REPORT ON

COSTS TO DELIVER WATER FROM WARIFERS TO LINDA VISTA MESA BY VARIOUS ROUTES OF VOLCAN SYSTEM

By

Francis L. Sellew
and
W. S. Post

March 6, 1917.

COPY

March 5, 1917.

Col. Ed Fletcher,

My dear Colonel:

Attached is a report by Mr. Post and the writer prompted by your inquiry of Feb. 28th. Your direct questions have been answered in another letter, enclosed, but you will find in the report figures more in detail and several alternate schemes which we have taken the liberty to present.

Page eleven gives a tabulation of the costs of transmitting water from the Santa Ysabel to the Linda Vista Mesa or San Clemente, from which it appears that a pumping plant below Carroll dam discharging along the route of the suggested University Heights line would be somewhat cheaper than pumping at Bernardo. It also appears from page eleven that a redwood pipe from Warners Power House to Pamo eliminating the Pamo diversion dam accomplishes some reduction in cost.

Your attention is particularly directed to pages 12 to 16 inclusive which give a general review of the Volcan System emphasizing certain features which we feel it our duty to place before you.

We appreciate your firm grasp upon the strategy of the situation and that the engineering features may be but one factor in a complicated problem, nevertheless a clear presentation of the technical side may assist in the solution. On page 13 is shown the approximate value of water for different purposes, indicating that its use for power should be subordinated to domestic supply and agriculture.

On the accompanying map we have outlined in yellow those areas of irrigable land which are within reach of the system, the total gross area being 98,000 acres. Deducting the area probably unsuited for agriculture and making due allowance for fallow land, dwellings and that devoted to public use, it appears reasonable to assume that not over 60,000 acres will require water in any one season.

As the safe irrigation yield of the system is sufficient for 50,000 acres, there is close agreement between the agricultural area and the volume of water available for its cultivation.

The costs on page 16 of the estimate are for a complete system including the Warner Dam; while those on page eleven cover only that portion of the works lying below the proposed Warner Power House in the Santa Ysabel drainage area.

Very truly,

Francis L. Sellew

FLS=K

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March 5, 1917.

Col. Ed Fletcher,

Sir:

Your communication of the 28th ult. to Mr. Post makes the following inquiries which are answered as indicated.

(1) Cost of conduit of 40 million gallons daily capacity from Bernardo to San Clemente:

Answer: Pamo Conduit, Bernardo to San Clemente 14 miles lined ditch, flumes tunnel and siphon ---------- $ 521,700
15% ---------- 78,000 $ 599,700

(2) Cost of San Clemente Dam 90' High

Answer: Earth dam 98' high, water level 90 feet, capacity 2-3/4 million gallons or 8570 ac-ft. 1,000,000 yds at .30 ------- $ 300,000
15% ---------- 45,000 $ 345,000

(3) Cost of Pumping Station at Bernardo with Pipe Line to Pamo Conduit for 5,000,000 gallons daily.

Answer: Plant complete, 3-250 HP motors, 2740 ft. 24" force main, etc. ---------- $ 30,900
15% ---------- 4,600 $ 35,500

(4) Cost of Pumping Station at Bernardo, capacity 10,000,000 gallons daily.

Answer: Add two pumping units to the 5 million plant, total cost ---------- 44,700

(5) Cost of Diversion Dam at Pamo with conduit to San Clemente.

Answer: For conduit is ---------- $ 896,550
Diversion dam 50' high ---------- 90,000
$ 986,550
15% ---------- 148,000 1,134,550

(6) Cost, Diversion Dam Pamo Redwood Pipe to Bernardo, conduit to San Clemente.

Answer: $ 924,600

(7) Advisable height of San Clemente Dam.

Answer: We are impressed with the fact that the proximity of Pamo Dam and the supply in the Bernardo gravels renders unnecessary the construction of San Clemente until its capacity is needed to develop the net safe yield of the entire system.

(8) Comparative costs of delivering water to San Clemente by gravity and by pumping.

Answer: Costs exclude San Clemente Reservoir

(1) 10 million gallon plant at Bernardo, Pamo Conduit to San Clemente, Capital cost--------- $ 644,700
Annual charges $213,428, total water pumped 3,650,000,000, cost 6 cents per 1,000 gallons.

(2) Pamo Diversion dam, standard conduit to San Clemente, Capital cost ---------- $ 1,132,000
Annual charges $152,136, cost per 1,000 gallons (capacity 22 M.G.D.) = 1.8 cents.

(3) Pamo Diversion, redwood to Bernardo, Standard Conduit to San Clemente, capacity limited by redwood to 10 M.G.D. Capital cost ---------- $ 924,600
Annual charges $138,925
Cost per 1,000 gallons 3.8 cents.

You also ask as to the advisability of further examination of the foundation at San Clemente and the feasibility of building there a multiple arch dam:

As there appears no necessity for building this structure at present we advise that further examination of the site and the determination of the type of dam be left for the future.

Respectfully submitted,

William S. Post,
Francis L. Sellew,

By Francis L. Sellew.

FLS=K

REPORT ON COSTS TO DELIVER WATER

FROM WARNERS TO LINDA VISTA MESA

BY VARIOUS ROUTES OF VOLCAN SYSTEM

By

Francis L. Sellew
and
W. S. Post

March 5, 1917.

REPORT ON COSTS TO DELIVER WATER TO LINDA VISTA MESA BY VARIOUS ROUTES, VOLCAN SYSTEM

By Francis L. Sellew & W. S. Post

March 5, 1917.

Replying to Mr. Fletcher's letter of February 28th relative to pumping into Pamo Conduit at Bernardo, we have to answer several questions based on the following assumptions:

1. A Pamo Conduit of 50,000,000 Gallons daily capacity; built from Bernardo to San Clemente.

2. A 90 ft. dam at San Clemente.

3. A pumping plant at Bernardo of 5,000,000 Gallons daily capacity, with connecting pipe line to Pamo Conduit; also an alternative pumping plant of 10,000,000 Gallons capacity.

From the instructions in your letter, we assume that this plant will be located at the upper end of Carroll Reservoir, say at the Fenton place or Ward place.

4. Electrical energy to be 1-1/4 cents per K. W. hour.

Your questions are as follows:

A. What is the cost of the San Clemente Dam 90 feet high, Pamo Conduit from Bernardo to San Clemente, capacity 50 million gallons daily, and a pumping plant at Bernardo to provide 5 million gallons daily and again 10 million gallons daily.

B. What is the advisable height of San Clemente Dam; whether multiple arch would apply and what investigation of the foundation should be made.

C. We submit an obvious alternative estimate, being a modification of the original Carroll-University pipe line estimate made for City of San Diego.

D. The cost of a temporary diversion Dam at Pamo Dam site; and the cost to build from Pamo dam site to Bernardo, as a permanent conduit, and also the cost of a Redwood pipe alternative. This to be compared with the pumping plant. We submit also a third alternative - Warner power house to Bernardo, all Redwood pipe.

Question "A"

In answering this question, we have been guided by the previous Hickok report on the same subject on January 1914, which was as follows:

Steam Pumping Plant on Fenton Ranch	$ 81,945
Pipe Pump to Receiving Basin	7,795
Receiving Basin	300
Conduit from Receiving basin to Main Line Pamo Conduit	7,563
Pamo Conduit, Bernardo to San Clemente, 14 miles, Lined Ditch, Flume, tunnel & syphon	521,702
San Clemente Reservoir, Earth Dam 20' high, 36,000 cu. yds and gates	12,650
Supply Roads	5,000
20% Overhead	127,391
	$764,346

Note: The above estimate included other items as the line to the City of San Diego which are here omitted.

There was also estimated by Hickok the cost delivered to University Heights Reservoir including operation, depreciation, taxes and interest of 6-1/3 cents per 1,000 gallons.

To conform to the present assumed conditions, we substitute electricity for steam and provide for a 90 ft. dam at San Clemente, while the Hickok estimate was based on a dam 20 feet high.

A Plant for 5,000,000 Gallons Daily

Pumping Plant Lift 500 ft.

Temporary Diversion and Ditch, say	$ 500
3 - 250 H. P. Motors direct connected to Centrifugal Pumps, at $4,000 erected complete	12,000
Building and accessory piping	2,500
	$ 15,000
24" Force Main - 2,740 lin. ft.	8,000
Connecting Flume and Syphon, 3,300 lin. ft.	7,900
Pamo Conduit - Bernardo to San Clemente, 14 miles Lined Ditch, Flume, Tunnel, and syphon	521,700
San Clemente Reservoir (Upper Site) Earth Dam - Top 98 feet high, water level 90 feet, capadity 2-3/4 billion gallons, or 8,570 acre feet, 1,000,000 cu. yds at $0.30 -- Price includes all auxiliary works	300,000
15% Overhead	127,900
	$980,500

Operating Cost

Data

Power - 440 K. W. multiplied by 24 hours = 10,560 K.W. hours at 1-1/4 cents or per day	$ 132
Labor - 6 men at $3	18
Waste and Supplies	10
Depreciation and Repairs - 16-2/3%	7
Interest on $15,000	4
Taxes	1
Per day	$ 172

Yearly Operating Cost (5,000,000 Gallons daily)

Pumping Plant at $132 per day	$ 62,780
Interest on System Exclusive of pumping unit (965,500) at 10%	96,550
Depreciation, force main and connecting flume, 10%	1,590
Depreciation - 2% on all other structures	18,992
Taxes $2.00 on 1/3 value	6,436
Operating and Maintenance	20,000
	$206,348

Total water pumped 1,825,000,000 Gallons or 11⅓ cents per 1,000 gallons.

Plant 10,000,000 Gallons Daily

For a 10 million Gallon plant the cost of the 5 million plant will be increased by additional pumping units as follows:

Cost of 5 million gallon plant, force main, Pamo Conduit and San Clemente Reservoir as before	$980,500
Two additional pumping units, plus 15%	9,200
Total Cost 10 million gallon system	$989,700

Yearly Operating Cost

As before for 5 million gallon system	$206,348
Add additional power	48,180
Add depreciation repairs, taxes, etc. of extra pumping units	2,500
	$257,028

Total Water pumped 3,650,000,000 Gallons or 7 cents per 1,000 gallons.

Answer to Question "B"

and Comment on above Scheme

We are impressed with the fact that the proximity of Carroll Reservoir to the ultimate destination of this water renders unnecessary the construction of San Clemente Reservoir for the purposes of initiating the scheme, and will probably not be needed until it is necessary to develop the full safe yield of the system. At the most it need only be built of a size to store water for temporary shut downs of a few days.

Eliminating San Clemente from the preceeding figures, we have -

5 Million Gallons Daily

First Cost	$635,500
Annual Operating and fixed charges	162,748
Cost per 1,000 Gallons	9 cents

10 Million Gallons Daily

First Cost	$644,700
Annual Operating and fixed charges	213,428
Cost per 1,000 Gallons	6 cents

There appears to be no necessity for core drills at the San Clemente Site, the foundation can be explored much more satisfactorily by test pits. Further examination is unnecessary until the dam is decided upon. Because of the extreme length of the dam, an earth structure seems preferable, but the foundation appears suitable to the construction of an Ambursen or multiple arch dam, and decision as to the most economic structure should be left to the future. At the present time it appears that an earth dam is the cheapest, but the development of the other types and future prices of materials may change these conditions.

"C" - Carroll Pumping Plant, Being a Suggested Alternative to the Bernardo Pumping Plant.

Estimate of Cost

Carroll Dam to Linda Vista Mesa

Pumping Plant

3 - 250 H.P. Electric Motors connected to 3 Stage Centrifugal pumps - at $4,000	$ 12,000	
Building and foundations	4,000	
Pipe from Reservoir to Pump	3,100	
Force main to Canal	2,600	
Receiving Basin	500	$ 22,200

Pipe Line - Carroll to Linda Vist

Clearing Right of Way	$ 1,000	
Canal, 8,000 ft. at $2	16,000	
Basin at end of canal	3,000	
Lock bar Pipe		
34" x 3/16" x #90 - 57,500 lin. ft. 5,175,000 lbs.		
34" x 1/4" x 116 lbs - 4,000 lin. ft. 464,000 lbs.		
Total 5,639,000 lbs. at 60¢ in place	338,340	
All Valves and Specials	2,500	
Trenching and backfilling	47,000	407,840
High Service Pump - 75 H.P. Electric Motor and Centrifugal		2,000
15% Overhead		64,860
Total		$496,900

Operating Cost

Data

Power - 550 K.W. - 24 hours is 13,200 K.W. hours at 1-1/4	$ 165	per day
Labor - 5 men at $3.00	15	"
Waste and Supplies	10	"
Depreciation & Repairs - 16-2/3%	10	"
Interest on $22,200 at 10%	6	"
Taxes	1	"
	$ 207	"

Yearly Operating Cost

Pumping Plant at $207 per day	$ 75,555
Interest at 10% on system, exclusive of pumping plant (474,700)	47,470
Depreciation 4%	18,988
Taxes $2 on 1/3 value	3,164
Operating and Maintenance	20,000
Booster Plant for 1/3 of water, at $20 per day for power and all charges	7,300
	$172,477

The annual amount of water pumped is 3,650,000,000 gallons and the cost per 1,000 Gallons is 4.7 cents.

Carroll - Linda Vista using Redwood Pipe

Cost

Pumping Plant, Force Main and Canal as before		$ 42,200
Booster Plant as before		2,000
Redwood Pipe (instead of Lockbar)		
57,500 lin.ft. 34" R.Pipe at $2	$115,000	
Supports and grading 11 miles at $1,500	16,500	
4,000 lin.ft. R.Pipe (High Heads) at 2.25	9,000	
Supports and grading	1,000	
Trestles 3,000 lin.ft. at $1.50	4,500	146,000
Overhead		28,500
		$218,700

Yearly Operating Cost

Pumping Plant at $207	$ 75,555
Interest 10% on system, exclusive of pumping plant($167,900)	16,790
Depreciation 6%	10,074
Taxes $2 on 1/3 value	1,460
Operating and Maintenance	20,000
Booster Plant	7,300
	$131,179

The annual pumped is 3,650 million gallons or the cost per 1,000 Gallons is 3.6 cents.

Answer to Question "D"

The Field Cost, exclusive of contingencies, of Pamo Conduit, 28.3 miles long, is variously estimated as follows:

Post - 1912	$896,550
Hawgood - 1912	918,232
Harroun - 1914	862,000
O'Shaughnessy & Lippincott - 1915	891,200
Average	$892,000

Because of the close agreement with the average and being in possession of the details, the Post Estimate has been accepted for field cost.

Field Cost Entire Pamo Conduit	$896,550	
Deduct lower 14 miles as given in Question A	521,700	
	$374,850	
Construction Roads	10,000	
Overhead 15%	57,750	$442,600

A diversion dam at Pamo Site B would necessarily have to be of concrete overfall type. A height of 50 feet above stream bed is adopted or to elevation 900 above sea, and 10 feet above the outlet of Pamo Conduit.

Estimate

11,600 cu.yds. concrete at $6.00	69,600	
Excavation for Dam - 4,000 cu.yd. at $1.00	4,000	
Excavation for Trench 1,200 cu.yd. at $1.50	1,800	
Gates	3,000	
Overhead 15%	11,600	90,000
GRAND TOTAL		$ 532,600

ALternative Wood Stave Line.

from Pamo Dam to Bernardo

Diversion Dam as before			$ 90,000
Pipe Line			
14.3 miles 32" wood stave pipe as follows:			
1000 lin.ft. steel pipe syphon at $4.		$4,000	
1000 " " " $3.		3,000	
1000 " Redwood syphon at $2.25 -		2,250	
73000 " " pipe (not over 70' head) at $2.00		146,000	
Grading and supports, 14.3 miles at $1,500 say		22,000	
Trestles, 10,000 lin.ft. at $1.50		15,000	192,250
Overhead, 15%			42,350
			$ 324,600

Another Alternative

It may be suggested that a redwood pipe line might be extended 5 miles to Warner Power House, which would eliminate the necessity of the diversion dam at Pamo.

The cost of such a pipe is as follows:

20" Redwood pipe (sufficient to convey 10 million gallons at the increased grade Warner to Pamo) 26,000 ft. at $1.35	$ 35,100
5 miles of grading and supports at $1200	6,000
2600 lin.ft. Trestles at $1.50	3,900
34" wood stave pipe, Pamo to Bernardo	192,250
Overhead, 15%	35,550
	$ 272,800

Notes on Annual Charges of Preceeding Costs

Pamo Diversion Dam to San Clemente, Standard Conduit.

Interest on $1,132,600 at 10%	$ 113,260
Depreciation, 1%	11,326
Taxes, 1/3 value at $2.00 per $100.00	7,550
Operating and Maintenance	20,000
	$ 152,136

The Warner Water will amount to 22 million gallons

daily or 8,030 million gallons per year or 1.8 cents per 1000 gallons.

Pamo Diversion Dam to San Clemente, 32" Redwood

Interest on $924,600 at 10%	$ 92,460
Depreciation, 1% on $703,500	7,035
Depreciation, 6% on $221,100	13,266
Taxes, 1/3 value at $2.00 per $100.00	6,164
Operating and Maintenance	20,000
	$ 138,925

Warner Power House to San Clemente, with 20" and 34" Redwood

Interest on $872,800 at 10%	$ 87,280
Depreciation 1% on $600,000	6,000
" 6% on $272,800	16,368
Taxes on 1/3 value at $2. per $100. -	5,818
Operating and Maintenance	20,000
	$ 135,466

Comparison of Above to Determine Relative Cost per 1,000 gallons.

Scheme	Capital Expenditure	Annual Charges	Capacity Million Gals Daily		Cost per 1000 Gals	Annual Cost per Acre(c)
Carroll to Linda Vista Mesa.						
(a) Heavy Steel pipe	$496,900	$172,477	10	M.G.D.	4.7	$15.40
(b) Redwood	218,700	131,179	10	"	3.6	11.80
Bernardo Pumping to San Clemente (Excluding San Clemente Reservoir)	644,700	213,428	10	"(a)	6.0	19.70
Pamo Diversion to San Clemente Valley Standard Conduit						
Pamo-Bernardo	532,600					
Bernardo-San Clemente	600,000					
Same	1,132,600	152,136	22	"(a)	1.8	5.90
34" Redwood Pamo to Bernardo						
Pamo-Bernardo	324,600					
Bernardo-San Clemente	600,000					
Warner Power House to San Clemente Valley using Redwood Line to Bernardo	924,600	138,925	10	" (a)	3.8	12.45
Power House-Bernardo	272,800					
Bernardo-San Clemente	600,000					
	872,800	135,466	10	"(a)	3.7	12.15

(a) 14 miles of Pamo Conduit for 50 million gallons.
(b) 28 " " " " " " " "
(c) Cost per acre figured on basis of 1 acre-feet per acre or 1 M.I. for 10 acres.

General Review

So far this report has considered only those matters suggested in your letter of the 28th ult. but before closing the discussion, we wish to call attention to some general features of the Volcan Problem which should have careful analysis before work is initiated that will control definitely the future construction programme.

In such an enterprise as you contemplate, the most advantageous development is one that co-ordinates the power, agricultural and domestic supply possibilities. The acceptance of a proposition superficially attractive, promising immediate returns, has oftentimes seriously abridged the development of large projects. One second foot continuous flow equal to 50 miners inches or 640,000 gallons daily has the following approximate values for the various uses.

A second foot falling 1500 feet, which is the maximum power head available on the Volcan System will develop 8 K.W. on the Switchboard, having a commercial value of $20. per K.W. or $160. annually.

This same quantity of water devoted to domestic purposes, sold at 10 cents per 1,000 gallons, yielding a net profit of 4 to 8 cents, will at the lower figure net about $9400 per year. Or if applied to irrigation 735 acres may be cared for and assuming a net profit of $3.60 per acre the annual return will be about $2600. per year.

Unit	For Power	For Domestic Use	For Agriculture
One Second-foot	$160	$9400	$2600
One Million Gallons Daily	$248	$14600	$4000
One Miners Inch	$3.20	$187	$52

This paragraph is written as a word of caution and what follows has been prepared in order that you may have at your disposal as complete a resume as our limited time will permit.

The previous estimates have been based upon the assumption that the proper development involves the transfer of the Warner run-off to the drainage area of the Santa Ysabel. Such treatment involves expensive tunnel construction at the upper end of the system; the line is close to and parallel with the logical diversion from Sutherland; the water ultimately reaches one locality thereby limiting the market.

As a matter of fact a reservoir at Warner's with elevation 2600 is well located to serve Bear Valley, Escondido, San Marcos, Vista, the Coast, San Bernardo Valley and Linda Vista Mesa at such elevations that power plants may operate under heads of 1000 to 1500 feet. The Sutherland reservoir dominates in the same manner Ramona Valley. Thus the Volcan System controls all the really valuable irrigable land in the County on the westerly slope, which emphasizes the importance of determining the most economic development. Furthermore the recent report upon the safe yield of the system indicates that none of these areas need suffer for water. To show the possibilities consideration of the following plan is invited:

Build Warner dam; Transmit the stored water through San Luis Rey to the Escondido diversion, thence through Escondido ditch to the Escondido reservoir. Below the reservoir continue with about 2 miles of concrete pipe to a favorable point for

dropping to elevation 750± on the Escondido plains; thence follow supporting ground on the westerly slope of the San Marcos Hills to Carroll reservoir; Siphon San Dieguito River and continue with concrete pipe to delivery point on the Linda Vista Mesa. By such a plan the works will have a capacity of 20 M.G.D. to Escondido and 10 M.G.D. beyond, all delivery being by gravity flow. Estimates for the inauguration of this plan are given below.

Power Possibilities

While this plan is probably the most efficient for domestic purposes and agriculture, the power possibilities suffer but little. A power conduit from Warners to a point 10½ miles below will allow a drop into the Escondido ditch of about 850 feet and below Escondido there will be a fall of 630 feet, making a total head of 1480 feet which is but 20 feet less than that now proposed at the Warner Plant. These plants can be installed in the future without interference with the operation of the suggested system and as the power feature should finance itself, the cost has not been included in the estimates.

Objections

The only apparent objection to this plan is the responsibility which may come to the Company from the use of the Escondido System. This however, should not be vital for if the time ever comes when the cost of using the Escondido works outweighs the advantages, parallel routes are available which are perfectly feasible.

Other Irrigation Charges

For your information the irrigation rates now in force at several localities are tabulated below.

Irrigation Rates

	Per Inch	Per 1000 Gallons	Approx. Annual Charge for acre
Sweetwater Company		2 cents	$ 6.40
Cuyamaca Water Co.			
1912-16	$60 to $70		$6 to $7
1917 R.R.Com.		2½ cents	$8
Oceanside Mutual Water Co.		3 cents	$10
Riverside General			$12
Hemet			$ 5.30
Mulholland, Practical Rate			$10.

Estimated Cost - Warners Dam to Linda Vista Mesa - Via Escondido and Carroll Dam.

Warner Dam, 107' water line		$ 307,000
Follow channel San Luis Rey		
Use of Escondido Works and lining of same		100,000
Conduit beyond Escondido reservoir,		
2 miles 42" cement at $12,000		24,000
Drop, 1 mile steel pipe		25,000
Conduit from Drop to Carroll Dam		
1½ miles steel siphon 42"	$ 45,000	
5 " 42" cement pipe at $12,000-	60,000	
5½ " 34" " " " 9,300-	51,000	156,000
Syphon across San Dieguito River at Carroll Dam		5,200
On Linda Vista Mesa, 14 miles 34" cement pipe at $9300		130,200
		$ 747,400
15%		112,110
		$ 859,510

Annual Charges

Interest at 10% on capital invested	$ 86,000
Depreciation 2%	17,000
Taxes $2 per $100 on 1/3 value	5,700
Maintenance and operation	20,000
	$ 128,700

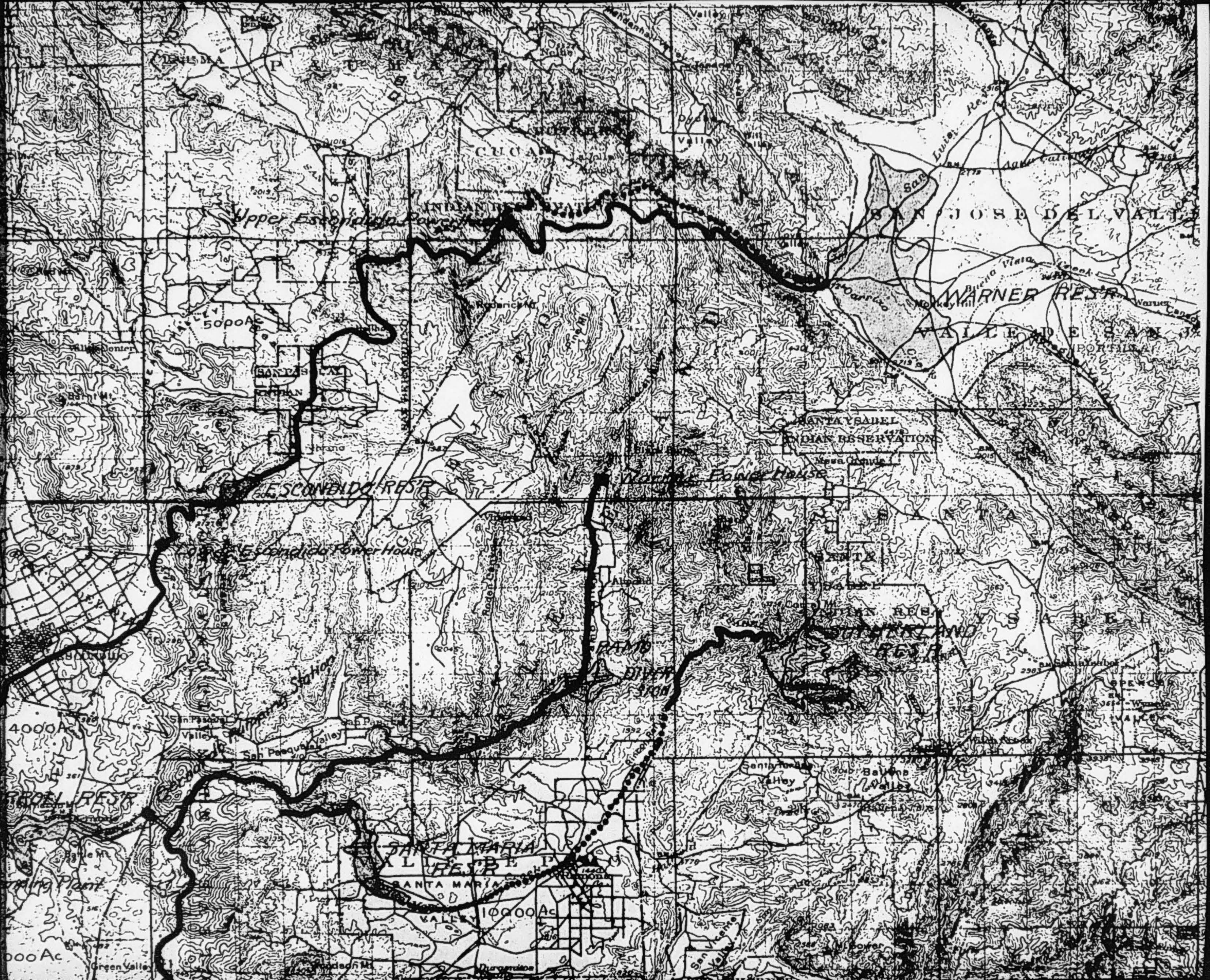
If the entire 20 M.G.D. are sold, a reasonable assumption as the line commands practically all the irrigable areas, the annual cost per 1000 gallons would be

$\frac{128,700}{7,300,000}$ = 1-8/10 cents equal to a yearly cost per acre of $5.90. Assuming that in the earlier years but 10 M.G.D. are disposed of and the returns from this lesser quantity must carry the entire project then the cost would be $\frac{128,700}{3,650,000}$ = 3-6/10 cents per 1000 gallons or a yearly cost per acre of $11.80.

In addition to the sale of water there would be returns from electric power of which there may be developed about 3200 K.W. on the Switchboard.

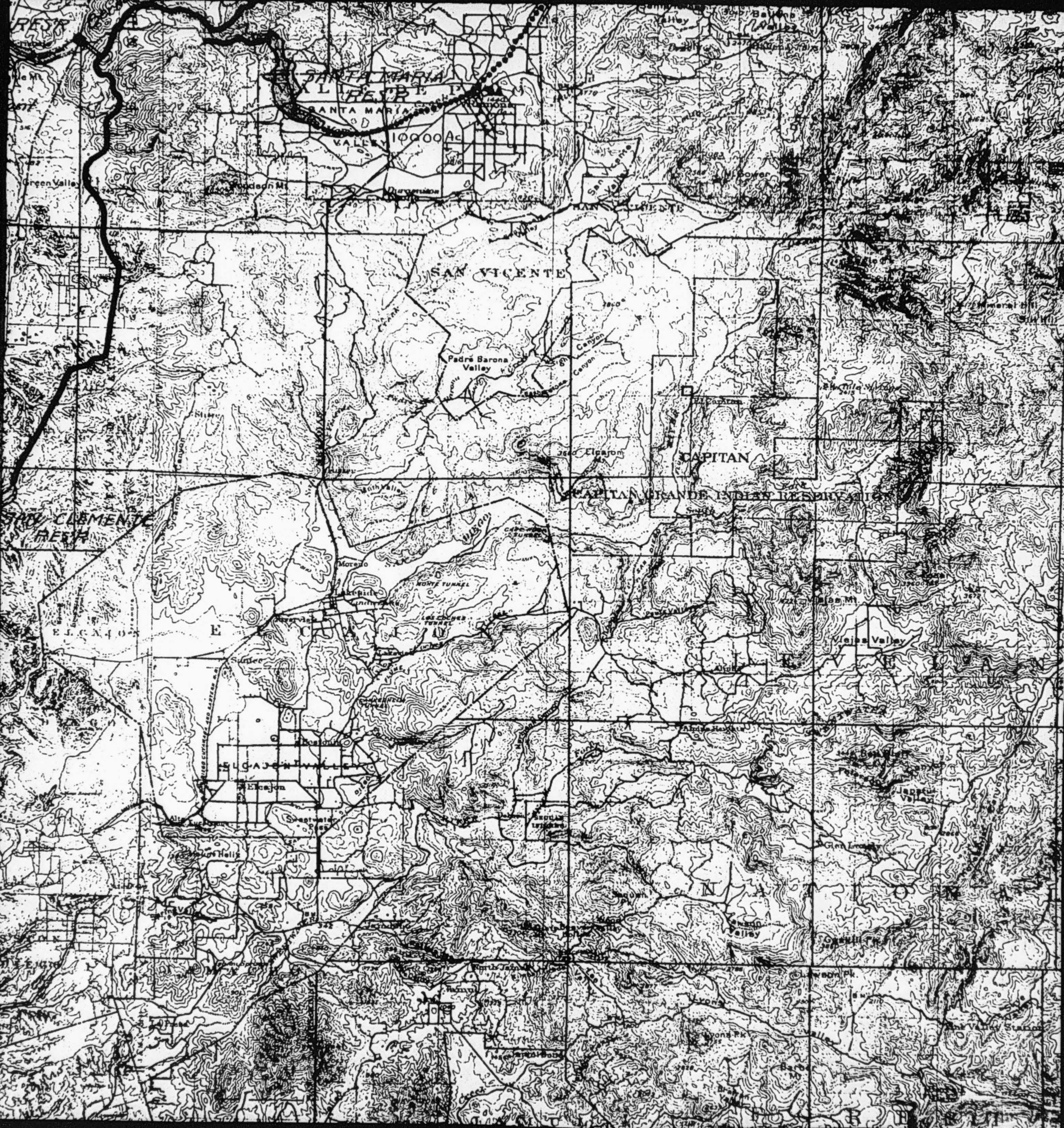
Respectfully Submitted,

Loma Alta Mt
21000 Ac
3000 Ac
Cerro de la Calavera
SAN MARCOS VALLEY
4000 Ac
CARROLL RES
Carroll Pumping Plant
5000 Ac
10000
SAN DIEGUITO
12000 Ac



Upper Escondido Power House
ESCONDIDO RESR
Lower Escondido Power House
Warner Power House
WARNER RESR
SAN JOSE DEL VALLE
SANTA YSABEL
INDIAN RESERVATION
Mesa Grande
SANTA MARIA RESR
SANTA MARIA
VALLEY 10000 Ac
5000 Ac
4000 Ac
DAM
DIVERSION
CUCA
PAUMA
San Pasqual Valley
Green Valley


12000 Ac
2800b Ac
PACIFIC
OCEAN


SANTA MARIA
RESR
SANTA MARIA
VALLEY
10000 Ac
Green Valley
SAN VICENTE
San Vicente Valley
Padre Barona
Valley
Canyon
El Capitan
CAPITAN
CAPITAN GRANDE INDIAN RESERVATION
SAN CLEMENTE
RESR
Sycamore
Canyon
Moreno
Lakeside
MONTE TUNNEL
LOS COCHES
TUNNEL
Santee
ELCAJON VALLEY
Elcajon
Viejas Mt
Viejas Valley
Japatul
Valley
Lyons Pk
Lyons
Barber
Mt

Rep 137

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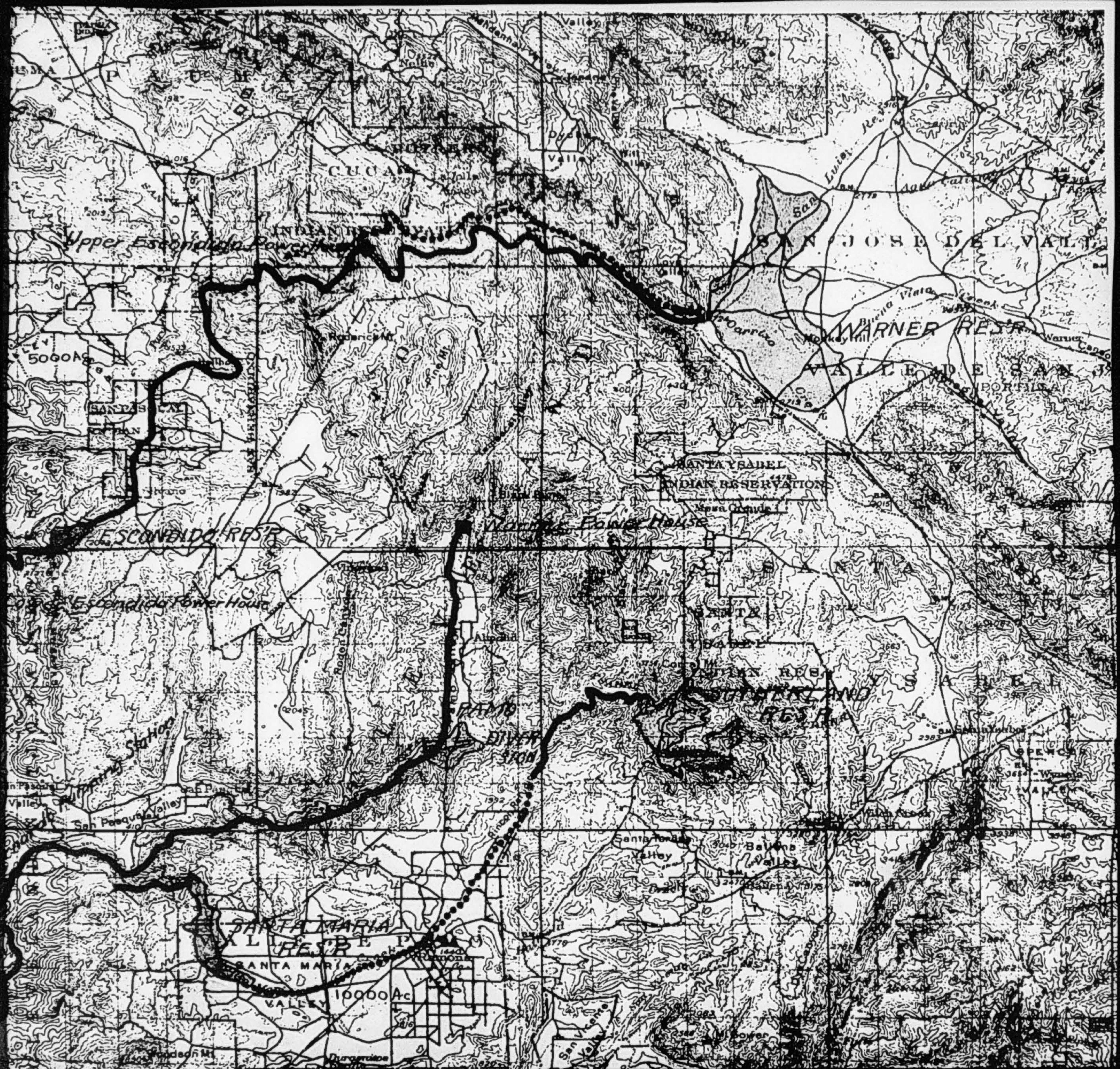
By

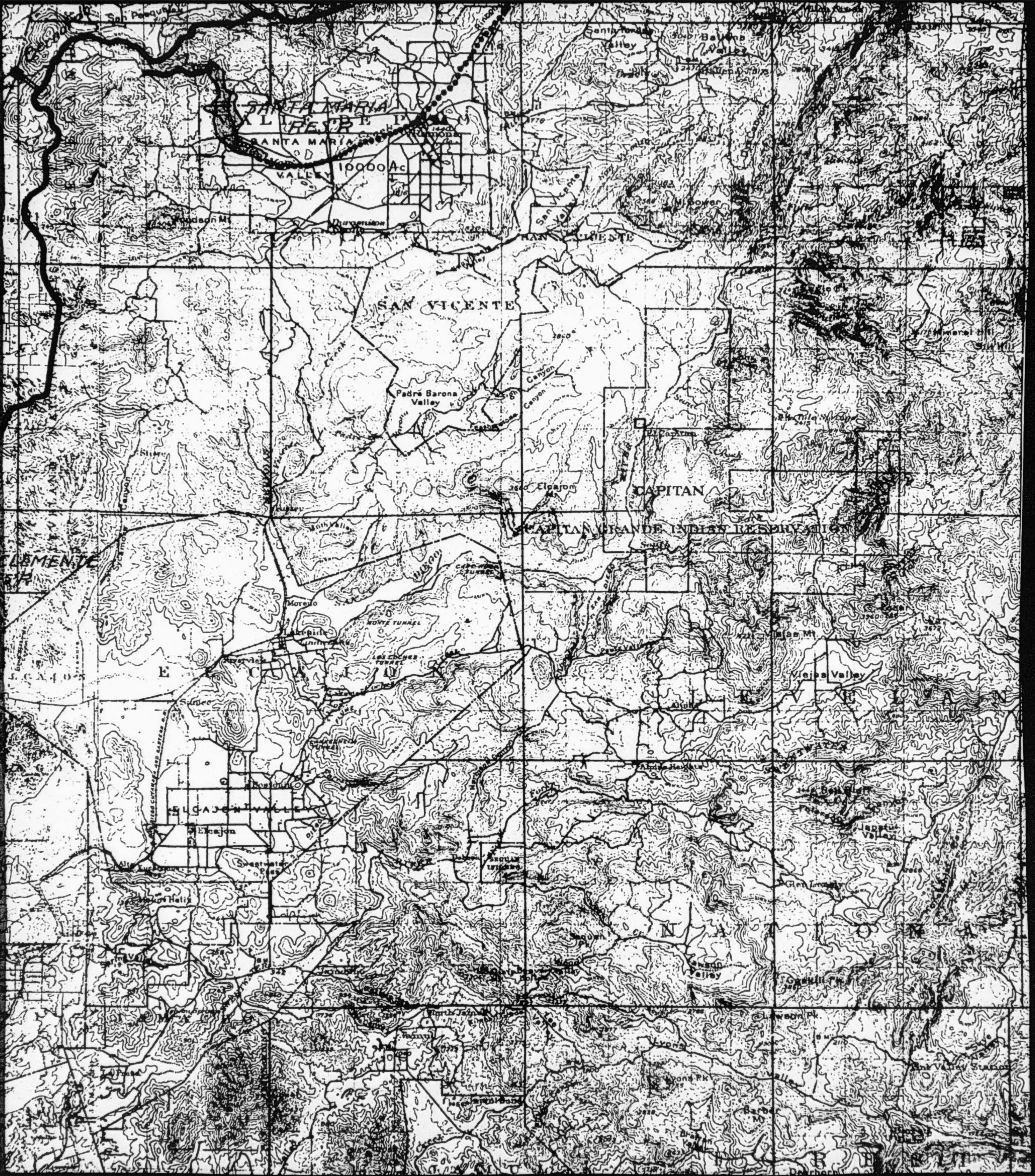
Francis L. Sellew
and
W. S. Post

March 6, 1917.

5000
Los Angeles Junction
Loma Alta Mt
VISTA
21000 Ac.
3000 Ac.
Carlsbad
SAN MARCOS VALLEY
4000 Ac.
San Pasqual Valley
CARROLL RES'R
Carroll Pumping Plant
5000 Ac.
SAN DIEGUITO
12000 Ac.
Green Valley


Upper Escondido Power House
5000 Ac
ESCONDIDO RES'R
Lower Escondido Power House
WARNER RES'R
SANTA YSABEL
INDIAN RESERVATION
Mesa Grande
SUTHERLAND RES'R
Pumping Station
San Pasqual Valley
SANTA MARIA RES'R
SANTA MARIA
VALLEY 10000 Ac


12 000 Ac
28000 Ac
5000 Ac
PACIFIC
OCEAN


SANTA MARIA
RES'R
SANTA MARIA
VALLEY
10000 Ac
Ramona
Woodson Mt
Ballena
Valley
San Vicente
Valley
SAN VICENTE
Mt Gower
Padre Barona
Valley
Canyon
Canyon
El Capitan
CAPITAN
Elcajon
Mt
CAPITAN GRANDE INDIAN RESERVATION
Sycamore
Canyon
CLEMENTE
Moreno
Lakeside
MONTE TUNNEL
LOS COCHES
TUNNEL
Viejas Mt
Viejas Valley
Santee
Bostonia
EL CAJON VALLEY
Elcajon
Sweetwater
Pass
Mount Helix
Alpine Heights
Japatul
Valley
Glen Lonely
Lawson
Valley
Lawson Pk
Lyons Pk
Barber
Mt
Pine Valley Station

Ed Fletcher Papers

1870-1955

MSS.81

Box: 42 Folder: 6

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