Excerpts from H. Hangood's Report

ESTIMATE OF COST - November, 1912.

Warner-Pamo,

| | |
|---|---|
| Cash cost of works, exclusive of water rights, lands and financing, | $1,118,000 |
| Pamo-Lindo Project, Do- | 2,096,000 |
| | $3,214,000 |

Product,

| | | |
|---|---|---|
| Power 3900 K.W. - net annual operating earnings | $261,000, | |
| capitalized at 10%, | | $2,610,000 |
| Water 5200 Miners' inches (during irrigating season) | | 7,800,000 |
| | | $10,410,000 |

Sutherland and Santa Maria Auxiliary

| | |
|---|---|
| Cash cost of works, do as above, | $800,000 |

Product,

| | |
|---|---|
| Power 1500 K.W. - net annual operating earnings, $133,000 @ 10%, | $1,330,000 |
| Water, 1000 Miners' inches, (Irrigating season) | 1,500,000 |
| | $2,830,000 |

O.E. Kleppe

SUMMARY

| | |
|---|---|
| Cash cost of works, do. | $4,014,000 |
| Resulting created values, | 13,240,000 |

Estimate of cost of Initial Installation of the Warner-Pamo and Pamo-L.V. Projects alone- Cash cost exclusive of W.R.L and F.

| | | | |
|---|---|---|---|
| Warner Dam and Conduit, | $549,385 | | |
| Power Plant, | $251,920 | | |
| 50 miles transmission line, | 192,500 | 444,420 | $993,805 |
| Temp. Conduit from power plant to head of Pamo-Linda V. Conduit, 4.m.' | | | 30,000 |
| Pamo Linda Vista Conduit, postponing greater part of cement lining, | | | 825,000 |
| Part of San Clemente Reservoir, | | | 50,000 |
| | | | $1,898,805 |

| | |
|---|---|
| (Brought forward) | $1,898,805 |
| Eng.legal and sundry expenses and contingencies, approx. 15% | 284 195 |
| | 2,183,000 |

The Warner-Pamo- Pamo Linda Vista works produce alone 3900 K.W. (5200 H.P.) and deliver 2200 Miners' inches continuous flow to Linda Vista, less seepage and evaporation losses. seepage 20% to 30%,leaving about 1600 M.I. continuous or 2000 to 2500" during irrigating season, which willtake care of 20,000 to 25,000 acres of orchards if not cropped between the trees.

Warner Pamo Hydroelectric Project,

Storage Reservoir on the upper waters of the San Luis Rey River - catchment area of 210 □ miles, great floods, Data obtained more or less for 7 years " " closely last 1 1/2 years which justify an average net discharge into forebay of Power Plant of 44.6 c.f.s., with average power at S.P. of 4375 K.W.; this is for average output. On basis of an average demand factor of 60% of station capacity, the installation needed would be about 7500 K.W. calling for an hydraulic capacity in the conduit of 77 sec. feet. However conduits have been designed for 87.5 c.f.s.with an 8500 K.W. installation.

Project consists of
100 foot dam

8.8 miles of conduit

Forebay with Pressure pipe 2670 ft. long under max. head of 1500 feet.

Power House and Plant of 8500 K.W.

50 miles of H.T. trans.line at a total est. cost of $1,118.000 exclusive of W.R.E. and F.

The prospective annual surplus from operation over and above operating expenses, repairs, depreciation interest on bonds and sinking fund, is estimated at first $61,000.

Field or Market -

Supplying domestic industrial and municipal requirement in and around San Diego, Escondido, Del Mar, Oceanside and other Places and for Pumping of irrigating water on lands which have deficient surface supply but underlaid by water bearing strata.

Consumption of Power for Pumping is about 1 H.P. to every 205 M.I. Per foot of lift, or in average acreage 1 H.P. to about 20 acres. The ordinary charge for pumping is 2 1/2 to 3¢ per K.W. hour.

The revenue estimated has been arrived at by omitting the Pumping field and estimated on 1¢ per K.W.H. for wholesaling to distributing concerns.

The Warner Pamo is the hydro electric project; from here the water passes into the Pamo-E.V., which conveys it to their Place of use.

Reservoir and Dam,

Is situated at the lower end of Valle de San Jose, known as Warner Ranch - 40 miles n.e. from San Diego. The dam site is in the gorge where the San Luis Rey River leaves the valley and enters a narrow canyon - average bottom width of canyon of 300 ft. for 13 miles.

A dam 100 feet high creates a reservoir of 157,000 acre ft. cap. covering 4800 acres. (See table for evap. in field book)

Floor of Reservoir is deposit of sandy clay of alluvial or lacrustine nature overlying granite.

Dam of earth - crest length of 575 ft. 350,000 c.y.

2 minor dams across depression on the S. rim.

Dam designed -

Water face slope of 1:3 - riprapped,
Rear slope 1:2 for the upper third and 1:2.5 for the lower two thirds with two terrace benches 12 ft. wide, one at elevation 2655 and other 2685.

Concrete Parapet wall at crest for wave.

Front portion to extent of 2/3 of entire mass of dam is to be of selected impervious material - in layers sprinkled and rolled - remaining or rear 1/3 of porous material, so that plane of saturation shall not intersect the line of rear slope above its toe. One or more cut off walls - concrete - one has been built.

Good authority for building dams on sand, which is not what we have here.

Spillway on n. side of Warner Dam site.

Outlet system is a tunnel 640 ft. long with gate tower control - 22 ft. above bed of river. No sedimentation to speak of.

Conduit-

| | | | |
|---|---|---|---|
| Tunnels (6) | 11000 ft. | 2.983 m. |
| Steel and concrete Flume | | |
| (On banks) | 2300 " | .453 |
| " " | 2900 " | .549 |
| (On piers) | | |
| Exc. conduit, concrete lined | 30580 " | 5.788 |
| | 46880 | 8.873 |

to convey 87.5 c.f.s. with slope of 1 in 1000 - n= .017.

Tunnels -6- longest 3510 ft.; shortest 140 ft., probably very hard granite.

Forebay -

18.5 acre ft. capacity - damming up river.

Consider a closed pressure instead of open conduit from Warner Reservoir.

Pressure Pipes or Penstocks 6670 ft. long - 2500 ft. head Max. 55" diam. at head to 30" at bottom - Total weight of 3041000# - The controlling features in arriving at the economic diam. are the addition to rev. by one additional K.W. and the increased expenditure for steel to obtain. At present writing rev. due to 1 K.W. was taken at $55.00 per annum and steel at 7¢.
(Loss due to friction head).

Power Plant.

Cost based on 8500 K.W.
Concrete and iron building covering 4000 □'
Tail Race discharges into Tenessee Creek;
Transmission - steel towers - double circuit line - volt 85000.

Estimate of Costs-

| | | | |
|---|---|---|---|
| Dam | | | |
| 340000 c.y. @ 30¢ | | | 91200 |
| 55000 " | 25 | | 13750 |
| 395000 | | | 104950 |
| Cut offwall | | | 15000 |
| RiP RaP 117000 □ ' @ 20¢ | | | 23400 |
| Crest wall | | | 8000 |
| | | | 151350 |
| Spillway Gate and Tower | | | 60000 |
| | | | 211350 |
| Conduit, | | | |
| Exc. Earth | 96000 c.y. | 18¢ | 17280 |
| L.Rock | 34000 | 35 | 11900 |
| S.R. | 26000 | 1.10 | 28600 |
| | | | $57780 |
| Tunnels, | | | |
| 6510 ft. @ $20 | | 131200 | |
| 4420 " | 16 | 71840 | 203040 |
| Steel and Concrete Flumes | | | |
| (On banks) 3300 ft. @ 3.75 | | | 8875 |
| (On 15 ft.Piers 2430 ft. @ 8.75 | | | 21263 |
| On 15 to 30' " 420 @ 10.75 | | | 4515 |
| On 30 to 50' " 50 @ 15.75 | | | 787 |
| | | | $35440 |
| Water Passage under conduit 60 @ $100 | | | $6000 |
| Cement lining 30500 ln.ft. $1.00 | | | 30500 |
| Wagon Roads | | | 5000 |
| | | | 337908 |
| Total Hydraulic Works to Forebay | | | $549258 |

Hydro Electric Plant-

| | | |
|---|---|---|
| Forebay | 5400 | |
| Steel Penstocks | | |
| 2041000# @ 7¢ laid | 142870 | |
| Buildings 4000 □' | 14400 | |
| Installation of 8500 Kw. | | |
| Water Wheels and Adjuncts @ $43.00 | | |
| Generators " 7.50 | | |
| 8500 K.W. | 50.50 | 80150 |
| | | $237120.00 |

Transmission,

| | |
|---|---|
| Step up and step down trans. | |
| 17000 K.W. @ 3.50 | $42500 |
| 50 miles steel Tower line | 150000 |
| 2 circuits #5 copper @ 3000 | 444.20 |
| | 992678 |
| Eng. Leg. and sundry exp. and conting. 12 1/2% | 124322 |
| Total | $1118000. |

Railway Base-

Escondido 33 miles from Power House. 30 miles from Usman's Dam.
9 miles from head of Penstocks to dam.

Av. cost of cement on work est. at $3.50 barrel.

Estimate of Annual Receipts and Expenditures,

| | | |
|---|---|---|
| Receipts 3900 K.W. @ 1¢ K.W.Hour | | |
| 3900 K.W. @ $87.60 Per year | | 341640 |
| On switchboard at Power House 4375 K.W. 77% eff. | | |
| Transmission losses (transformers and line) | | |
| Delivered | 3900 K.W. | |

Expenditures,

| | | |
|---|---|---|
| Operating expenses, | | |
| Power House, Transmission line and misc. | .070¢ Per K.W.Hour | |
| General | .024 | |
| | .100 " " | |
| 3900 K.W. @ 1¢ Per K.W.Hr. | | |
| $8.76 year | $34104 | |
| Depreciation or Reserves | | |
| Dam and Conduit, $518000 @ 2½% | 12950 | |
| Power Plant, $283000 @ 8% | 22640 | |
| Trans.Line, 317000 @ 5% | 15850 | $45850 $80010 |
| $1118000 | | $80100 |

## Pamo Linda Vista Project.

Reservoir to catch waters from Warner Pamo Project and waters of the Santa Ysabel river also - catchment area natural of 114 □ m, add 210 □ m. from the San Luis Rey diverted by the Warner Dam. Also Planned to have a Sutherland Reservoir.

Water Product here is 72.4 sec. ft. or 3620 M.I. after evap. Uniform continuous or concentrated in irrig. periods is 5800 inches. This Project for irrigation.

Fixed charges,

Bonds, $1387500 @ 80 - 1118000 Const. cost
1102500 for water rights and contingencies
$2500000

Int. 6%
Sinking fund 2
8% $200000
Annual SurPlus, 61626

Masonry,
Dam 185 ft. high,
Conduit 34.2 miles long.
Distributing Reservoir in San Clemente Valley requiring a 65 ft. earth dam.

## Sutherland Project.

185 ft. dam, 1400 M.I. = 28 c.f.s.
Diversion Conduit 1 1/2 miles
Power Conduit 5 mile
3000 K.W.
800 ft. head.

## Santa Maria Project.

80 ft. dam 570 M.I.
Power conduit 1 1/2 miles
750 K.W.
435 ft, head.

## Pamo Reservoirs and Dam.

Pamo site - 185 ft. dam high; reservoir 48100 ac. ft 825 acres, Exp. to evap. is 18.8 acres per 1000 ac. ft. Granitic formation - Dam estimated of multiple arch type. Outlet tower through masonry of dam.
No sediment to speak of- Warner Dam having caught most already.

Conduit,
24.83 miles into a water course, then 4400 to reservoir
174 c.f.s. cap. (No river tunnels 14535 ft.
S= 1 in 1000 (Steel & con. flumes, 11485 "
N= .017 (Syphon 10700 "
22 tunnels (Rec. Conduit, concrete lined, 85380 "
131100 "=24.8 miles,

## Flumes

Steel with concrete sub-structure syphons,
11 - of steel pipe - total length of 10700 lin.ft.

### San Clemente Reservoir-

Acts as a balancer
" as a storer.
Holds 4 weeks' supply for land below;
65 ft. dam - earth, 4500 acre ft.

Distribution System,

Pipe System not estimated yet.

Yearly Expenditures up keep light.

Depreciation 2%
Interest and Sinking fund 8%.

### Cost Estimate - Pano L.V.

| | | | |
|---|---|---|---|
| Dam and adjuncts, | | | $700000 |
| Conduit 131100 ft. = 24.83 mi. | | | |
| Exc. | | | |
| Earth 306600 @ 18¢ | | 55188 | |
| L.R. 70000 @ 35¢ | | 24500 | |
| S.R. 53200 @ 1.10 | | 58520 | |
| | | 138208 | |
| 22 Tunnels 7120 ft. @ $18, | | 128160 | |
| 7415 ft. @ 16 | | 118640 | |
| | | 246800 | |
| 58 Steel Concrete Flumes | | | |
| On 15 ft. Pier 8820 ft. @ 8.00, | | 70560 | |
| " 15-30 " 1455 @ 11 | | 16005 | |
| " 30-50 " 1100 @ 15 | | 17000 | |
| 50-65 110 @ 19 | | 2090 | |
| | | 106255 | |
| End connections for 58 flumes @ 80.00 | | 4640 | 110895 |
| Under Culverts 50 @ $100, | | | 5000 |
| 11 Syphon Steel, Under Road | | | |
| 0 to 125 - 10700 ft. @ 11.00, | | | 118000 |
| 125 to 200 4710 @ 17 | | | 80070 |
| 200 to 275 3730 @ 23 | | | 85790 |
| 275 to 375 470 @ 30 | | | 14100 |
| 10700 | | | $298960 |
| End Connection 11 @ 100, | | | 1100 |
| | | | 299760 |
| Cement Lining 85380 lin.ft. @ 1.26 | | | 107579 |
| | | | $408339 |
| Roads | | | 10000 |

San Clemente Dam, 65' high - 350000 c.y. @ 70¢ 245000
$1863232
Eng.S.and S. Exps.and Cost 12 1/2% 232768
$2096000

Exp. and Revenue,
Del. of water, care taking, etc. : $6000
General misc. and overhead 4000
$10000

for 36000 acres= $0.278 per ac. per annum. The cost in the San Gabriel and San Bernardino Valleys ranges from 48¢ to $1.30.

Sutherland Auxiliary-

Dam site on Santa Ysabel Creek (Hard granitic rock) 7 miles above Pamo dam site natural catchment area of 53 □ miles, artificial by a conduit 1 1/2 miles long adds 15 □ ".
A conduit 5 miles discharges into Pamo reservoir with a drop of over 900 ft. for generation of 1500 K.W.
Hydraulic works estimated cost, [illegible]
Power insulator of 3000 K.W. 90000

Santa Maria
Rock Gorge - good dam site.
57 □ miles of the S.M.Valey
12 sec.ft. developed
1 1/2 mile conduit
435 ft. drop
340 K.W.

Hydraulic works cost $126000
Hydroelectric Plant
750 K.W., 24000

H. HAWGOOD
CONSULTING ENGINEER
H.W. HELLMAN BUILDING

M. AM. SOC. C.E.
M. INST. C.E. (LONDON)
M. AM. RY. ENG. ASSOC.

LOS ANGELES, CALIFORNIA

July 2nd, 1913.

Mr. Ed. Fletcher, Secretary,
Volcan Land & Water Co.,
San Diego, Cal.

Dear Mr. Fletcher:-

Enclosed please find the following documents for your attention in connection with the application of the Volcan Land & water Company for a final water power permit for the Warner-Pamo Project.

Form of Resolution of the Board of Directors adopting location and designs.

Blue print of location and copy of field notes for use of Board. Return the latter to me as early as possible. (It is unnecessary to send the designs and estimates of power, which are matters of detail.)

Application in triplicate to be attested by Secretary.

Exhibit J to be attested by Secretary.
Exhibit K to be prepared by Secretary.
Exhibit M to be attested by Secretary, and to be sent to Mr. Metcalf, Vise President, for execution.

Also enclosed, please find such copies as are necessary of the above documents, with notation as to their disposal. I t is necessary that these papers be sent to Mr. Metcalf with the utmost dispatch, and that after he has affixed his signature he send them to me by the next mail, and upon their receipt I will take care of all the rest that may be necessary and make the filing.

I would suggest that you telegraph Mr. Metcalf that that these papers are coming and require his immediate action, for if the Company fails to make the filing on or before the date described in the Preliminary permit, they are barred from making any filing for one year, and there is no time to lose.

Yours very truly,

H. Hawgood

H. HAWGOOD, CONSULTING ENGINEER, LOS ANGELES

July 3rd, 1913

Mr. H. Hawgood,
H.W.Hellman Bldg.,
Los Angeles, Calif.

Dear Sir:

We are in receipt of your letter of July 2nd. together with enclosures pertaining to the final government permit to the Volcan Land & Water Co. The documents were immediately signed and sent by special mail to Mr. Metcalf with your instructions.

Yours very truly,

Ed. Fletcher Co.

Per T.P. Ellis.

E:B

H. HAWGOOD
CONSULTING ENGINEER
H.W.HELLMAN BUILDING

M.AM.SOC.C.E.
M.INST.C.E.(LONDON)
M.AM.RY.ENG.ASSOC.

LOS ANGELES, CALIFORNIA

March 25th, 1914.

Mr. Ed. Fletcher,

San Diego, Cal.

Dear Mr. Fletcher:-

Re-checking of maps, etc., confirms what I said to you regarding the relation of the Carrol Dam Site to the Linda Vista. To cover the Linda Vista project requires the placing of water at an elevation of at least 500 feet, and the cheapest line to get the water from the Carrol site involves about 15 miles of conduit, a 7,000 H.P. pumping plant, and over 3 miles of pumping main, which means that the Carrol Dam Site is not a commercially available source for the Linda Vista. It has value, however, for lands of lower elevation, up to 200 feet above sea level. As the riparian through the Carrol Dam Site are needed in any event, for either the Pamo Dam or the Sutherland Dam if the Pamo were not constructed, it does not appear to me that there is any question as to the desirability of obtaining it, they are needed in any event as part and parcel of the original Warner to Linda Vista project. I have written Mr. Henshaw to this effect. I think it was a wise proceedure on your part to obtain options, for they protect the original project.

Yours very truly,

H. Hawgood.

H. HAWGOOD
CONSULTING ENGINEER
H.W. HELLMAN BUILDING

M. AM. SOC. C. E.
M. INST. C. E. (LONDON)
M. AM. RY. ENG. ASSOC.

LOS ANGELES, CALIFORNIA

April 4th, 1914.

Mr. C. E. Hickok,

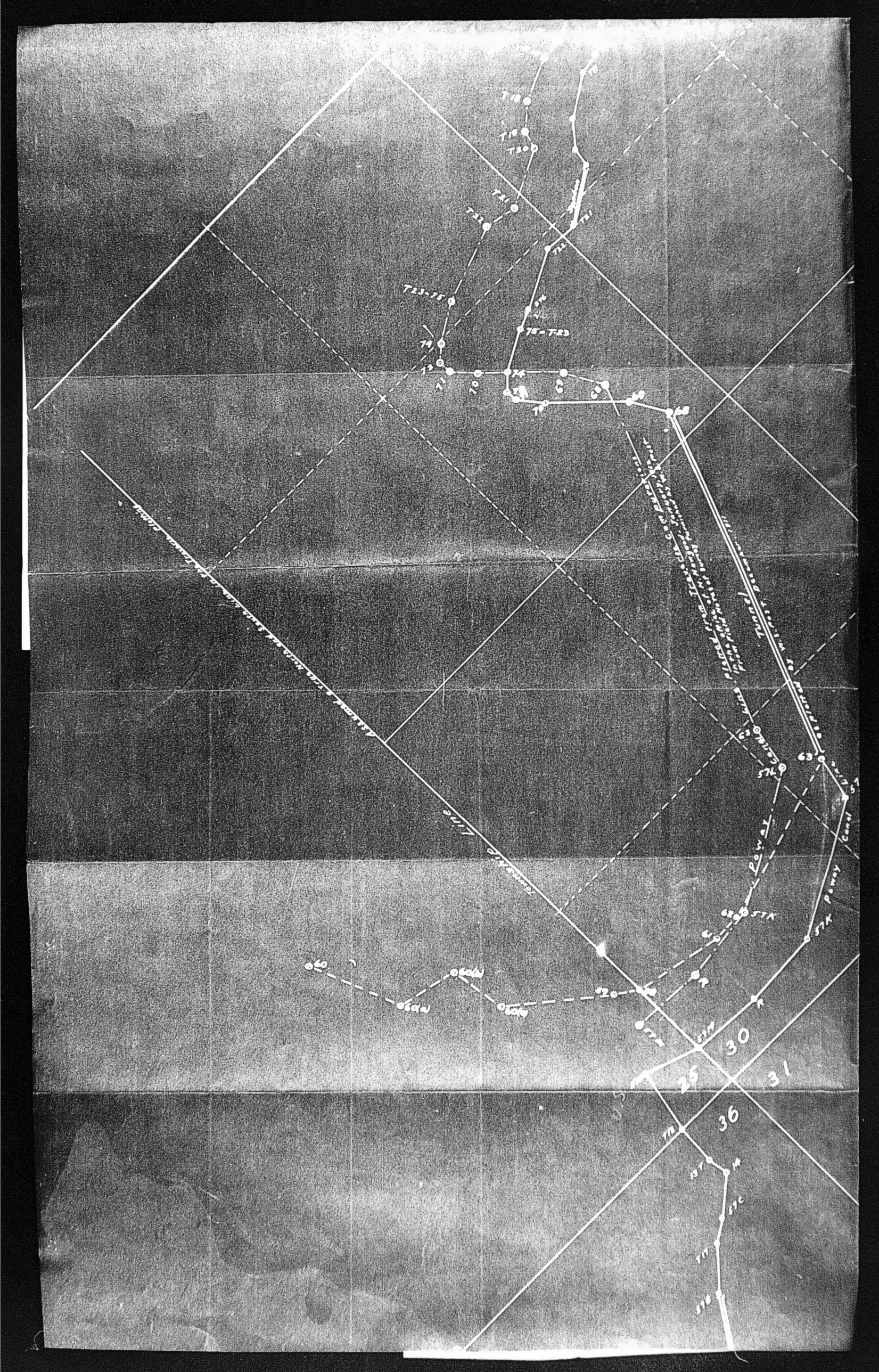
San Diego, Cal.

Dear Sir:-

Your letter of the 3rd inst, with enclosed blue print of record of core drillings at Pamo Dam Site, received today.

Yours very truly,

H. Hawgood


Transmission Line
Power
Canal
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31
36


Traverse Plotting
Line Plotted from Traverse Computations
January, 1913
From Field Notes and Survey furnished by W. C. Post
Tunnel
Canal
Syphon
Syphon
68
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T3
75-T23
T23-75
19
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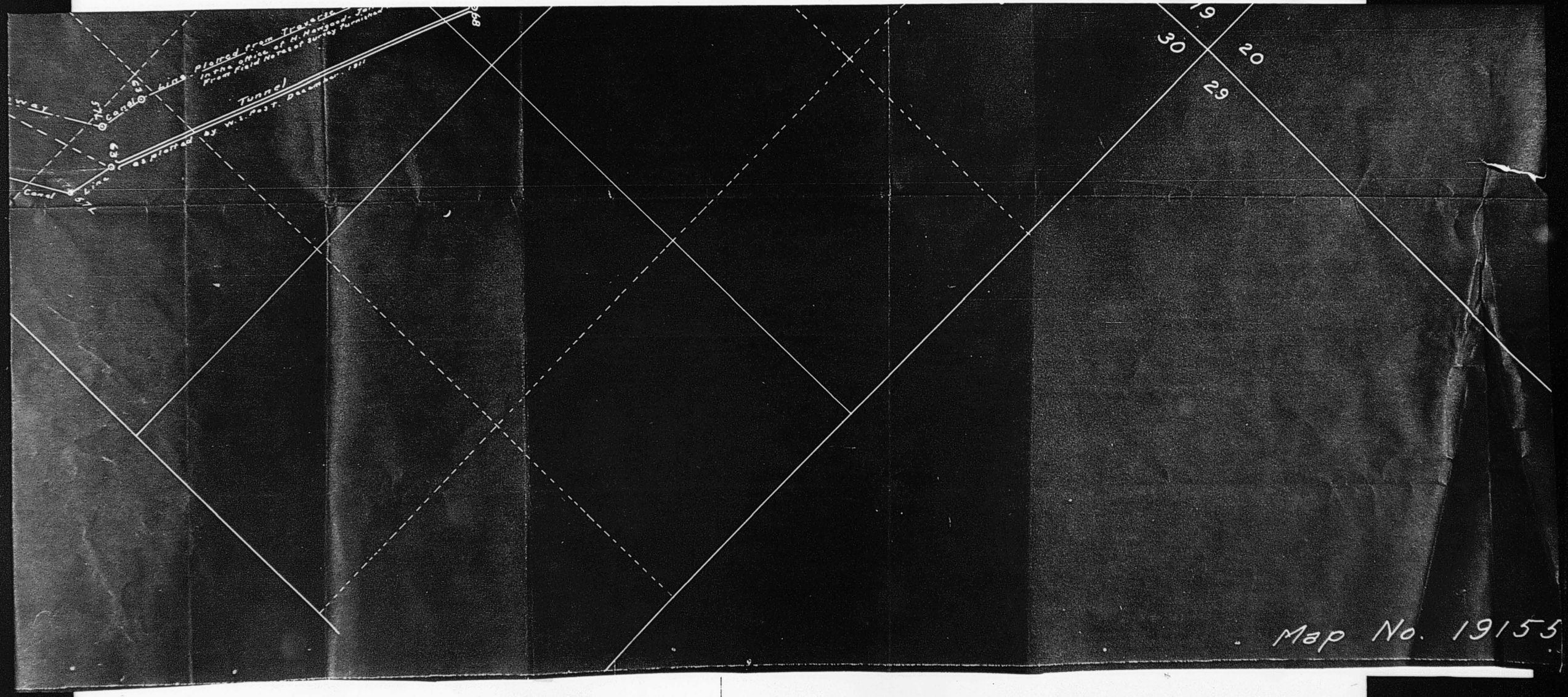
29
30

Plotted from Traverse
In the office of H. Nordgood
From field notes of Sunday Furniture
Tunnel
Surveyed by W. E. Frost December 1911
Power
Canal
Line
Poway
Canal
Line
36
30
31
25


Plotted from Traverse
in the office of N. Hargood, Jun.
From Field Notes of Survey furnished
Tunnel
as plotted by W. S. Post T. December 1911
Canal
Line
Canal
Line
63
64
65
67
68
19
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29
30

Map No. 19155

H. HAWGOOD
CONSULTING ENGINEER
H.W. HELLMAN BUILDING

M. AM. SOC. C.E.
M. INST. C.E. (LONDON)
M. AM. RY. ENG. ASSOC.

LOS ANGELES, CALIFORNIA

April 29th, 1914.

Col. Ed. Fletcher,

San Diego, Cal.

Dear Mr. Fletcher:-

I have been turning over your idea of taking the Warner and allied waters to San Diego through the Cuyamaca Flume. The project is all right and feasible, but I think there is a better plan. The difference in cost between taking the water to the head of the Cuyamaca Flume on the San Diego River, 45 miles from San Diego, or taking it to San Clemente Canyon, 8 miles from San Diego, would be insignificant, and it is self evident that water 8 miles away is better than water 45 miles away, even though a pipe and flume line exists over the longer distance; further, the Mesa Reservoir at the San Diego end of the Cuyamaca line has an elevation of 485 feet, and the San Clemente reservoir would have an elevation of 625 feet, both reservoirs being practically the same distance from the City University Heights Reservoir, which has an elevation of about 350 feet. The 140 feet higher elevation of San Clemente over Mesa is a material advantage.

As a commencement about 2,000 inches of water, which is equivalent to 26,000,000 gallons per diem, a sufficient supply for a population of about 180,000, could be delivered into the San Clemente Reservoir at a cost approximately of $1,750,000 for the works,

over Page



exclusive of cost of water rights and rights of way. The cost of the physical structures would thus be about $875 per inch, to which is to be added whatever might be the cost of the water rights, etc. Los Angeles Aqueduct water will cost all told over $1,700 per inch at San Fernando, 20 miles from Los Angeles. The possibilities of the San Clemente proposition show up very favorably in comparison with this.

The quantity of water could be increased by extending the works from time to time as the growing City needs might require, and in addition, when the proper time came, 4,000 to 5,000 horse power could be generated and delivered in San Diego, or any other point of equal radius, at a cost of about $250 per horse power for plant and transmission line. Taking the water to the Cuyamaca Flume would reduce the quantity of possible horse power about fifty per cent unless there was multiplicity of plants.

In a general way this covers the situation. I have not gone laboriously into all the details, but know full well that if that task should be undertaken the general figures I have given would be more than sustained.

Yours very truly,

H. Hawgood

V. I. & T. CO.

FILE

copy

May 1, 1914.

Mr. H. Hawgood,

Los Angeles, Cal.

Dear Mr Hawgood:

I am in receipt of yours of the 29th and contents noted. I am very much impressed with your statement and you have convinced me already. The only thing that I had in mind was that the Helena damsite just above the diverting dam is a wonder; it holds about 60,000 acre feet, and again the end of our flume is 630 ft elevation and only three miles from the Chollas Height Reservoir owned by the city. We only have to build a three mile pipe line from the end of our flume at La Mesa to connect up with the pipe line from Otay dam at Chollas reservoir. We will then be able to put Barnard water, Santa Ysabel Water and San Diego River water into Otay dam and make said Otay dam of great value because we can fill it each year with flood waters. The trouble is the Otay dam has a carrying capacity but not the water, so it makes the Otay dam 100% efficiency. As stated before, the end of our flume at La Mesa has 630 ft elevation, while the top of Otay dam is only 510 ft I believe. In the winter will have enough water to supply the city coming down the flume, at the same time use the pipe line to put water into Otay dam. Then later on, the same pipe line will be utilized to furnish the city with water from Otay dam after the floods have passed. La Mesa reservoir is simply a storage reservoir,

H. HAWGOOD
CONSULTING ENGINEER
H.W. HELLMAN BUILDING

LOS ANGELES, CALIFORNIA

M. AM. SOC. C.E.
M. INST. C.E. (LONDON)
M. AM. RY. ENG. ASSOC.

Returned W.S.P.

June 19th, 1914.

Col. Ed. Fletcher,

San Diego, Cal.

Dear Mr. Fletcher:-

The three copies of my 1912 report will go forward to you Monday next.

I have about completed my studies of the water data collated since my 1912 report, and the subject matter will be given to the typewriter and draughtsman very soon.

The quantity of water which can be developed at Warner is limited by your offer to the City of 2960 acres for reservoir purposes, which gives with 80' dam a storage capacity of 78,310 acre-feet; to develope Warner to its full extent would require a reservoir of 100,000 acre-feet capacity, calling for a 90-foot dam, and a flooded area of about 4,000 acres.

I find the possible delivery from an 80-foot dam would be equivalent to a continuous flow of about 1550 inches delivered through the long tunnel into the head of the Temesaal or Pamo Valley.

The Carrol Dam, with 30,000 acre-foot reservoir, is good for about 1100 inches.

I have examined the estimated cost of the Carrol-Warner project ($1,500,000), and consider it to be an estimate leaving little or

only three miles away from the city's Chollas Heights reservoir and three miles from the end of our flume as well, and approximately six miles to the City Heights reservoir belonging to the city.

The greatest advantage the Cuyamaca water has is its ability to fill Otay dam; all we have to do is to spend $50,000 today and we can fill Otay dam with flood waters from San Diego River. To take advantage of the storage capacity of Otay dam along the lines you propose we ld mean expensive pipe line from San Clemente to Chollas Heights Reservoir, a distance of fully twelve miles to fourteen miles and you would have the Big San Diego River Valley Canyon to cross. With the end of the Cuyamaca flume only three miles away, as against San Clemente twelve or fourteen and the elevation being approximately the same, (800 ft) you see the Cuyamaca has a decided advantage; in fact the pipe line would have to be so large on account of friction that I do notbelieve you would have the pressure behind it from San Clemente to force the water thru into Otay dam and fill it, while we will have direct from our flume at La Mesa. If it was not for that one fact, your plan to my notion is the best. After all is said and done, the probabilities are that the flood waters from the San Diego River alone will take care of Otay dam each year and the water can be carried from the Sutherland along the lines you suggest.

Very truly yours,

EK

no margin for profit.

If there are any particular points that you would like to ask questions about in advance of my supplemental report, would be glad to hear from you.

Yours very truly,

H. Hawgood.

H. HAWGOOD, CONSULTING ENGINEER, LOS ANGELES

H. HAWGOOD
CONSULTING ENGINEER

H.W. HELLMAN BUILDING
LOS ANGELES, CALIFORNIA

My dear Fletcher.

In place of sending a short estimate I thought it might suit you better to have it prefaced, as it were, for the benefit of those not as well posted as your self if you needed to use it – Hope the form suits you, if not will re-write. I enclose copy if you wish to send it Mr Henshaw

Go to it and good luck to you

Yrs Hawgood

Dear Colonel July 26

Please cancel and destroy estimates sent yesterday & substitute these

H H

H. HAWGOOD
CONSULTING ENGINEER

H.W. HELLMAN BUILDING
LOS ANGELES, CALIFORNIA

July 26th. 1918

Colonel Ed. Fletcher,
San Diego.

Dear Colonel;

I submit the following estimates of cost of construction as requested by your letter of the 18th. inst.

( 1 ) Warner to San Clemente, via Rodriguez Mt., Escondido Mutual Water Co's system, and syphon across San Pasqual Valley. Capacity 50 Sec. Ft., = 32.3 Million gallons Daily.

| | | | |
|---|---|---|---|
| Warner Dam | | | $ 362,910 |
| Conduit to power drop to Escondido conduit Rodriguez Mt. | | | 557,420 |
| Rodriguez power house to Escondido Dam | | | 100,000 |
| Escondido Dam to south side San Pasqual Valley | | | 411?700 |
| South side San Pasqual Vy. to San Clemente | | | 809,475 |
| San Clemente Dam | | | 239, 275 |
| | | | 2,480, 780 |
| | 15 % | | 372,177 |
| | | | 2,852,957 |
| Power Plant ,Rodriguez Mt. 3,500 K.V.A. | | $ 252,000 | |
| | 15% | 37,800 | |
| | | 289,800 | 289,800 |
| Estimated Power revenue, net $ 61,320 annually. | | | $ 3,142,757 |

( 2 ) Warner to San Clemente, via Post-Hawgood 6,840 ft. tunnel as origanally planned. NO storage at Pamo.

| | | | |
|---|---|---|---|
| Warner Dam | | | $ 362,910 |
| Conduit to power drop, Pamo. | | | 586,206 |
| Diversion dam & conduit San Ysable Ck. to S.Clemente | | | 1,347,497 |
| San Clemente Dam | | | 239,275 |
| | | | 2,535,878 |
| | 15 % | | 380,382 |
| | | | $ 2,916,250 |
| Power Plant, Pamo. | 6,000 K.V.A. | $ 576,000 | |
| | 15 % | 86,400 | |
| | | $ 662,400 | 662,400 |
| Estimated Power Revenue, net $114,800 annually. | | | $ 3,578,658 |

This plan contemplates that the water from the tail race of the power plant will be allowed to follow the natural water course for the five miles down the Pamo Valley to Santa Ysable Creek, there to be picked up by small diversion dam. If conduit is desired in place of natural water-way add approximately $75,000. In any even this expehditure could be postponed until water demands necessitated conservation of evaporation and seepage.

E.F. No.2.

The hydraulic capacity of plan 2 is 50 Sec.ft. Warner to Pamo and 80 Sec.ft. Pamo to San Clemente, with an initial capacity at Santa Maria and five other of the larger canyons of 40 Sec.ft. A second pipe can be laid across these canyons when needed to bring t the capacity up to 80 Sec.ft. at a cost of $ 136,000.

( 3 ) Warner to San Clemente, via Bond-Ellis 16,640 tunnel, thence same route and construction as plan 2.

| | | | |
|---|---|---|---|
| Warner Dam | | | $ 362,910 |
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| San Clemente | | | 239,275 |
| | | | 2,601,829 |
| | | 15 % | 390,274 |
| | | | $ 2,992,103 |
| Power Plant, Pamo. 6,000 K.V.A. | | $ 576,000 | |
| | 15 % | 86,400 | |
| | | $ 662,400 | 662,400 |
| | | | $ 3,654,503 |

Estimated net earnings from power $114,800 annually.

Hydraulic capacities of plan 3 same as plan 2.

Plans 2 & 3 give greater hydraulic capacity between Pamo and San Clemente than between Warner and Pamo, to provide for diversion of water from Santa Ysable Creekas originally planned but omitting the Pamo storage dam and reservoir.

To place plan 1 on a comparable basis with plans 2 & 3 it is necessary to add the cost of an extension from the outlet of the the San Pasqual syphon up to the point of diversion on Santa Ysable Creek, an item of $ 618,000 inclusive of the 15%. There is also to be added the capitalized value of the lost power revenue amounting to $ 53,480 per annum, which capitalized at 10% is $ 534,800

Comparing on this basis we have;

| | | |
|---|---|---|
| Plan 1, | $3,142,757 + $618,000 + $534,800 = | $ 4,295,557 |
| Plan 2, | 3,578,650 | 3,578,650 |
| Plan 3, | | 3,654,503 |

In comparing plan 3 with plan 2, plan 3 has to be credited with a saving of 9,590 ft. in length of conduit. The saving in upkeep of this length of conduit would not be sufficient to balance the interest on the larger investment. In the even ,however, of a decision to use wood stave pipe between Warner and the head of the Pamo pressure pipe the saving of 9,590 feet in length, together with the saving in upkeep, would probably fully compensate for the additional investment.

With the element of time entering into the question, the difference of time between driving a 6,480ft. tunnel,and a 16,640 ft. tunnel, ~~plan 2~~ would select plan No 2 ~~be the selection~~. For even with the use of a central working shaftthe longer tunnel would require fifty to one

hundred per cent longer time for completion.

All the foregoing estimates are computed on the high unit prices which now pervail.

Yours very truly,

H. Hawgood

H. HAWGOOD, CONSULTING ENGINEER, LOS ANGELES

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CONSULTING ENGINEER

H.W. HELLMAN BUILDING
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H. HAWGOOD
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H.W. HELLMAN BUILDING
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(Signed) H. HAWGOOD

H. HAWGOOD
CONSULTING ENGINEER

H.W. HELLMAN BUILDING
LOS ANGELES, CALIFORNIA

August 1st. 1918.

Col. Ed. Fletcher,
920 Eighth St.
San Diego.

My dear Colonel;

Answering yours of the 13th. ulto., and returnits enclosed letter from John S. Eastwood, regarding a concrete versus an earth dam for Warner, my opinion thatit would not pay to make any core drill explorations at the lower dam site, is based substantially on the following facts;

| | Upper site. | Lower Site. |
|---|---|---|
| Base length | 1,100 ft. | 1,680 ft. |
| Crest length | 630 " | 1,100 ft. |
| Height | 105 " | 135 ft. |
| Area of cross section | 4,490 sq.ft. | 7,070 sq.ft. |

all wrong - J.S.E.

Representing these in percentages we have;

| | Upper site. | Lower site. |
|---|---|---|
| Base length | 100 | 153 |
| Crest length | 100 | 175 |
| Height | 100 | 129 |
| Area of cross section | 100 | 157 |

also all wrong. J.S.E.

These tables of the physical facts show that the lower site calls for a dam of 54 % greater magnitude than the upper site, and with the magnitude go the risks whatever they may be and however remote.

In the matter of respective costs, the estimate recently given you of $ 362,910 for an earth dam at the upper site, is based on the figures thrashed out by Stanley Bent, of Bent Bros. the contractors, and myself some fifteen months ago plus an addition to cover the higher unit prices of today. Get a bid for one to Contour 2737!

The cost of a concrete arch dam at the lower site may be approximated by comparison with Lake Hodges dam. I understand that dam has a crest length of 560 ft., a height of 115 to 125ft. 130' and will contain about 17,700 cubic yards of reinforced concrete. 738

Comparing the Lake Hodges figures with the Warner Lower site figures it will be apparent that a dam at the latter place would require not less than 35,000 cub. yards of concrete. Estimate of yardage worked out along other lines confirms this. Guess again! not by a city Block

With foundation and all other construction cost referred to



the cubic yardage of concrete the cost thereof would certainly be considerably in excess of fifteen dollars per yard, but even at that figure the concrete dam at the lower site would cost sixty thousand dollars more than the earth dam at the upper site. Figure - why go around the actual estimate?

There is nothing, in my judgment, in the surface outcroppings at the lower site to warrant any reasonable expectation that any different sub formation exists than at the upper site. Part of the cut off wall at the upper site is founded on granite in every respect equal, if not better, than the rock in sight at the lower site, yet the core drill holes through this good rock disclosed broken and soft stuff below. See reasons why.

If you would like to discuss this matter verbally I am at your service at any time, and if you have any additional facts throwing light on the matter I would like to have them.

Yours very truly,

H. Hawgood

Should think it would be better as accuracy not so necessary as in writing a letter.

Sept. 3, 1918.

Mr. H. Hawgood,
H. W. Hellman Building,
Los Angeles, California.

Dear Mr. Hawgood:

In reporting for the State Department of Engineering upon the proposed San Luis Rey Irrigation District I have had submitted to me, by Colonel Fletcher, a report of the safe yield of Warner Reservoir as determined by a Board of Consulting Engineers, of which board you were a member. The capacity of the reservoir therein contemplated is 200,000 acre feet.

More recently I have received from Mr. Faude an estimate of cost based upon a lower dam which would impound but 164,000 acre feet. Mr. Fletcher is apparently of the opinion that the reservoir of 200,000 acre feet capacity is to be constructed. Obviously, I wish to clear up the matter before reporting to Mr. McClure because I cannot use the greater capacity and at the same time the lesser cost. Will you please write me which height of dam should govern and the reasons?

Very sincerely,

W. L. Huber

1204 First National Bank Bldg.,
San Francisco, California.

WLH/RH

H. HAWGOOD
CONSULTING ENGINEER

H. W. HELLMAN BUILDING
LOS ANGELES, CALIFORNIA

September 19th. 1918.

H-2

Col. Ed. Fletcher
920 Eighth St.
San Diego.

Dear Colonel;

In reply to your request for an estimate of the cost of works to deliver about ten or eleven million gallons daily into San Clemente reservoir from Warner, I submit the following.

The work is divided into two sections;
1st. Warner to Pamo Valley.
2nd. Pamo Valley to San Clemente.

It has been determined, from the results of the exhaustive investigations made to determine the water yield which may be safely used in considering the Warner-Santa Ysable- San Clemente project, that a conduit from Warner reservoir to the head of the power drop in Pamo Valley should be given a capacity of 50 c.f.per second, to meet peak conditions, and that a conduit from Santa Ysable Creek, Pamo Valley, to San Clemente reservoir should be given 80 c.f.per second capacity, to provide for the additional water and peak conditions.

An initial capacity of 11 million gallons daily, 17c.f.s, cannot be advantageously given Section 1, for the reason that seventy five per cent of the cost of the section is, in the main, made up of two items the cost of which would be unaltered whether the conduit capacity be 50c.f.s. or less. The two items referred to are Warner reservoir dam and the main tunnel through the divide between the San Luis Rey and Santa Ysable watersheds, and for the further reason that proper conservation of the fuel resources would require full development of the water power, and also that the earnings from the power would be of substantial aid. The conditions of Section 2 are different and these arguments do not apply.

For the foregoing reasons the estimates of costs have been based on capacities of 50c.f.s. for Section 1 and 17c.f.s. initial for Section 2 with facility for expansion to 80c.f.s.

The previous estimates of July 26th. were based on a capacity of 50c.f.s. for Section 1 and an initial capacity of 40c.f.s. for Section 2 with faciliy for expansion to 80c.f.s.

For convenience of comparison the present and previous estimates are shown, on the next page, in parallel columns.

SEP 20 1918

Both estimates contemplate that, for the present at least, the discharge from the tail race of the power plant would be turned into and follow the natural water course of Temescal Creek down Pamo Valley to Santa Ysable Creek. Should it become necessary or desirable at any time to employ a closed conduit, in place of the natural water course, about 26,000ft/ of 36" concrete pipe, or its equivalent would be required.

The types of construction covered by the estimates are:-
for Sec.1. Cement lined ditch and metal flumes.
" Sec.2. Estimates of July 26th.. Cement lined ditch of 80c.f.s. capacity. This form of construction forms 66% of the entire length of the conduit. Pipe or metal flumes of 80c.f.s. capacity, all except the six deepest canyon crossings. At these places, which aggregate 9½% of the entire length, the use of pipe of 40c.f.s. capacity is planned. Additional pipe or pipes to be laid when increased capacity is required.
Sec.2. Present estimate. Bench graded as though for cement lined ditch but trenching omitted. Pipe of 17c.f.s. laid for entire length of conduit. When necessary to increase the capacity a cement lined ditch and, or, additional pipes can be used, as deemed best at that time.

Both estimates provide for storage of 3,750 acre ft., equal to 1,232 million gallons or 112 days supply at 11 millions per day, at San Clemente

The estimates in each case include provision for roads, drain-culverts and telephone lines, but do NOT include costs of lands for reservoirs, power house sites, rights of way or water rights, nor, the cost of the penstock and hydraulic and electric appliances and structures of the power plant.

| | | Present Est. | July 26 Est. |
|---|---|---|---|
| Sec.1. Warner-Pamo. | | | |
| Warner Dam. 164,000 ac.ft. storage | | $ 380,000 | 362,910 |
| Conduit to head of power drop | | 570,526 | 586,206 |
| | | 950,526 | 949,116 |
| | 15% | 142,579 | 142,367 |
| | | $ 1,093,105 | $ 1,091,483 |
| | Capacity | 50c.f.s. | 50c.f.s. |
| Sec.2. Pamo-San Clemente | | | |
| Diversion dam & conduit | | 1,155,129 | 1,347,497 |
| San Clemente reservoir 3,570 ac.ft. storage | | 239,275 | 239,275 |
| | | 1,394,404 | 1,586,772 |
| | 15% | 209,161 | 238,016 |
| | | $ 1,603,565 | $ 1,824,788 |
| | Capacity | 17c.f.s. | 40c.f.s. |
| | Total | $ 2,696,670 | $ 2,916,271 |

Yours very truly,

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SEP 20 1918



E.F. #2. 9/19/18.

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It has been determined, from the results of the exhaustive investigations made to determine the water yield which may be safely used in considering the Warner-Santa Ysable- San Clemente project, that a conduit from Warner reservoir to the head of the power drop in Pamo Valley should be given a capacity of 50 c.f. per second, to meet peak conditions, and that a conduit from Santa Ysable Creek, Pamo Valley, to San Clemente reservoir should be given 80 c.f. per second capacity, to provide for the additional water and peak conditions.

An initial capacity of 11 million gallons daily, 17c.f.s, cannot be advantageously given Section 1, for the reason that seventy five per cent of the cost of the section is, in the main, made up of two items the cost of which would be unaltered whether the conduit capacity be 50c.f.s. or less. The two items referred to are Warner reservoir dam and the main tunnel through the divide between the San Luis Rey and Santa Ysable watersheds, and for the further reason that proper conservation of the fuel resources would require full development of the water power, and also that the earnings from the power would be of substantial aid. The conditions of Section 2 are different and these arguments do not apply.

For the foregoing reasons the estimates of costs have been based on capacities of 50c.f.s. for Section 1 and 17c.f.s. initial for Section 2 with facility for expansion to 80c.f.s.

The previous estimates of July 26th. were based on a capacity of 50c.f.s. for Section 1 and an initial capacity of 40c.f.s. for Section 2 with facility for expansion to 80c.f.s.

For convenience of comparison the present and previous estimates are shown, on the next page, in parallel columns.

SEP 20 1918

November
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1920

Mr. H. Hawgood,
H. W. Hellman Bldg.,
Los Angeles, California.

My dear Hawgood:

Glad to hear from you under date of October 28th.

The Lake Hodges system, under a contract with Mr. Henshaw, was entitled to all the watershed, 196 miles, below Pamo dam. In our present negotiations with the proposed Cardiff District, however, a tentative arrangement has been made that this will be increased by delivery of approximately 2,000 acre feet of water from Pamo into Lake Hodges, after Pamo is built. This should be confirmed first by Mr. Griffith Henshaw and Mr. John Treanor.

You can get Mr. Lippincott on the phone and find out how far the negotiations have proceeded.

Mr. Henshaw and I are building a pipe line to La Jolla, under a ten year contract, with a minimum of 2,000,000 gallons per day, the water coming from Lake Hodges. I will ask King to send you a rough sketch.

My leg is not in full working order, and will have to have another operation, but do not consider it particularly serious.

With kind regards, I am
Very sincerely yours,

EF:KLM

# Ed Fletcher Papers

# 1870-1955

# MSS.81

# Box: 10 Folder: 12

# General Correspondence - Hawgood, H.