, after providing for Escondido, 28,000 acre feet annually; equivalent to 2,800 miners inches based upon 8 months continuous flow.

To accomplish this result the dam at Warner will be required to hold up a normal depth of 107 feet, the storage at this elevation being 200,000 acre feet. Above this height the dam should be raised to provide for infrequent severe freshets, wave action and necessary freeboard above maximum flood level to insure, in conjunction with a proper spillway, that the dam will never be overtopped.

Santa Ysabel at Sutherland Site

A storage capacity of 60,000 acre feet will give a net safe yield for domestic purposes of 11,200 acre feet annually, equivalent to about 10,000,000 gallons daily.

For irrigation, allowing a 50% supply for two consecutive years, this reservoir will give a safe yield of 12,900 acre feet annually, equal to 1,290 eight months miners inches.

The inference to be drawn from the above statement is that the Santa Ysabel at the Sutherland Site can be thoroughly developed with a storage of 60,000 acre feet. If this storage is secured locally, a dam impounding water to a depth of 190 feet will be required. While this height is perfectly feasible and practical as a matter of dam construction, there is a reasonable probability that the same storage can be developed in the adjacent areas at less cost. Although the consideration of other drainage lines is not included in the instructions given to the Board, we nevertheless wish to advise that from the information available it appears that 60,000 acre feet of storage may be obtained elsewhere with a lower dam. It is the opinion of the Board that in considering the potentialities of the system it is proper to assume that the Santa Ysabel may be completely regulated as shown above and as carried in the mass curves, but before comitting the company to this development it would be well to examine the economic side and determine whether you could not store this water at other points for less money.

Santa Ysabel at Pamo Site

A masonry dam with water level 156 feet above the stream bed, storing 47,500 acre feet will in conjunction with San Clemente reservoir allow a safe domestic yield of 7,000 acre feet annually equivalent to about 6,200,000 gallons daily.

The safe yield for irrigation purposes is 7,950 acre feet annually, equal to 795 eight months miners inches.

The "safe yields" have been determined without allowance for priorities in San Pasqual Valley.

Riparian lands between Pamo and Carroll.

Mr. W. S. Post has advised this Board by letter of January 30, 1917, that the total area which can be reasonably anticipated to be irrigated in the San Pasqual Valley lying between the opening of the canyon on the east to the east line of the Bernardo Rancho to the west, is 2,400 acres.

The lands of the San Pasqual Valley are composed of detrital fill, are porous and have great absorbent capacity. They are fertile and a large portion of them are already under irrigation. There are 130 square miles of drainage area below the Pamo damsite tributary to this valley. The runoff from this area will be sufficient to recharge the underlying water plane in the San Pasqual Valley in normal years when all the irrigable land is under cultivation. In a sequence of years during which the runoff is below normal, this condition may not obtain and it might be necessary to release water at Pamo to make up the deficit. The East and West San Pasqual Ditches have points of diversion upon the main river and command a total of 740 acres. These ditches have diversion rights between January 15th and June 15th. The Board considers that under existing conditions, relinquishments to the extent of 1,100 acre feet per annum must be made at Pamo to satisfy these diversions. Allowing for priorities under existing conditions, the safe yield from the Pamo Reservoir would be 5,300 acre feet for domestic uses and 6,000 acre feet for irrigation use, equal to 600 eight months miners inches.

The above discussion is based upon the apparent rights of San Pasqual Valley, but in the opinion of the Board the irrigation of this area may be accomplished by pumping from the gravel storage without lowering the water plane beyond the economic reach of pumps.

At present during portions of the year, the high level of the ground water renders much of the valley unfit for crops, is detrimental to health and contributes to large losses through evaporation from the moist areas. The construction of Pamo dam will protect from floods with the attendant soil saturation, and pumping from the underflow will further assist in maintaining the water plane at a proper agricultural and sanitary depth.

The Board suggests that negotiations with the riparian owners, during which the advantages above outlined are fully impressed, might result in a relinquishment of rights to stored water at Pamo Dam except an agreement that when the ground water dropped below a plane 20 feet from the surface, the irrigators would be reimbursed for the cost of pumping below that plane. The study indicates that the chances of the water ever falling so low are too remote to have any financial influence upon the feasibility of the projected development.

Methods of Calculation

In comparing these results with previous determinations, attention should be given to the following features of this report which have had an important influence upon the findings.

(a) A longer record of stream flow than was available in any previous determination.

(b) The assumption of greater storage, providing a most

efficient conservation of the run-off. The records in San Diego County show that stream flow is subject to wide variations and the sequence of dry years which have occurred in the past makes advisable the storage of extreme floods which in a measure compensate for the periods of drought.

(c) Less gross evaporation, the figure used (47") being in full accord with recent scientific investigations not available in former determinations.

(d) Basing the estimates of stream flow upon measured run-off instead of an assumed relation to rainfall as has been done previously.

Warner's Runoff

Regarding paragraph (d) the years of actual measured runoff of the San Luis Rey have been compared with that of other Southern California streams - Sweetwater, San Diego, Cuyamaca, Hemet, San Gabriel - giving due consideration to the difference in surrounding conditions - and a fixed relation established from which it has been possible by comparison with earlier records on these streams to restore the run-off at Warners back to the Season 1888-89. In making this restoration, three independent methods were employed: Two of the results were 4% apart and the third was a mean between the two. This close agreement allows the results adopted to be accepted with confidence.

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There are eleven years of synchronous measurements on the San Luis Rey and the Santa Ysabel from which a relation can be established. With this relation controlling, the runoff of the Santa Ysabel has been restored from the amounts estimated for Warners as above outlined.

Conclusions

The Board's determination of safe yield is tabulated below:

Table No. 1

Net Safe Yield of Volcan Water System without allowance for Priorities in San Pasqual Valley.

	Net safe Yield				
	Domestic		Irrigation		Storage
Reservoir	Acre-feet	Gallons Daily	Acre Feet	Miners In.	Capacity
Warner's	24,750	22,000,000	28,000	2,800#	200,000
Sutherland	11,200	10,000,000	12,900	1,290#	60,000
Pamo and San Clemente	7,000	6,200,000	7,950	795#	56,000
TOTAL	42,950	38,200,000	48,850	4,885#	316,000

Table No. 2

Same as Table No. 1 but with allowances for priorities in San Pasqual Valley.

	Net safe Yield				
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TOTAL	41,250	36,700,000	46,900	4,690#	316,000

= Miner's Inches based upon 8 months continuous flow.

H. B. Hapgood
H. [illegible]
Francis S. [illegible]
Willis [illegible]

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J. B. Lippincott,

H. Hawgood,

Francis L. Sellew,

William S. Post.

BOARD ON SAFE WATER YIELD OF PROPERTIES

OF THE

VOLCAN LAND AND WATER CO.

Memorandum on determination of Run-off and Evaporation at Warners.

H. Hawgood Dec-Jan. 1916-17.

Runoff

The estimation of run-off from rainfall has rarely proved satisfactory, and the method is not regarded by the Board with favor.

Members of the Board have on different occasions in the past compared the recorded run-offs of Southern California streams and found they bore a marked relationship the one to the other. Diagram No. 1 of the "O'Shaugnessy Lippincott" report of May 1915 is cited as an illustration of the existence of such inter-stream relationship.

The rational method of determining the San Luis Rey run-off by stream relationship curves was adopted.

The relationship curves between the San Luis Rey at Warners and Sweetwater, San Diego, Cuyamaca, Hemet and San Gabriel were developed by platting synchronal run-offs

taken from the records of the various streams. These curves are shown on the attached diagram.

The run-off records used in the preparation of the curves are given in Table A.

Values of San Luis Rey run-offs appear on the X axis and values of compared streams on the Y axis.

Table B gives the run-offs 1886 to 1916 inclusive for the San Luis Rey as taken off the various relationship curves. These run-offs have been ascribed the weighted values noted at foot of table. The combined weighted average is given in the last column of the Table.

The quantities taken from the preliminary relationship curve studies and used in the mass curve tabulation differ slightly from the quantities as now given by the finished diagram. The difference, however, is trifling and on the safe side. Original total 1888-95 inclusive 290,500 ac. ft. Present total 291,660 ac. ft. This difference would go to increase the "waste" in 94-95. For the critical period 1895-03 the original total was 77,510 ac. ft. The present total is 77,960 ac. feet.

TABLE A

Synchronal Run-offs used in developing curves of relationship of the run-off of the streams named to the run-off of the San Luis Rey Run-off at Warner.

Season	San Luis Rey at Warners		Sweet-water River at Dam	San Diego River at Divert. Dam	Cuyamaca		Hemet	
	Observed Ac.Ft.	Computed from Pala. Post Ac.Ft.			Post Ac.Ft.		Post A.Ft	San Gabriel Ac.Ft
1903-04		5 784		579	385		2 234	28 700
04-05		27 400	13 760	22 259	5 258		6 408	160 000
05-06	67 910		35 000	31 998	9 785		18 032	236 000
06-07		52 153	30 000	29 209	7 550		10 854	350 000
07-08		17 734	4 140	11 554	1 635		4 132	29 627
08-09		32,924	16,007	19 295	5 683		9 627	180 000
09-10		30 899	9 619	13 814	4 095		6 627	139 000
10-11	[a]21 160		3 160	8 376	2 400		5 766	273 000
11-12	12 030		5 000	9 420	3 028		5 153	70 700
12-13	5 910		915	5 514	2 383		4 157	50 300
13-14	22 630		3 525	10 355	1 932		7 840	296 000
14-15	60 440		27 085	40 947	8 630		16 025	151 940
15-16	182 000		155 673	102 208	17 794	55 733 237 075	[a]	350 000

a - partly estimated.

The seasonal run-offs are those of W. S. Post's Table No. 5

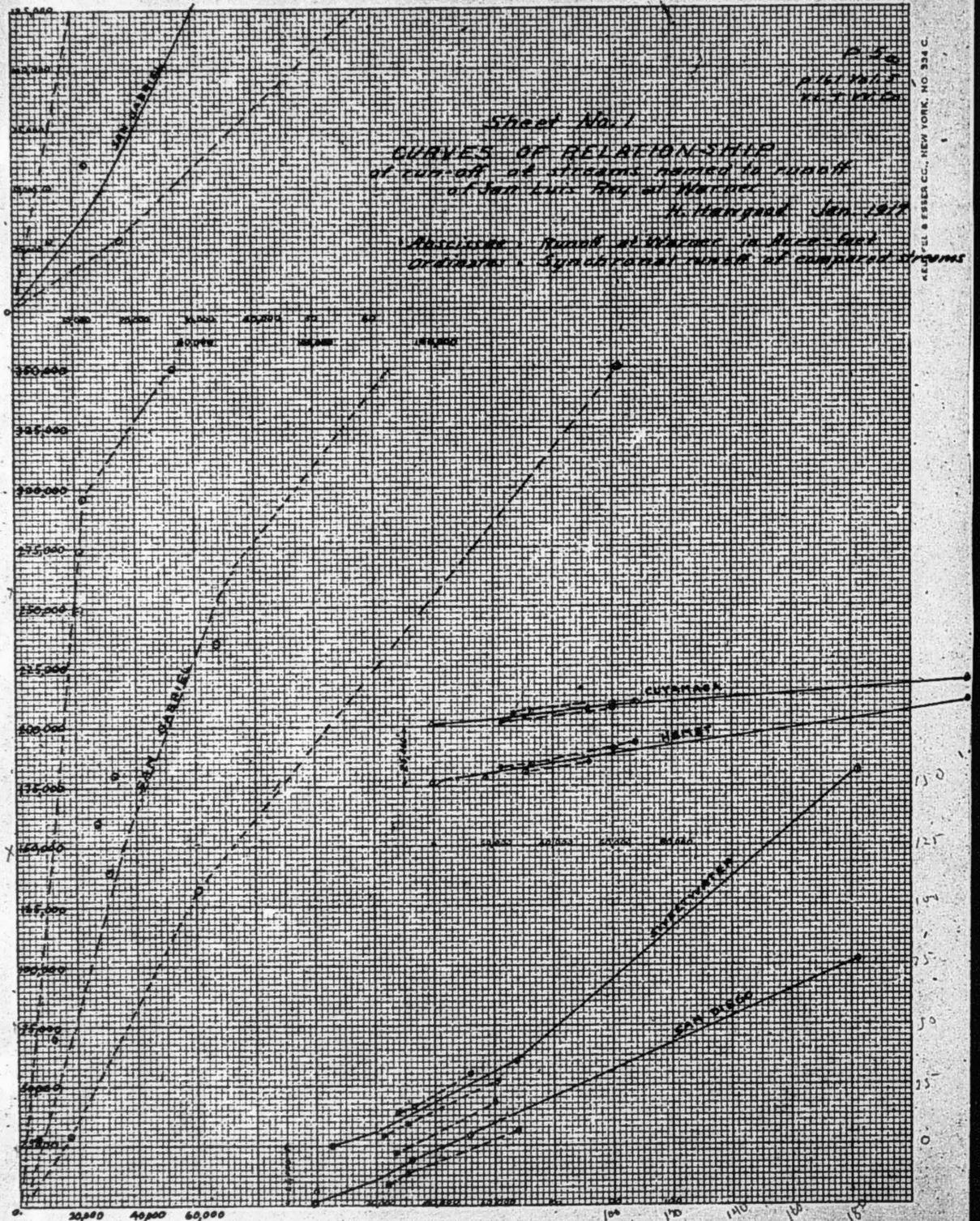
TABLE B

Runoff of San Luis Rey at Warners as determined by curves of relationship to run-offs of other streams
H. Hawgood January 1917

Season	Sweetwater			San Diego			Cuyamaca			Hemet			San Gabriel			Total		Weighted Average
	Ac.F.	Wt.	Ac.F.x Wt.	Ac.F.	Wt.	Ac.F.x Wt.	Ac.F.	Wt.	Ac.F.x Wt.	Ac.F. x	Wt.	Ac.F. x Wt.	Ac.F.	Wt.	Ac.F. x Wt.	Ac. F. x	Wt.	Ac. Ft.
1886-87							3 100											4 100
87-88							23 000											23 000
88-89	23 200	4	92 800				30 200	4	120 800							213 600	8	27 950
89-90	52 000	4	208 000				44 000	4	176 000							384 000	8	48 000
1890-91	40 000	4	160 000				62 000	4	248 000							408 000	8	51 000
91-92	21 400	4	200															21 400
92-93	34 500	4	138 000				28 000	4	112 000							250 000	8	32 500
93-94	8 500	1	8 500				14 250	3	42 750							51 250	4	12 810
94-95	104 000	4	416 000				92 000	4	368 000							784 000	8	98 000
1895-96	8 400	1	6 400				9 500	3	28 500	4 500	3	13 500	8 300	1	4 150	54 550	7⅝	7 270
96-97	22 800	4	91 200				24 500	4	98 000	22 000	4	88 000	23 000	1	11 500	238 700	12	23 100
97-98							3 000	3	9 000	3 800	3	11 400	7 000	½	3 500	25 700	6	3 950
98-99	5 500	1	5 500	2 500	4	10 000	2 000	3	6 000	3 500	3	10 500	3 000	½	1 500	31 400	11	2 910
99-00				1 300	4	5 200	600	3	1 800	5 900	3	11 700	5 600	½	1 800	24 200	10	1 950
1900-01	6,750	1	6,750	8 000	4	32 000	19 500	4	78 000	14 750	4	59 000	24 500	½	12 250	188 000	13	15 920
01-02				7 750	4	31 000	13 500	4	54 000	5 500	4	22 000	7 000	½	3 500	104 100	12	8 840
02-03				15 800	4	63 200	14 500	4	58 000	16 500	4	66 000	26 000	½	13 000	200 200	12	16 020
03-04																		5 784
04-05																		27 451
1905-06																		67 910
06-07																		52 153
07-08																		17 734
08-09																		32 924
09-10																		30 900
1910-11																		21 160
11-12																		12 030
12-13																		5 910
13-14																		22 630
14-15																		60 440
1915-16																		182 000

Weighted values ascribed to different streams

Sweetwater When Run-off above 20 000 Weight 4; when runoff below 20 000/ Weight 1; when run-off below 100 Weight 0
San Diego For all run-offs Weight 4
Cuyamaca When runoff above 15 000 " 4; when runoff below 15 000 " 3
Hemet " " " 10 000 " 4; " " " 10 000 " 3
San Gabriel For all runoffs
Santa Ana Rejected account records vitiated by storage and discharge from Bear Valley reservoir
Arrowhead " " drainage on desert slope of mountain range, hence not comparable.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Evaporation.

The nearest point to Warner where reservoir Evaporation measurements have been taken over a period of years is Cuyamaca.

The U. S. Weather Bureau publish records of monthly temperature at Cuyamaca and Warners Hot Springs.

Duryea in his paper before the Am. Soc. C. E. on the depth of annual evaporation from Lake Conchos, Mexico demonstrates a relationship between temperature, elevation and evaporation. W. S. Post in his discussion of Duryea's paper introduced data of measured evaporations in San Diego County and introduced a temperature-elevation-evaporation diagram for San Diego County similar to Duryea's diagrams for numerous other localities.

Post's diagram as it appears in the Am. Soc. C. E. publications has been expanded for convenience of use and is here attached.

Post in the paper referred to gives the average evaporation from Cuyamaca as 57.6 inches, and he has furnished this Board with the results from Evaporating Pans for 1913-16 inclusive at the Warner Dam Site, average 55.07 inches, and at "By Lake", a point in Warner Valley somewhat to the north of the proposed reservoir high water line, average 66.61 inches, Mean 60.71.

The elevation of Cuyamaca Reservoir 4620 feet above sea level and of Warner Reservoir 2700 feet.

With this data the method of determination of evaporation at Warner is as follows:

(a) Determine mean monthly temperature at Cuyamaca and Warners. Table C gives the determination for years 1909-1915 inclusive.

(b) Segregate average annual evaporation of 57.6 inches at Cuyamaca into average monthly evaporation. See Table D.

(c) By months, find from the elevation, temperature evaporation diagram, evaporation at Cuyamaca and Warners due to their respective elevations and temperatures.

(d) Multiple monthly evaporations (c) by ratio of relative evaporations (d) and quotient is evaporation at Warners.

Table D covers in detail operation b.c.d.

The result of the computations is an average annual evaporation at Warners of 45.95 inches. By an arithmetical error of 1 inch in the preliminary calculations, the Board adopted 47 inches for the annual evaporation. The correct figure of 46 inches leaves a 2½% margin on the "safe yield" side.

The mean evaporation from the Warner pans, as stated before, was 60.71 inches, of which 46 inches in 76%. In other words, the actual evaporation from the reservoir surface, as computed, would be 76% of the pan evaporation.

In the Salton Sea tests Bigelow, Robson and Grimsky found ratioes of actual evaporation to 3 ft. floating pan evaporation ranging from 58.8% to 64.6%.

In the Lake Concho tests Duryea found values from 62% to 67.5%.

In the light of these much lower ascertained percentages, the use of an evaporation rate giving a ratio of 75% cannot be regarded other than very conservative, and this has been accentuated by the accidental use of 47 inches which is the equivalent of 78%.

TABLE C

Mean Monthly Temperature from U.S.G. Weather Reports

Temperature at Warner's Hot Springs.

28 Dec. 1916

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual.
1909	49.0	47.8	47.1	55.0	57.6	67.2	71.1	74.0	67.7	61.4	54.4	45.6	58.2
10	46.4	48.2	50.0	59.0	63.8	65.2	74.0	74.9	70.2	62.2	55.0	52.0	60.1
11	49.8	43.2	52.5	52.5	55.9	64.4	73.5	71.8	66.5	61.0	54.5	47.0	57.7
12	51.4	52.0	45.8	49.7	58.7	66.5	69.6	68.8	66.6	57.0	56.4	48.7	57.6
13	44.2	45.6	49.4	53.4	58.8	63.6	71.5	73.0	71.3	62.3	53.0	47.1	57.8
14	47.8	49.4	54.2	55.2	58.7	66.0	74.4	73.2	68.6	61.7	57.2	42.0	59.0
15	43.8	45.2	50.6	52.9	56.5	66.6	71.4	75.2	68.4	65.6	54.4	48.6	58.3
16	43.8	53.0	56.4	57.4	58.5	67.1	74.4	72.9	70.5	56.5	53.8	47.0	57.6
E	376.2	384.4	406.0	415.1	468.5	526.6	579.7	583.8	549.8	487.7	438.7	378.0	
Mean for 8 yrs.	47.0	48.1	50.7	51.9	58.6	65.8	72.5	73.0	68.7	61.0	54.8	47.2	58.0

Temperature at Cuyamaca

1909	42.7	40.4	40.0	50.1	55.7	67.5	72.2	72.0	65.1	56.4	47.0	38.4	53.8
10	38.0	41.8	49.2	54.8	62.2	66.2	73.1	74.3	69.2	56.5	47.2	44.4	56.4
11	43.8	36.1	46.2	47.2	52.8	65.0	71.0	71.0	64.5	50.7	45.9	34.8	52.1
12	40.4	40.4	37.1	42.6	55.2	63.2	66.5	65.8	59.9	49.6	46.8	38.3	50.3
13	34.8	37.5	39.2	48.6	56.1	59.0	66.6	68.2	65.4	54.8	45.1	38.5	51.2
14	42.4	42.0	47.4	49.4	55.9	65.4	70.6	70.3	64.0	54.0	48.9	35.2	53.5
15	38.4	39.6	46.2	47.8	50.4	64.9	68.2	69.8	61.6	56.2	46.4	41.2	52.7
16	35.8	44.8	50.0	52.6	55.2	64.0	70.5	66.5	63.5	48.2	46.2	38.7	52.9
E	316.3	322.6	355.3	393.1	437.5	511.2	558.7	557.9	512.8	428.2	367.4	309.5	
Mean for 8 yrs.	39.5	40.3	44.4	49.1	54.7	63.9	69.8	69.7	64.1	53.5	45.9	38.7	52.8

Precipitation for December 1916 estimated

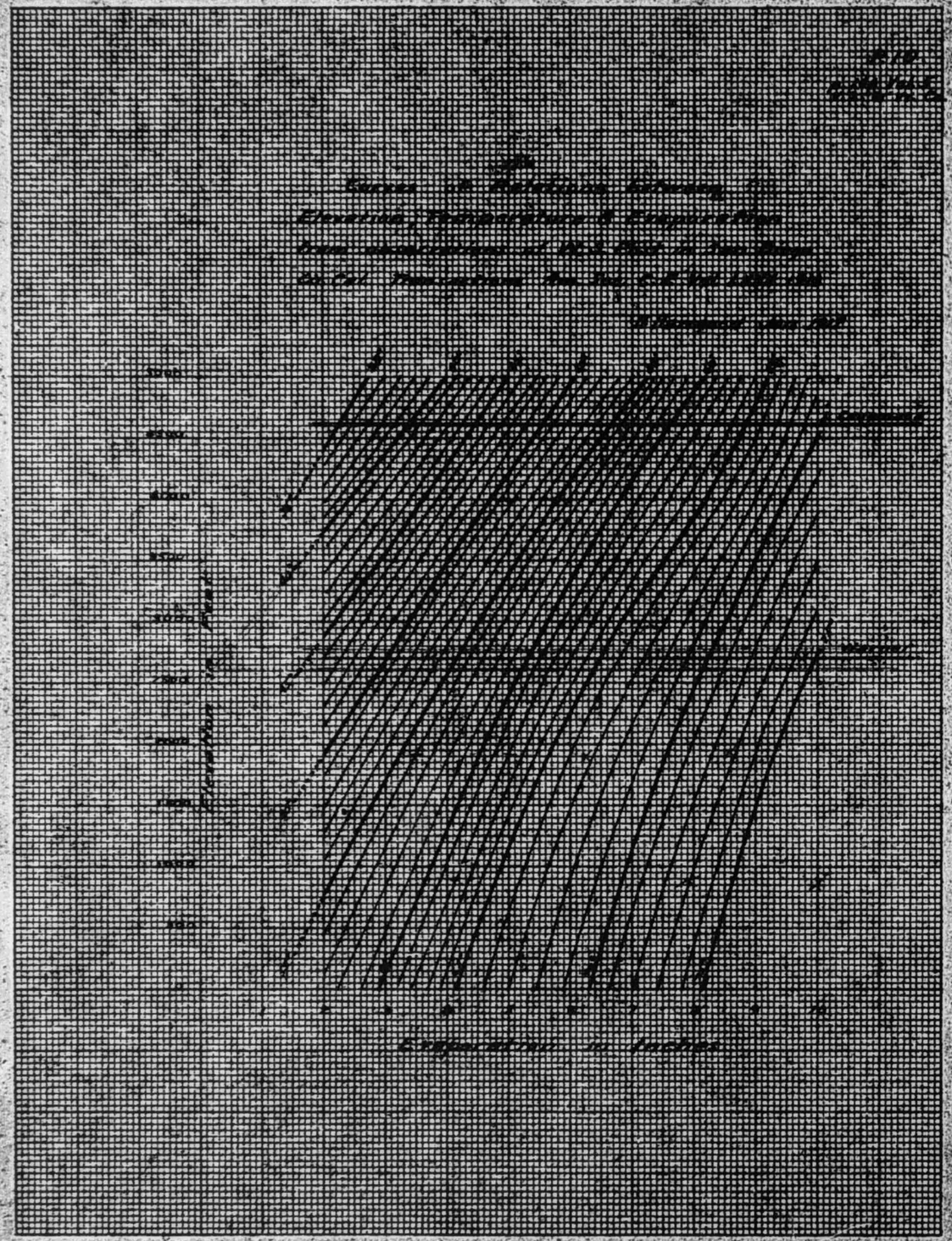

TABLE D

Dec. 1916.

	(1) Relative Cuyamaca Elev.4620' Temp.	(2) Inches	(3) Evaporation Warner Elev. 2700' Temp.	(4) Inches	(5) Ratio of Evap.	(6) Measured evap.at Cuyamaca	(7) Probable Evap. Warner Col.5 x Col.6 Inches	(8) Evap^{n} Monthly %
Jan.	40°	3.4	47°	2.1	$\frac{2.1}{3.4}$ x	2.88	1.78	5
Feb.	40	3.4	48	2.5	$\frac{2.5}{3.4}$ x	2.88	2.12	5
Mar.	44	4.4	51	3.2	$\frac{3.2}{4.4}$ x	4.03	2.93	7
Apr.	49	5.4	52	3.4	$\frac{3.4}{5.4}$ x	6.34	5.99	11
May	55	6.6	59	5.1	$\frac{5.1}{6.6}$ x	6.91	5.34	12
June	64	8.6	66	6.8	$\frac{6.8}{8.6}$ x	8.64	6.83	15
July	70	10.1	73	9.3	$\frac{9.3}{10.1}$ x	7.49	6.90	13
Aug.	70	10.1	73	9.3	$\frac{9.3}{10.1}$ x	5.76	5.30	10
Sep.	64	8.6	69	7.9	$\frac{7.9}{8.6}$ x	5.19	4.77	9
Oct.	54	6.5	61	5.5	$\frac{5.5}{6.5}$ x	2.88	2.44	5
Nov.	46	4.8	55	4.1	$\frac{4.1}{4.8}$ x	2.30	1.97	4
Dec.	39	3.2	47	2.2	$\frac{2.2}{3.2}$ x	2.30	1.58	4
Annual	52.9		58.4			57.60	45.95	100

Cols. 1 and 3 mean monthly temperature in nearest degrees U.S. Weather Bureau Records 1909-1916 inclusive.

Cols. 2 and 4 Evap.^{n} corresponding to temperature and elevation from diagrams of curves of relations of Elevation, Temperature and Evaporation.

Col. 6 Average Cuyamaca annual evap^{n} distributed monthly on percentages. Col. 8 for San Diego as given Page 2080 Vol.LXXX Trans.Am. Soc. C. E.

MEMORANDUM CONCERNING METHODS AND COMPUTATIONS USED IN THE STUDY ON THE SAFE NET YIELD FROM WARNER'S RESERVOIR

ESTIMATED RUNOFF:

(To be supplied by Mr. Hawgood.)

SAFE YIELDS:

In the mass studies of the Warner's Reservoir it has been decided to approach the actual conditions of operation as nearly as possible within limits consistent with the accuracy of basic data. The draft upon the reservoir is considered to begin with 10 per cent of the ultimate total and increase a like amount each year until the total draft is reached the tenth year. This conclusion was reached after consideration of the usual rate at which new projects are developed. Upon this hypothesis two safe yield studies have been made. First, a domestic supply, and second, an irrigation supply. The domestic supply will require a one hundred per cent yield throughout the entire period. The curves submitted herewith show that 24,750 acre feet may be withdrawn from the reservoir each year for the period considered, and at its lowest stage would contain 1200 acre feet. Although this is drawing the reservoir down to a point that is probably below what would be considered as a conservative safeguard to a domestic supply, the draft has been considered one hundred per cent throughout the entire dry period. As a matter of fact, when the reservoir showed serious depletion the use of water would be curtailed by regulation.

The consumption of water in the City of San Diego for the years 1913 and 1914 shows that an average of 59 per cent of the total annual draft occurs between April and September inclusive, and that 41 per cent occurs during the period October to March, inclusive. In the study of the domestic yield 40 per cent of the total annual draft is considered as occurring between October and March inclusive, and 60 per cent between September and April.

There are even wider fluctuations between the summer and winter use of the water for irrigation than occur in the domestic use. The use of water by five irrigation systems extending over a five year period indicates that 36 per cent of the total annual draft occurs during the period October to March inclusive and 64 per cent between April and September inclusive.

The irrigation draft from the Warner Reservoir has been assumed to occur in the ratio of 5 in the winter to 6 in the summer. The accompanying mass curves indicate that 28,000 acre feet per annum may be withdrawn from the reservoir for irrigation use at the rate of 18,700 acre feet during the summer and 9300 acre feet during the winter.

The irrigational use does not require so great a safeguard as a domestic supply. It has been considered permissible to allow for a half supply during two consecutive years whenever conditions demand it; that is, the mass tabulation has been prepared under the assumption that the demand will be 50 per cent when the reservoir contains less than 17,000 acre feet at the beginning of the summer season.

The measured runoff at Warner's has been tabulated in Table No. 3 which shows the runoff occurring between October and March inclusive and that between September and April inclusive. Eliminating the year 1915-16 as extraordinary it is found that 72 per cent of the total seasonal runoff occurs during the winter months and 28 per cent during the summer. A ratio of 70 to 30 has been adopted.

Table No. 2 shows the estimated runoff of the San Luis Rey River at Warner's Dam. This runoff has been divided into that occurring during the winter and summer seasons in accordance with the percentages found in Table No. 3. To the seasonal runoff thus obtained there has been added 350 acre feet prior to the season 1912-13. During the construction of the cut-off wall at the Warner's Dam a subsurface stream of one second-foot was uncovered and stopped with the closing of the cut-off wall. This water has been measured during the season 1912-13 and subsequent thereto and should be considered as an addition to the measured or estimated runoff prior to that season. The seasonal runoffs shown in Table No. 2 are those appearing on the mass tabulation.

EVAPORATION:

(Method of computing gross evaporation to be furnished by Mr. Hawgood.)

RAINFALL:

There are four years of record upon five stations near the Warner's Reservoir three of which are within the flooded area. Table No. 4 shows the observed rainfall at these stations divided into the seasons October to March and April to September. The observed total average annual rainfall for these five stations is 22.95 inches, 78 per cent of which occurs from October to March and 22 per cent from September to April. This average rainfall has been expanded in Table No. 5 by the average per cent rainfall years for nine base stations in San Diego County extending over a 44 year period.

NET EVAPORATION:

From the total evaporation 90 per cent of the rainfall occurring on the reservoir surface is subtracted. Ten per cent of the rainfall is considered as already accounted for in stream flow. Evaporation and rainfall should be considered as yearly conditions rather than an average extending over a period of years as during dry seasons there is little rainfall and consequently larger net evaporation than upon wet years when the reverse condition exists. Table No. 5 shows 90 per cent of the total seasonal rainfall subdivided into the winter and summer rains in accordance with the percentages found in Table No. 4. Table No. 6 is

a tabulation of the net evaporation during the summer and winter seasons and gives the difference between the gross evaporation and the rainfall in feet and inches. The plus sign in the columns under the winter season indicates that the rainfall exceeds the evaporation.

ESCONDIDO DIVERSIONS:

The Volcan Land & Water Company has entered into a contract with the Escondido Mutual Water Company under which they agree to maintain the diversions of the mutual water company up to 1,350,000,000 gallons per annum, subsequent to the building of the Warner's Dam, providing the water is diverted between November 1st and July 1st and that the maximum rate of diversion is 27,000,000 gallons per day and also providing that this amount of water could have been diverted by the Escondido Mutual Water Company had the Warner Dam not been constructed.

An elaborate study of the relinquishments at the Warner's Dam necessary to satisfy this diversion has been made in connection with the Lippincott-O'Shaughnessy report. It has been decided to use the diversions estimated in that report in this study. Table No. 7 shows these diversions. The method of computing them is explained in Appendix I attached hereto.

CONSERVED EVAPORATION:

There is a total area of 740 acres of moist land lying within the Warner Reservoir site some of which is kept moist by springs. The greater portion, however, becomes charged with water during the rainy season and this retarded

water evaporates and drains out to a depth of probably 6 feet during the summer. The water that is at present lost by evaporation from these lands will be conserved when this area is submerged. It is considered that the evaporation losses occurring from these lands are equal to a depth of water of 19 inches per annum over the moist area. The accompanying diagram has been prepared on this basis and shows the volume of water impounded in the reservoir and the corresponding evaporation losses from the submerged moist lands.

MASS TABULATION:

Table No. 8 is a mass tabulation for the Warner's Reservoir considering a domestic supply and shows the operation of the reservoir during the winter season and during the summer season. The tabulation is self explanatory. Similarly Table No. 9 is the mass curve tabulation for the Warner's Reservoir under an irrigational draft. In this tabulation it is assumed that when the reservoir contains 17,000 acre feet or less at the beginning of the summer season the draft will be reduced 50 per cent.

Method of Obtaining Relinquishments at
Warner's to Satisfy Escondido Diversions.

Mr. W. S. Post, Chief Engineer of the Volcan Land & Water Company has prepared a daily hydrograph of the flow of the San Luis Rey River at Warner's for the past twenty years. The flow on those years during which there were no measurements at Warner's has been reproduced by a study of the rainfall. The annual runoff thus obtained does not agree exactly with that estimated by Mr. Lippincott.

Table No. Col. No. 2 shows the annual runoff of the San Luis Rey River at Warner's as estimated by Mr. Lippincott; Col. No. 3 as estimated by Mr. Post. Col. No. 4 shows the percentage ratio of Mr. Lippincott's estimate to Mr. Post's. Col. No. 5 shows the ratio of the runoff of the 33 square miles tributary to the Escondido diversion below Warner's damsite, to the runoff at Warner's. Col. No. 6 shows the adjusted percentage to apply to Mr. Post's hydrograph to obtain the runoff for the Escondido area on the basis of Mr. Lippincott's estimated runoff at Warner's. Col. No. 7 shows the annual runoff of this area.

Table No. B is a study of the amount of water to be turned out at Warner's to satisfy the Escondido diversion made in accordance with the contract between the Volcan Land & Water Company and the Escondido Mutual Water Company, under date of June 21st, 1912. It is considered that the Escondido ditch would divert water up to a capacity of 41.75 second feet from November 1st to July 1st of each seasonal year and that at no time the diversion shall be below two second feet.

This table is a study of those years during which the runoff of the area below Warner's dam and above the Escondido diversion point is not sufficient to satisfy these diversions. Col. No. 2 of this table shows the monthly runoff of the San Luis Rey River at Warner's on the basis of Mr. Lippincott's estimate. Col. No. 3 shows the monthly runoff of the 33 square miles between Warner's and Escondido diversion estimated at 44 per cent of the runoff at Warner's as estimated by Mr. Lippincott. Col. No. 4 shows the sum of these quantities.

The scale of Mr. Post's hydrograph was adjusted so that the hydrograph would fit the quantities in Col. No. 4 and the capacity of the Escondido ditch drawn to this scale. Col. No. 5 of Table B shows the amount available for diversion between 4 acre feet and 82 acre feet per day if the stream were not regulated by a dam at Warner's. The scale of Mr. Post's hydrograph was then again adjusted so that the hydrograph would fit the quantities given under Col. No. 5 and the capacity of the Escondido ditch drawn to this new scale. With this as a basis the amounts produced by the 33 square miles below the Warner Dam site and above the Escondido ditch available for diversion were obtained and are listed in Col. No. 6. The difference in the seasonal totals of Cols. Nos. 5 and 6 gives the amount necessary to release at Warner's to satisfy these diversions. Upon the years not considered in this table no relinquishments are necessary at Warner's for the Escondido diversion.

RELATION BETWEEN RUNOFF OF SAN LUIS REY RIVER AS ESTIMATED BY W. S. POST & J. B. LIPPINCOTT

(1) Year	(2) Lippincott	(3) Post	(4) Percent Lippincott Post	(5) Ratio Escondido Warner's	(6) Percent to apply to Post Hydrograph to get Escondido Runoff per Lippincott	(7) Escondido Runoff Acre Foot
1893-94	14000		100	44	44	6180
94-95	44400	71981	62	44	27	19600
95-96	7400	3229	230	44	101	3260
96-97	17800	22785	78½	44	34½	7820
97-98	4000	6543	61	44	27	1760
98-99	1800	1967	92	44	40½	792
99-00	1600	4209	38	44	17	704
1900-01	13400	22229	60	44	26	5890
01-02	6800	9320	75	44	32	2990
02-03	15200	27410	55	44	24	6680
03-04	3600	3656	98½	44	43	1580
04-05	27500	56764	48½	44	21	12100
05-06	66957	66957	100	44	44	29400
06-07	54000	42218	128	44	56½	23700
07-08	16900	20900	81	44	35½	7430
08-09	31700	26350	121	44	53	13900
09-10	30560	25189	121	44	53	13400
10-11	21600	16966	127	44	56	9500
11-12	12030	12030	100	44	44	5290
12-13	6042	6042	100	44	44	2660
13-14	22521	22521	100	44	44	9900

STUDY OF AMOUNT OF WATER TO BE TURNED OUT BY THE VOLCAN LAND & WATER CO. TO ESCONDIDO DITCH IN ACCORDANCE WITH CONTRACT OF JUNE 21, 1912, ASSUMING THE AREA BELOW THE DAM PRODUCED 44 PER CENT OF THE RUNOFF ABOVE WARNER DAM.

Maximum Capacity Escondido Ditch 41.75 s. f.

Minimum Diversion " " 1.0 s. f.

1895-96

To get hydrograph at Warner, multiply Post's hydrograph by 230 per cent.

To get Escondido hydrograph (33 sq.mi.) multiply by 101 per cent.

(1) Month	(2) J.B.L.'s Runoff at Warner's a.f.	(3) Escondido Runoff Local 33 sq.mi. a.f.	(4) Total Runoff above Escondido 234 sq.mi. a.f.	(5) Amount Available between 4 ac.ft. & 83 ac.ft.of Total Runoff	(6) Of this Available from Local 33 Sq.mi.	(7) Amount to be turned out by V.L.& W.Co.
Nov.	391	172	563	563	172	
Dec.	310	136	446	446	136	
Jan.	1060	465	1525	1289	465	
Feb.	520	228	748	748	228	
Mar.	2460	1080	3540	1260	605	
Apr.	1335	585	1920	1290	556	
May	209	92	301	301	0	
June	207	91	298	298	91	
				6195	2253	1897

1896-97

To get hydrograph at Warner's intake, multiply Post's hydrograph by 78-1/2 per cent.
To get Escondido hydrograph (33 sq.mi.) multiply by 34-1/2 per cent.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Nov.	242	114	356	356	22	
Dec.	352	155	507	507	95	
Jan.	4160	1830	5990	1570	670	
Feb.	7950	5480	11410	1855	920	
Mar.	2730	1200	3930	2454	1022	
April	1430	625	2055	1889	625	
May	579	254	835	835	254	
June	187	82	269	269	82	
					3590	460

1897-98

To get hydrograph at Warner's multiply Post's hydrograph by 61 per cent.
To get Escondido Hydrograph (33 sq.miles) multiply by 27 per cent.
Except Tabor data shown by #

Nov.	35	16	51	51	0	
Dec.	254 #	112 #	366 #	366	112	
Jan.	987 #	433 #	1420 #	1356	433	
Feb.	531 #	233 #	764 #	764	233	
Mar.	694 #	304 #	998 #	998	304	
Apr.	488	216	704	704	216	
May	970	429	1399	809	375	
June	59	26	85	85	26	
			5787	5133	1699	2451

1898-99

To get hydrograph at Warner's multiply Post's hydrograph by 92 per cent.
To get Escondido hydrograph (33 sq.mi.) multiply by 40½ per cent.
Except Tabor data shown by #

Nov.	47	21	68	0	0	
Dec.	104	45	149	97	0	
Jan.	229 #	100 #	329 #	329	100	
Feb.	364 #	161 #	525 #	525	161	
Mar.	416 #	184 #	600 #	600	184	
Apr.	212 #	93 #	305 #	305	93	
May	11	5	16	0	0	
June	55	24	79	56	24	
				1912	562	1350

1899-1900

To get hydrograph at Warner's multiply Post's hydrograph by 38 per cent.
To get Escondido hydrograph (33 sq.mi.) multiply by 17 per cent.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Nov.	12	5	17	0	0	
Dec.	32	14	46	0	0	
Jan.	908	407	1315	518	297	
Feb.	66	29	95	0	0	
Mar.	107	48	155	155	48	
Apr.	314	140	444	444	140	
May	107	49	156	156	49	
June	36	16	52	0	16	
				1273	550	723

1900-1901

To get hydrograph at Warner's multiply Post's hydrograph by 60 per cent.
To get Escondido hydrograph (33 sq.mi.) multiply by 26 per cent.

Nov.	1475	640	2115	960	542
Dec.	312	135	447	447	135
Jan.	451	195	646	646	195
Feb.	8210	3560	11770	1890	1020
Mar.	1025	444	1469	1469	444
Apr.	726	314	1040	1010	314
May	899	390	1289	1047	390
June	143	62	205	205	62
				3102	1048

1901-02

To get hydrograph at Warner's multiply Post's hydrograph by 73 per cent.
To get Escondido hydrograph (33 sq.mi.) multiply by 32 per cent.

Nov.	87	38	125	125	0
Dec.	88	39	127	127	0
Jan.	493	216	709	709	216
Feb.	1380	605	1985	1249	555
Mar.	3500	1535	5035	2573	1452
Apr.	727	319	1046	1000	319
May	184	81	265	265	81
June	69	30	99	0	30
				2553	1497

1902-03

To get hydrograph at Warner's multiply Post's hydrograph by 55 per cent.
To get Escondido hydrograph (33 sq. mi.) multiply by 24 per cent.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Nov.	154	67	221	192	57	
Dec.	560	244	804	804	244	
Jan.	348	152	500	500	152	
Feb.	8800	3840	12640	2220	1220	
Mar.	1793	781	2574	2198	771	
Apr.	2730	1190	3920	1870	1053	
May	440	192	632	632	192	
June	131	57	188	188	57	
					3746	404

1903-04

To get hydrograph at Warner's multiply Post's hydrograph by 98-1/2 per cent.
To get Escondido hydrograph (33 sq. mi.) multiply by 43 per cent.

Nov.	35	15	50	0	0
Dec.	61	26	87	0	0
Jan.	61	26	87	0	0
Feb.	265	115	380	380	115
Mar.	2020	880	2900	1256	870
Apr.	585	255	840	840	255
May	181	79	260	260	79
June	88	39	127	127	39
				2863	1358 1505

1907-08

To get hydrograph at Warner's multiply Post's hydrograph by 81 per cent.
To get Escondido hydrograph (33 sq.mi.) multiply by 35-1/2 per cent.

Nov.	206	90	296	296	90
Dec.	298	131	429	429	131
Jan.	2505	1100	3605	1055	892
Feb.	9250	4050	13300	2320	1300
Mar.	1895	830	2725	1915	830
Apr.	1540	675	2215	1620	675
May	463	203	666	666	203
June	145	63	208	208	63

1911-1912

To get hydrograph at Warner's multiply Post's hydrograph by 100 per cent.
To get Escondido hydrograph (33 sq. mi.) multiply by 44 per cent.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Nov.	100	44	144	144	0	
Dec.	168	74	242	242	7	
Jan.	290	128	418	418	96	
Feb.	212	93	305	305	8	
Mar.	4640	2040	6680	2270	1210	
Apr.	4730	2080	6810	2360	1335	
May	1270	560	1830	1510	560	
June	228	101	329	329	101	
					3317	833

1912-1913

To get hydrograph at Warner's multiply Post's hydrograph by 100 per cent.
To get Escondido hydrograph (33 sq.mi.) multiply by 44 per cent.

Nov.	117	51	168	168	0
Dec.	138	61	199	199	0
Jan.	443	195	638	568	195
Feb.	2008	883	2891	1171	667
Mar.	1758	780	2538	2296	780
Apr.	744	328	1072	1072	328
May	252	111	363	363	111
June	94	41	135	30	41
					2122 2028

1913-1914

To get hydrograph at Warner's multiply Post's hydrograph by 100 per cent.
To get Escondido hydrograph (33 sq.mi.) multiply by 44 per cent.

Nov.	111	49	160	127	6
Dec.	200	88	280	280	20
Jan.	4740	2090	6830	1030	486
Feb.	12600	5550	18150	2250	1220
Mar.	2210	970	3180	2150	926
Apr.	1313	578	1891	1832	578
May	795	350	1145	1145	350
June	243	107	350	350	107
					3693 457

Table No. 2

ESTIMATED RUNOFF SAN LUIS REY RIVER AT WARNER'S DAM

SEASON	Total Seasonal Runoff at Warner's Acre Feet	Runoff from Oct. to Mar. inclusive Acre Feet(c)	Additional Runoff for Subterranean Stream (d) Acre Feet	Total Winter Runoff Acre Ft.	Runoff from Apr. to Sept. inclusive Acre Feet (e)	Additional Runoff for Subterranean Stream Acre Feet	Total Summer Runoff Acre Feet
1888-89	27,500	19,250	350	19,600	8,250	350	8,600
89-90	45,500	31,850	350	32,200	13,650	350	14,000
90-91	51,000	35,700	350	36,050	15,300	350	15,650
91-92	21,000	14,700	350	15,050	6,300	350	6,650
92-93	31,250	21,870	350	22,220	9,380	350	9,730
93-94	15,250	10,680	350	11,030	4,570	350	4,920
94-95	99,220	69,450	350	69,800	29,770	350	30,120
95-96	7,210	5,080	350	5,430	2,160	350	2,510
96-97	23,990	16,800	350	17,150	7,200	350	7,550
97-98	3,680	2,580	350	2,930	1,100	350	1,450
98-99	2,690	1,880	350	2,230	810	350	1,160
99-00	2,300	1,610	350	1,960	690	350	1,040
1900-01	13,360	9,350	350	9,700	4,010	350	4,360
01-02	9,250	6,470	350	6,820	2,780	350	3,130
02-03	15,120	10,580	350	10,930	4,540	350	4,890
03-04	5,780(b)	4,050	350	4,400	1,730	350	2,080
04-05	27,450(b)	19,220	350	19,570	8,230	350	8,580
05-06	67,910(a)	47,540	350	47,890	20,370	350	20,720
06-07	52,150(b)	36,510	350	36,860	15,650	350	16,000
07-08	17,730(b)	12,410	350	12,760	5,320	350	5,670
08-09	32,920(b)	23,050	350	23,400	9,880	350	10,230
09-10	30,900(b)	21,630	350	21,980	9,270	350	9,620
1910-11	21,160(a)	14,810	350	15,160	6,350	350	6,700
11-12	12,030(a)	8,420	350	8,770	3,610	350	3,960
12-13	5,910(a)	4,140	0	4,140	1,770	0	1,770
13-14	22,630(A)	15,840	0	15,840	6,790	0	6,790
14-15	60,440(a)	42,310	0	42,310	18,130	0	18,130
15-16	182,068(a)	174,542	0	174,542	7,526	0	7,526
Total	907,398	682,322		690,722	225,156		283,556
Mean	32,407	24,368			8,040		

(a) Observed Runoff (b) Computed from Pala (c) Runoff from Oct.to March incl. = 70% of total seasonal.

(d) 700 acre feet per annum allowed prior to 1912-13 for subterranean stream uncovered and stopped with building of Warner's Dam cut-off wall.

(e) Runoff from April to September inclusive = 30% of total seasonal.

Table No. 3

MEASURED RUNOFF OF SAN LUIS REY AT WARNER'S

SHOWING RUNOFF FROM OCTOBER TO MARCH INCLUSIVE & FROM SEPTEMBER TO APRIL INCLUSIVE

SEASON	Total Seasonal Runoff Acre Foot	Percent Runoff Year	Runoff Oct. to Mar. incl. Acre Foot	Per cent Total Seasonal	Runoff Sept. to April incl. Acre Foot	Percent Total Seasonal
1905-06	67,910	214	51,628	76	16,282	24
1910-11	21,160	67	17,150	81	4,017	19
11-12	12,030	38	5,521	46	6,505	54
12-13	5,910	19	4,664	79	1,249	21
13-14	22,630	71	20,239	89	2,401	11
14-15	60,440	191	37,278	62	23,157	38
1915-16	182,068	586	174,542	96	7,526	4

Eliminating the year 1915-16 as extraordinary and averaging the other seasons there results:

72% of total seasonal runoff occurs from Oct. to March inclusive.

28% " " " " " " Sept. to April "

Or say 70% from October to March
30% from April to September.

Table No. 4

OBSERVED RAINFALL WARNER'S RESERVOIR

No.	Stations Name	1911-12 Oct. to Mar.	1911-12 April to Sept.	1912-13 Oct. to Mar.	1912-13 April to Sept.	1913-14 Oct. to Mar.	1913-14 April to Sept.	1914-15 Oct. to Mar.	1914-15 April to Sept.	Average Oct. to Mar.	Average April to Sept.	Average Total Seasonal
1	Warner's Dam Site	18.84	7.04	17.38	2.87	27.43	4.94	31.63	10.52	23.82	6.34	30.16
2	Damrons	18.83	7.01	21.26	5.77	27.73	3.81	33.86	13.37	25.42	7.49	32.91
3	Monkey Hill	7.14	4.54	8.27	2.90	12.95	1.71	17.84	4.44	11.55	3.40	14.95
4	Warner's Summer Road	9.98	5.35	10.42	2.39	15.96	2.48	20.79	6.48	14.29	4.17	18.46
5	Puerta la Cruz	9.30	4.90	10.19	2.49	15.22	2.98	20.88	7.26	13.90	4.41	18.31
	MEAN	12.82	5.77	13.50	3.28	19.86	5.18	25.00	8.42	17.79	5.16	22.95
	TOTAL SEASONAL	18.59		16.78		23.04		33.42				

Observed total average annual rainfall - 22.95"

78% occurring from October to March inclusive and 22% occurring from Sept. to April inclusive.

Table No. 5

ESTIMATED RAINFALL UPON WATER SURFACE

WARNER'S RESERVOIR

SEASON	Average Percent years for 9 base stations S.D.Co. 44 Year Period	Adjusted Percentage for 28 year Period	Estimated Rainfall on Reservoir Inches	90% of Estimated Rainfall Inches	Winter Rain Oct.to Mar.inc. Inches (2)	Summer Rain Sept.to Apr.incl. Inches (3)
1888-89	127	125	28.2	25.4	19.8	5.6
89-90	155	151	34.6	31.1	24.3	6.8
90-91	142	138	31.7	28.5	22.3	6.2
91-92	95	92	21.1	19.0	14.8	4.2
92-93	103	100	23.0	20.7	16.2	4.5
93-94	71	69	15.8	14.2	11.1	3.1
94-95	129	125	28.7	25.8	20.1	5.7
95-96	60	58	13.3	12.0	9.4	2.6
96-97	111	108	24.8	22.3	17.4	4.9
97-98	60	58	13.3	12.0	9.4	2.6
98-99	54	52	11.9	10.7	8.4	2.3
99-00	73	71	16.3	14.7	11.5	3.2
1900-01	94	91	20.9	18.8	14.7	4.1
01-02	76	74	17.0	15.3	11.9	3.4
02-03	110	107	24.6	22.1	17.3	4.8
03-04	51	50	11.5	10.4	8.1	2.3
04-05	145	141	32.4	29.2	22.8	6.4
05-06	150	146	33.5	30.2	23.6	6.6
06-07	116	113	25.9	23.3	18.2	5.1
07-08	85	82	18.8	16.9	13.2	3.7
08-09	112	109	25.0	22.5	17.6	4.9
09-10	94	91	20.9	18.8	14.7	4.1
1010-11	101	98	22.5	20.3	15.8	4.5
11-12	91	88 (1)	18.59	16.7 (4)	11.5 (4)	5.2
12-13	63	61 (1)	16.78	15.1 (4)	12.2 (4)	3.0
13-14	109	106 (1)	23.04	20.7 (4)	17.9 (4)	2.9
14-15	151	147 (1)	33.42	30.1 (4)	22.5 (4)	7.6
15-16	155	151	34.6	31.1	24.3	6.8
Total	2883	2800	6421			
Observed Mean	103	100	22.95			
Percent Period	103	100	100			

(1) Average of observed rainfall at 5 stations near reservoir 3 of which are in the flooded area.
(2) 78% of total seasonal.
(3) 22% " " "
(4) Observed.

Table No. 6

NET EVAPORATION

SEASON	October to March inclusive: Gross Evap. Ins.	October to March inclusive: Rainfall Inches	October to March inclusive: Net Evaporation & Rainfall Feet	April to September inclusive: Gross Evap. Ins.	April to September inclusive: Rainfall Inches	April to September inclusive: Net Evaporation & Rainfall Inches	April to September inclusive: Net Evaporation & Rainfall Feet
1888-89	14	19.8	+ 5.8	55	5.6	- 27.4	2.28
89-90	14	24.3	+10.3	55	6.8	- 26.2	2.18
90-91	14	22.3	+ 8.3	53	6.2	- 26.8	2.23
91-92	14	14.8	+ 0.8	53	4.2	- 28.8	2.40
92-93	14	16.2	+ 2.2	53	4.5	- 26.5	2.57
93-94	14	11.1	- 2.9	53	5.1	- 29.9	2.49
94-95	14	20.1	+ 6.1	53	5.7	- 27.5	2.28
95-96	14	9.4	- 4.6	53	2.6	- 30.4	2.53
96-97	14	17.4	+ 3.4	53	4.9	- 28.1	2.34
97-98	14	9.4	- 4.6	53	2.6	- 30.4	2.55
98-99	14	8.4	- 5.6	53	2.5	- 30.7	2.56
99-00	14	11.5	- 2.5	53	3.2	- 29.8	2.48
1900-01	14	14.7	+ 0.7	55	4.1	- 28.9	2.41
01-02	14	11.9	- 2.1	55	3.4	- 29.6	2.47
02-03	14	17.3	+ 3.3	55	4.8	- 28.2	2.35
03-04	14	8.1	- 5.9	55	2.3	- 30.7	2.56
04-05	14	22.8	+ 8.8	53	6.4	- 26.6	2.22
05-06	14	23.6	+ 9.6	53	6.6	- 26.4	2.20
06-07	14	18.2	+ 4.2	53	5.1	- 27.9	2.32
07-08	14	13.2	- 0.8	53	3.7	- 29.3	2.44
08-09	14	17.6	+ 3.6	53	4.9	- 28.1	2.34
09-10	14	14.7	+ 0.7	53	4.1	- 28.9	2.41
1910-11	14	15.8	+ 1.8	55	4.5	- 28.5	2.37
11-12	14	11.5	- 2.5	55	5.2	- 27.8	2.32
12-13	14	12.2	- 1.8	55	5.0	- 30.0	2.50
13-14	14	17.9	+ 3.9	55	2.9	- 30.1	2.51
14-15	14	22.5	+ 8.5	53	7.6	- 25.4	2.12
15-16	14	24.3	+ 10.3	55	6.8	- 26.2	2.18

+ Indicates the rainfall exceeds the evaporation and there is a net increase in the lake.
- Indicates the evaporation exceeds the rainfall and the lake is lowered.

Table No. 7

ESTIMATED RELINQUISHMENTS AT WARNER'S TO SATISFY THE ESCONDIDO DIVERSION

SEASON	Estimated Runoff at Warner's Acre Feet	Estimated Relinquishments for Escondido Acre Feet
1888-89	27,500	0
89-90	45,500	0
90-91	51,000	0
91-92	21,000	0
92-93	31,250	0
93-94	15,250	960
94-95	99,220	0
95-96	7,210	1,900
96-97	23,990	460
97-98	3,680	2,450
98-99	2,690	1,350
99-00	2,300	720
1900-01	13,360	1,050
01-02	9,250	1,500
02-03	15,120	400
03-04	5,784	1,500
04-05	27,451	0
05-06	67,910	0
06-07	52,153	0
07-08	17,734	0
08-09	32,924	0
09-10	30,900	0
1910-11	21,160	0
11-12	12,030	830
12-13	5,910	2,030
13-14	22,630	460
14-15	60,440	0
15-16	182,068	0

Note:- These relinquishments are taken to be the same as those computed in the Lippincott-O'Shaughnessy report.

Table No. 8

MASS TABULATION FOR WARNER'S RESERVOIR

D O M E S T I C U S E

Reservoir Capacity = 200,000 acre feet.
Draft ---------- = 24,750 acre feet per annum at the rate of 9,900 acre feet from October to March inclusive, and 14,850 acre feet from April to September inclusive.
Initial draft 10% of total, increasing uniformly and reaching 100% in 10 years.

. . . . . O C T O B E R 1st . . . . to . . . . . .

Season	Reservoir Oct. 1 Ac. Ft.	Runoff Ac.Ft.	Draft Ac.Ft.	Mean Area Water Surface Acres	Evaporation loss 90% of rainfall Feet	Evaporation loss 90% of rainfall Ac.Ft.	Total Adjusted Withdrawals Ac.Ft.
1888-89	50,000	19,600	990	2,400	+ .48	+ 1,150	+ 151
89-90	71,555	32,200	1,980	3,100	+ .86	+ 2,670	+ 690
90-91	110,055	36,050	2,970	4,350	+ .69	+ 3,000	+ 30
91-92	149,180	15,050	3,960	5,050	- .07	+ 354	- 3606
92-93	151,884	22,220	4,950	5,200	+ .18	+ 935	- 4015
93-94	162,444	11,030	5,940	5,300	- .24	- 1,270	- 7210
94-95	151,114	69,800	6,930	5,550	+ .51	+ 2,830	- 4100
95-96	200,000	5,430	7,920	6,050	- .38	- 2,300	- 10220
96-97	172,140	17,150	8,910	5,550	+ .28	+ 1,550	- 8910
97-98	165,505	2,930	9,900	5,250	- .38	- 1,990	- 11890
98-99	151,295	2,230	9,900	4,300	- .47	- 2,020	- 11920
99-00	99,445	1,960	9,900	3,400	- .21	- 715	- 10615
1900-01	71,110	9,700	9,900	2,700	+ .06	+ 162	- 9900
01-02	55,412	6,820	9,900	2,250	- .16	- 405	- 10305
02-03	35,187	10,930	9,900	1,800	+ .27	+ 486	- 9900
03-04	25,553	4,400	9,900	1,450	- .49	- 711	- 10611
04-05	1,242	19,570	9,900	680	+ .73	+ 496	- 9900
05-06	4,058	47,890	9,900	1,550	+ .80	+ 1,240	- 9900
06-07	46,078	36,860	9,900	2,400	+ .35	+ 840	- 9900
07-08	70,628	12,760	9,900	2,700	- .07	- 189	- 10089
08-09	59,639	23,400	9,900	2,580	+ .30	+ 774	- 9900
09-10	64,943	21,980	9,900	2,700	+ .06	+ 162	- 9900
1910-11	67,185	15,160	9,900	2,700	+ .15	+ 405	- 9900
11-12	60,310	8,770	9,900	2,350	- .21	- 494	- 10394
12-13	45,396	4,140	9,900	1,950	- .15	- 292	- 10192
13-14	19,314	15,840	9,900	1,500	+ .32	+ 480	- 9900
14-15	14,574	42,310	9,900	1,750	+ .71	+ 560	- 9900
15-16	47,854	174,542	9,900	4,250	+ .86	+ 3,655	- 9900

MARCH 31st		APRIL 1st to							SEPTEMBER 30th				
Net Additions or Deductions from Reservoir Ac. Ft.	Waste Ac.Ft.	Reservoir Apr. 1 Ac.Ft.	Runoff Ac.Ft.	Draft Ac.Ft.	Released for Escondido Ac.Ft.	Mean Area Water Surface Acres	Evaporation less 90% of Rainfall Feet	Ac.Ft.	Conserved Evaporation Acre Feet	Total Adjusted Withdrawals Ac.Ft.	Net Additions or Deductions from Reservoir Ac. Ft.	Waste Ac.Ft.	Reservoir Oct. 1 Ac.Ft.	Season
+ 19,760	0	89,769	8,600	1,485	0	2,700	- 2.28	- 6,150	+ 1,830	- 5,605	+ 1,795	0	71,555	1888-89
+ 32,890		104,445	14,000	2,970	0	3,700	- 2.16	- 8,080	+ 2,660	- 8,390	+ 5,610		110,055	89-90
+ 36 080		146,135	15,650	4,555	0	4,850	- 2.23	- 10,800	+ 2,750	- 12,605	+ 3,045		149,180	90-91
+ 11,444		160 624	6,650	5,940	0	5,100	- 2.40	- 12,200	+ 2,750	- 15,390	- 8,740		151,884	91-92
+ 18,205		170,089	9,750	7,425	0	5,350	- 2.37	- 12,700	+ 2,750	- 17,375	- 7,645		162,444	92-93
+ 5,620		166,264	4,920	8,910	960	5,200	- 2.49	- 12,950	+ 2,750	- 20,070	- 15,150		151,114	93-94
+ 65,700	16,814	200,000	30,120	10,395	0	6,100	- 2.28	- 13,900	+ 2,750	- 21,545	+ 8,575	8,575	200,000	94-95
- 4,790	0	195,210	2,510	11,880	1,900	5,750	- 2.53	- 14,550	+ 2,750	- 25,560	- 23,070		172,140	95-96
+ 9,790		181,930	7,550	15,365	460	5,500	- 2.34	- 12,900	+ 2,750	- 23,975	- 16,425		165,505	96-97
- 8,960		156,545	1,450	14,850	2,450	4,800	- 2.53	- 12,150	+ 2,750	- 26,700	- 25,250		131,295	97-98
- 9,690		121,605	1,160	14,850	1,350	3,850	- 2.56	- 9,870	+ 2,750	- 23,320	- 22,160		99,445	98-99
- 8,655		90,790	1,040	14,850	720	2,900	- 2.48	- 7,200	+ 2,050	- 20,720	- 19,680		71,110	99-00
- 58		71,072	4,360	14,850	1,050	2,400	- 2.41	- 5,780	+ 1,660	- 20,020	- 15,360		55,412	1900-01
- 3,485		51,927	3,130	14,850	1,500	2,000	- 2.47	- 4,950	+ 1,430	- 19,870	- 14,740		35,187	01-02
+ 1,516		36,703	4,890	14,850	400	1,700	- 2.35	- 4,000	+ 1,210	- 18,040	- 13,150		23,553	02-03
- 6,211		17,542	2,080	14,850	1,500	1,050	- 2.56	- 2,690	+ 860	- 18,180	- 16,100		1,242	03-04
+ 10,166		11,408	8,580	14,850	0	710	- 2.22	- 1,780	+ 700	- 15,930	- 9,350		4,058	04-05
+ 39,230		43,288	20,720	14,850	0	2,050	- 2.20	- 4,520	+ 1,440	- 17,950	+ 2,790		46,078	05-06
+ 27,800		73,878	16,000	14,850	0	2,700	- 2.32	- 6,260	+ 1,860	- 19,250	- 3,250		70,628	06-07
+ 2,671		73,299	5,670	14,850	0	2,550	- 2.44	- 6,230	+ 1,750	- 19,330	- 13,660		59,639	07-08
+ 14,314		73,953	10,230	14,850	0	2,650	- 2.34	- 6,200	+ 1,810	- 19,240	- 9,010		64,943	08-09
+ 12,242		77,185	9,620	14,850	0	2,750	- 2.41	- 6,650	+ 1,880	- 19,620	- 10,000		67,185	09-10
+ 5,665		72,850	6,700	14,850	0	2,600	- 2.37	- 6,170	+ 1,780	- 19,240	- 12,540		60,310	10-11
- 1,624		58,686	3,960	14,850	850	2,200	- 2.32	- 5,100	+ 1,530	- 19,250	- 15,290		43,396	11-12
- 6,052		37,344	1,770	14,850	2,030	1,650	- 2.50	- 4,150	+ 1,230	- 19,800	- 18,030		19,314	12-13
+ 6,420		25 734	6,790	14,850	460	1,450	- 2.51	- 3,640	+ 1,000	- 17,950	- 11,160		14,574	13-14
+ 32,970		47,544	18 130	14,850	0	2,100	- 2.12	- 4,450	+ 1,480	- 17,820	+ 510		47,854	14-15
+ 168,297	16,151	200,000	7,526	14,850	0	5,800	- 2.18	- 12 644	+ 2,750	- 24,744	- 17,218	0	182,782	15-16

Table No. 9

MASS TABULATION FOR WARNER'S RESERVOIR

I R R I G A T I O N U S E

Reservoir capacity = 200,000 acre feet.
Draft ---------- = 28,000 acre feet per annum at the rate of 9,300 acre feet from October to March inclusive, and 18,700 acre feet from April to September inclusive.
Initial draft 10% of total, increasing uniformly and reaching 100% in 10 years.

Season	Reservoir Oct. 1 Ac.Ft.	Runoff Ac.Ft.	Draft Ac.Ft.	Mean Area Water Surface Acres	Evaporation Less 90% of Rainfall Ft.	Evaporation Less 90% of Rainfall Ac.Ft.	Total Adjusted Withdrawals Ac.Ft.	Net Additions or Deductions from Reservoir Ac. Ft.	Waste	Reservoir Apr. 1, Ac. Ft.	Runoff Ac.Ft.	Draft	Released for Escondido Ac. Ft.	Mean Area Water Surface Acres	Evaporation Less 90% of Rainfall Ft.	Evaporation Less 90% of Rainfall Ac.Ft.
	OCTOBER 1st ..... to .... MARCH 31.										to				September	
1888-89	50,000	19,600	930	2,400	+ .48	+ 1,152	+ 222	+ 19,822	0	69,822	8,600	1,870	0	2,650	-2.28	-6150
89-90	72,222	52,200	1,860	3,150	+ .86	+ 2,702	+ 842	+ 33,040	0	105,264	14,000	3,740	0	3,800	-2.16	-8220
90-91	109,994	36,050	2,790	4,170	+ .69	+ 2,880	+ 90	+ 36,140	0	146,134	15,650	5,610	0	4,800	-2.25	-10700
91-92	148,224	15,050	3,720	5,200	+ .07	+ 364	- 3,356	+ 11,694	0	159,918	6,650	7,480	0	5,050	-2.40	-12100
92-93	149,738	22,220	4,650	5,180	+ .18	+ 933	- 3,717	+ 18,503	0	168,241	9,730	9,350	0	5,300	-2.37	-12570
93-94	158,801	11,030	5,580	5,200	- .24	- 1,250	- 6,830	+ 4,200	0	163,001	4,920	11,220	960	5,050	-2.49	-12600
94-95	145,691	69,800	6,510	5,500	+ .51	+ 2,800	- 3,710	+ 66,090	11,981	200,000	30,120	13,090	0	6,100	-2.28	-13900
95-96	200,000	5,430	7,440	6,050	- .38	- 2,300	- 9,740	- 4,310	0	195,690	2,510	14,960	1,900	5,700	-2.53	-14400
96-97	169,690	17,150	8,370	5,550	+ .28	+ 1,550	- 6,820	+ 10,330	0	180,020	7,550	16,830	460	5,300	-2.34	-12400
97-98	160,630	2,930	9,300	5,100	- .38	- 1,940	- 11,240	- 8,310	0	152,320	1,450	18,700	2,450	4,550	-2.53	-11500
98-99	123,870	2,230	9,300	4,050	- .47	- 1,900	- 11,200	- 8,970	0	114,900	1,160	18,700	1,350	3,550	-2.56	-9100
99-00	89,360	1,960	9,300	3,050	- .21	- 640	- 9,940	- 7,980	0	81,380	1,040	18,700	720	2,600	-2.48	-6450
1900-01	58,370	2,700	9,300	2,380	+ .06	+ 143	- 9,157	+ 543	0	58,913	4,360	18,700	1,050	2,150	-2.41	-5180
01-02	39,855	3,820	9,300	1,900	- .18	- 342	- 9,642	- 2,622	0	37,051	3,130	18,700	1,500	1,600	-2.47	-3950
02-03	17,171	10,930	9,300	1,360	+ .27	+ 367	- 8,933	+ 1,997	0	19,168	4,890	9,350	400	1,300	-2.55	-2820
03-04	12,408	4,400	4,650	1,020	- .49	- 500	- 5,150	- 750	0	11,658	2,080	9,350	1,500	600	-2.56	-1530
04-05	1,958	15,570	9,300	750	+ .73	+ 548	- 8,752	+ 10,818	0	12,776	8,580	18,700	0	800	-2.22	-1770
05-06	1,586	47,890	9,300	1,480	+ .80	+ 1,185	- 8,115	+ 39,775		41,361	20,720	18,700	0	1,950	-2.20	-4290
06-07	40,471	36,860	9,300	2,250	+ .35	+ 778	- 8,522	+ 28,338		68,809	16,000	18,700	0	2,550	-2.32	-5920
07-08	61,929	12,760	9,300	2,500	- .07	- 175	- 9,475	+ 3,285		65,214	5,670	18,700	0	2,300	-2.44	-5620
08-09	46,184	25,440	9,300	2,300	+ .30	+ 690	- 8,610	+ 14,830		61,014	10,280	18,700	0	2,300	-2.34	-5380
09-10	50,764	21,890	9,300	2,350	+ .06	+ 141	- 9,159	+ 12,731		63,495	9,620	18,700	0	2,350	-2.41	-5670
10-11	50,365	15,160	9,300	2,200	+ .15	+ 330	- 8,970	+ 6,190		56,555	6,700	18,700	0	2,120	-2.37	-5030
11-12	41,025	8,770	9,300	1,950	- .21	- 410	- 9,710	- 940		40,085	3,960	18,700	850	1,800	-2.32	-4180
12-13	21,555	4,140	9,300	1,400	- .15	- 210	- 9,510	- 5,370		16,185	1,770	9,350	2,030	950	-2.50	-2380
13-14	4,985	15,840	4,650	980	+ .32	+ 314	- 4,336	+ 11,504		16,489	6,790	18,700	460	850	-2.51	-2130
14-15	2,729	42,310	9,300	1,450	+ .71	+ 1,030	- 8,270	+ 34,040		55,769	18,150	18,700	0	1,800	-2.12	-5820
15-16	33,669	174,542	9,300	4,050	+ .86	+ 3,483	- 5,817	+ 168,725	2,394	200,000	7,526	18,700	0	6,000	-2.18	-13080

30th . . . . . .

Conserved Evaporation Ac. Ft.	Total Adjusted Withdrawals Ac. Ft.	Net Additions or Deductions from Reservoir Ac. Ft.	Waste Ac.Ft.	Reservoir Oct. 1, Ac. Ft.	Season
+ 1,820	- 6,200	+ 2,400	0	72,222	1888-89
+ 2,750	- 9.270	+ 4,730	0	109,994	89-90
+ 2,750	- 15,560	+ 2,090	0	148,224	90-91
+ 2,750	- 16,830	- 10,180	0	149,738	91-92
+ 2,750	- 19,170	- 9,440	0	156,801	92-93
+ 2,750	- 22,030	- 17,110	0	145,891	93-94
+ 2,750	- 24,240	+ 5,880	5,880	200,000	94-95
+ 2,750	- 28,510	- 26,000	0	169,690	95-96
+ 2,750	- 26,940	- 19,990	0	160,650	96-97
+ 2,750	- 29,900	- 28,450	0	125,870	97-98
+ 2,450	- 26,700	- 25,540	0	89,360	98-99
+ 1,820	- 24,050	- 23,010	0	58,370	99-00
+ 1,510	- 23,420	- 19,060	0	39,853	1900-01
+ 1,160	- 22,990	- 19,860	0	17,171	01-02
+ 920	- 11,650	- 6,760	0	12,408	02-03
+ 500	- 11,780	- 9,700		1,958	03-04
+ 700	- 19,770	- 11,190		1,586	04-05
+ 1,380	- 21,610	- 890		40,471	05-06
+ 1,740	- 22,880	+ 6,880		61,989	06-07
+ 1,620	- 22,700	- 17,030		48,184	07-08
+ 1,600	- 22,480	- 12,250		50,764	08-09
+ 1,620	- 22,750	- 15,150		50,365	09-10
+ 1,500	- 22,230	- 15,530		41,025	10-11
+ 1,220	- 22,490	- 18,550		21,555	11-12
+ 790	- 12,970	-11, 200		4,985	12-13
+ 740	- 20,550	- 13,760		2,729	13-14
+ 1,290	- 21,230	- 3,100		35,669	14-15
+ 2,750	- 29,030	- 21,504		178,496	15-16

Ed Fletcher Papers

1870-1955

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Business Records - Reports - Lippincott, J.B - Lippincott, et al., "Report of Board on the Net Safe Yield of Volcan Land and Water Company System, San Diego Country, California"