

Thesis

Collection of Data Regarding Pasadena's
Water Supply.

by

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Pasadena, California

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by former City Engineer Moody, made to the Mayor
and Board of Water Commissioners, May 3, 1913.

This thesis consists of a collection and arrangement of data regarding the Pasadena water supply, including the sources of same and the handling of the water.

PART I.

The City of Pasadena obtains the principle part of its water supply from what are known as the upper and lower Pasadena Basins.

BOUNDARY OF THE UPPER PASADENA BASIN, FROM WHICH SOME OF PASADENA'S AND SOUTH PASADENA'S WATER SUPPLY IS DERIVED.

The Upper Pasadena water-basin is bounded for the entire distance on the north by the mountains. It extends from the village of La Canada about two and one-half miles west of the Arroyo to Eaton's Canyon, about four miles east of the Arroyo. On the south, from La Canada to Devil's Gate, it is bounded by the San Rafael Hills and from Devil's Gate to Eaton's Canyon, it is bounded by Monk's Hill and an underground dyke extending both west and north-east from the hill. This dyke is evidenced by a sudden change in the underground water level. The extreme northwest end of the basin is marked off by an outcropping of granite, which connects the San Rafael Hills with the mountains. (See Accompanying Map #1, Appendix A.)

BOUNDARY OF THE LOWER PASADENA BASIN FROM WHICH PASADENA, MONROVIA, AND THE TERRITORY TOWARD THE SOUTH OF PASADENA OBTAIN SOME OF THEIR WATER SUPPLY. THE TERRITORY TOWARD THE SOUTH INCLUDES SOUTH PASADENA, ALHAMBRA AND OTHER TERRITORY.

The Lower, or Main Pasadena Basin, is bounded on the north by the upper basin just described; on the west, by an underground dyke extending along the east bank of the Arroyo from Devil's Gate to the south city limits at Columbia Street; and on the south and east by Raymond Hill and the underground dyke known as Raymond Hill Dyke, which extends both west and northeast from the hill. The northeast arm of the dyke extends to the mountains at the Santa Anita Wash, and as it passes below Sierra Madre it seems to join with the underground base of the mountains. (See Map #1.)

LOCATION OF THE SHEEP CORRAL BASIN FROM WHICH PASADENA AND SOUTH PASADENA ARE IN PART SUPPLIED.

This basin consists of the gravel-filled river bed of the Arroyo Seco, and it extends from Devil's Gate to the submerged dam located just below the Sheep Corral Springs.

Area of Basins.

The land lying over the upper and lower Pasadena basins and the Sheep Corral basin measures about 18,500 acres and nearly all of it is available for improvement. (See the report of the

Sub-Committee on Municipal Ownership of Water to the Pasadena
Board of Trade Water Committee - Dec. 1910.)

* * * * *

Part II.

Miner's Inch.

The "miner's inch used in this thesis is the Standard California Miner's inch as defined by the State Legislature. An act of the California Legislature, May 23, 1901, makes the Standard Miner's inch 1.5 cubic feet per minute, measured through any aperture or orifice. Based on 1 cubic foot equaling 7.48 gallons, this equals 0.187 gallons per second, 11.22 gallons per minute, or 673.2 gallons per hour.

* * * * *

Part III.

Pasadena's Pumping Plants and Wells.

The City of Pasadena acquired by purchase on the first of November 1912, the properties of the three independent water companies within the city limits; namely, the North Pasadena Land and Water Company, the Pasadena Lake Vineyard Land and Water Company, and the Pasadena Land and Water Company. The second-named company was generally spoken of as the "east-side company" to distinguish it from the last-named company, which was commonly called the "west-side company".

The city at present derives its supply from nine wells; namely, the Casitas Avenue well, the Sheldon Street well, the Copelin steam and the Copelin motor wells, the West and Middle Ohio Street wells, the Franklin Avenue well, the Sheep Corral well, and the Ritzman Street well. Some of the gravity flow comes from what is known as the Devil's Gate Tunnel System and part from the Arroyo Canyon flow.

The Copelin wells, before their purchase by the City, belonged to the Lake Vineyard Land and Water Company. They are located near the corner of Blaine and Glen Avenues, about one-half mile west of the corner of Fair Oaks Avenue and Mountain Street.

The Sheep Corral Springs well belonged to the Pasadena Land and Water Company. It is located in the bed of the Arroyo Seco, about 600 feet north of the southeast end of the Linda Vista bridge.

The Ohio Street Wells consist of three wells which belonged to the Pasadena Land and Water Company. They are located between Ohio and Glenarm Streets near Euclid Avenue. I am informed that the East well has been abandoned, the machinery removed, and the well filled up. The West and Middle wells are the two of this group now used by the City of Pasadena.

The Devil's Gate Tunnel system was the joint property of the Pasadena Lake Vineyard Land and Water Company and the Pasadena Land and Water Company. Seven-tenths interest belonged to the for-

mer and three-tenths interest to the latter company. It is located near the northwest corner of the City. In the winter time this system is often closed either entirely or partially, with gates provided for the purpose, the object being to conserve the water in the gravels that are tributary to the tunnels. The maximum capacity of the conduit leading from the tunnels to reservoir Number I is 275 miner's inches.

The Arroyo Canyon flow was claimed by the North Pasadena Land and Water Company and this company improved the system to take more of this flow. In the winter the flow is usually great but in the driest years the flow has dropped to 4.3 miner's inches.

* * *

Part IV.

Rainfall Chart.

A chart was made of the rainfall by months, from July 1882 to April 1914, giving the total for each year. It will be noticed that the year was taken from July 1 to June 30 of the subsequent year.

A curve was also plotted for the past 31 years, showing the fluctuation in the total yearly rainfall. It will be noticed upon examination of this curve that there were 15 years out of the past 31 years when the rainfall was below the average of 20.55 inches. It will further be noticed that there are not more than three successive years that are either above or below average, but rather the year following a low year will be above the average.

Official Government Rainfall Record for Pasadena for 31 Years

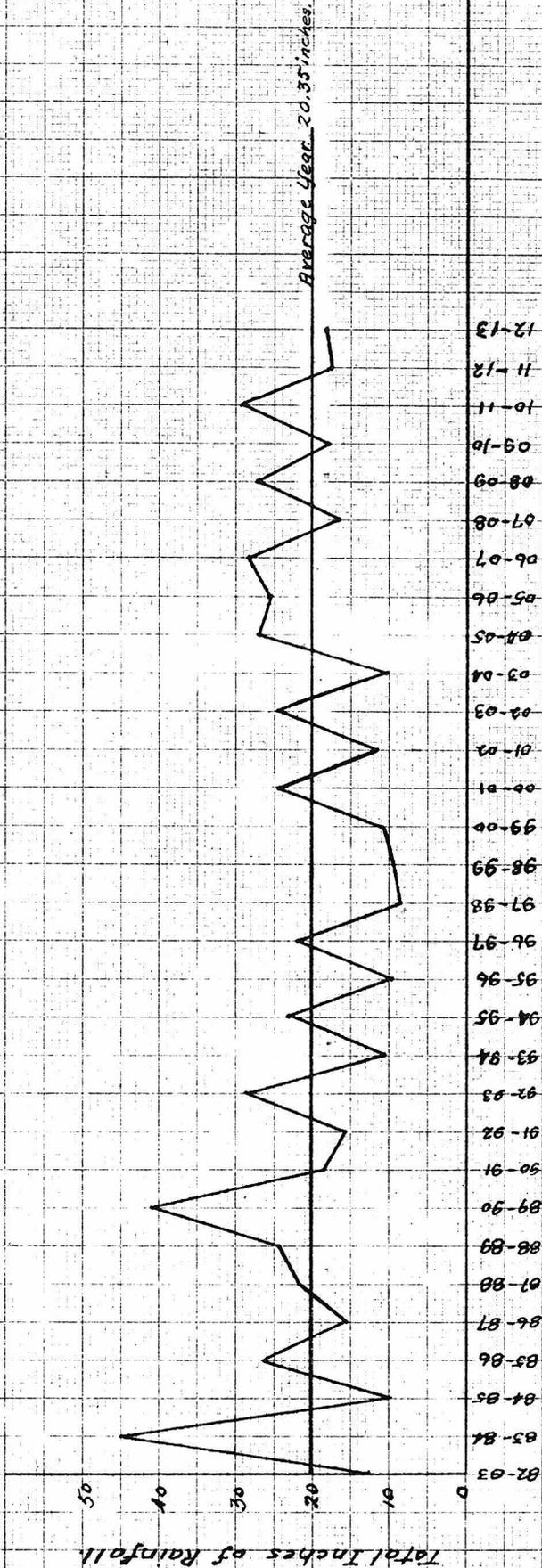
Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	Apr.	May	June	Total.
82-83	.00	.00	.00	.80	1.70	.00	.93	4.45	1.80	.58	2.36	.05	12.67
83-84	.00	.00	.00	1.30	.00	2.73	6.10	13.21	12.99	5.93	.77	1.90	44.93
84-85	.00	.20	.00	.25	.89	3.95	1.22	.00	.05	3.00	.33	.11	10.00
85-86	.00	.14	.00	.00	7.49	2.05	7.40	2.32	2.45	4.11	.15	.00	26.11
86-87	.05	.26	.04	.10	1.15	.17	.19	10.66	.27	2.33	.28	.00	15.50
87-88	.17	.00	.33	.12	1.12	4.98	7.40	1.57	5.62	.46	.00	.00	21.77
88-89	.00	.00	.00	.45	5.68	6.71	.09	1.08	8.83	.41	.95	.00	24.20
89-90	.00	.62	.00	9.31	1.45	7.17	7.92	2.66	.90	.60	.20	.06	40.89
90-91	.00	.00	.26	.07	.35	3.52	.14	10.75	.68	1.84	.73	.00	18.34
91-92	.00	.00	.09	.00	.05	2.25	1.54	3.40	4.23	.25	3.94	.00	15.75
92-93	.00	.00	.00	.62	3.72	4.30	7.65	2.07	9.84	.47	.00	.00	28.67
93-94	.70	.00	.00	.80	.20	4.77	1.61	.82	.96	.13	.61	.00	10.50
94-95	.00	.09	.85	.04	.00	7.24	8.10	1.44	4.53	.53	.25	.00	23.07
95-96	.00	.00	.00	.32	1.30	.91	2.96	.00	3.73	.50	.17	.00	9.87
96-97	.05	.15	.00	2.04	1.88	2.33	5.94	5.34	3.57	.00	.23	.00	21.53
97-98	.05	.15	.23	2.40	.10	.26	1.50	.69	1.14	.39	1.98	.03	8.82
98-99	.01	.00	.27	.49	.52	.64	3.18	.00	2.08	.12	1.88	.00	9.19
99-00	.00	.00	.00	2.02	1.43	1.62	1.11	.00	1.55	.82	2.42	.00	10.97
00-01	.00	.00	.05	.34	9.80	.00	3.78	6.80	.67	1.16	1.62	.00	24.22
01-02	.00	.00	.00	2.76	.73	.00	1.63	3.01	3.29	.38	.09	.00	11.89
02-03	.00	.00	.00	.53	3.24	3.07	4.03	.90	9.70	3.09	.00	.00	24.56
03-04	.00	.00	.34	.00	.00	.00	.21	3.89	4.81	.93	.01	.00	10.19
04-05	.00	.53	.34	.96	.00	1.90	2.63	10.44	8.65	.18	1.44	.00	27.07
05-06	.00	.00	.05	.17	2.55	.17	4.44	2.54	11.23	2.67	1.67	.00	25.49
06-07	.01	.02	.00	.00	.43	8.96	10.37	2.75	5.10	.36	.05	.17	28.22
07-08	.00	.00	.12	.00	2.09	1.14	6.42	4.72	1.38	.64	.00	.00	16.51
08-09	.00	.02	1.94	.26	.82	1.58	10.45	6.70	4.99	.07	.00	.20	27.03
09-10	.12	.06	.08	.65	2.25	8.66	2.96	.31	2.56	.32	.00	.02	17.99
10-11	.02	.00	.05	.75	.28	.15	9.82	4.70	7.59	.71	.02	.06	29.15
11-12	.00	.00	1.81	.11	.08	.95	.18	.00	11.83	2.62	.22	.00	17.80
12-13	.00	.00	.00	.69	.56	.30	3.13	11.20	.35	.92	.13	.76	18.04
13-14	.01	.06	.14	.01	3.20	1.84	15.07	11.44	.82	.80	.00	.00	40.00
14-15	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	0.00

W. F. Myers.

Average rainfall for 31 years - 20.35 inches per annum.

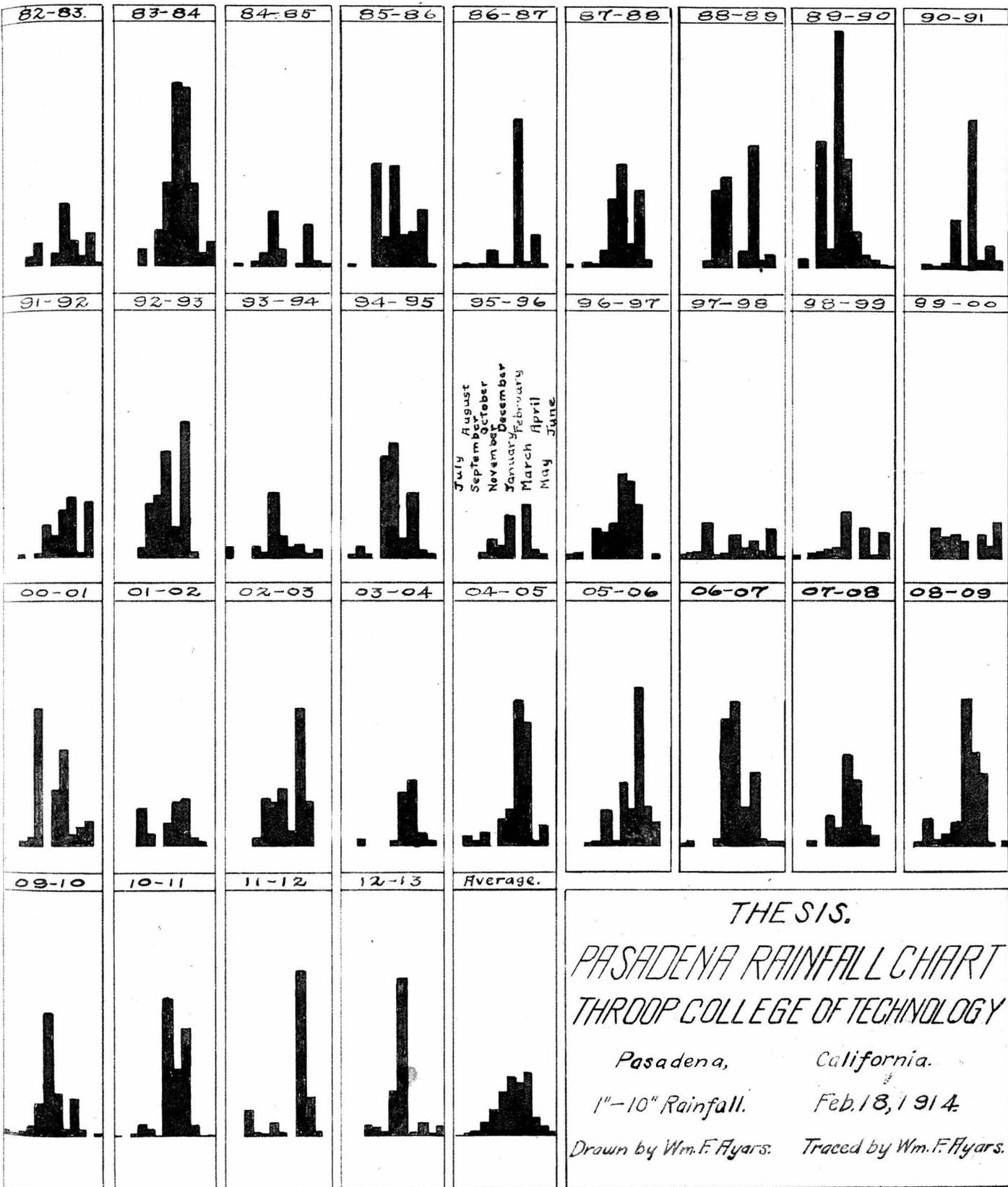
Rainfall Chart

Showing the Total Yearly Rainfall for Pasadena for 31 years.



Year is taken from July 1st to June 30.

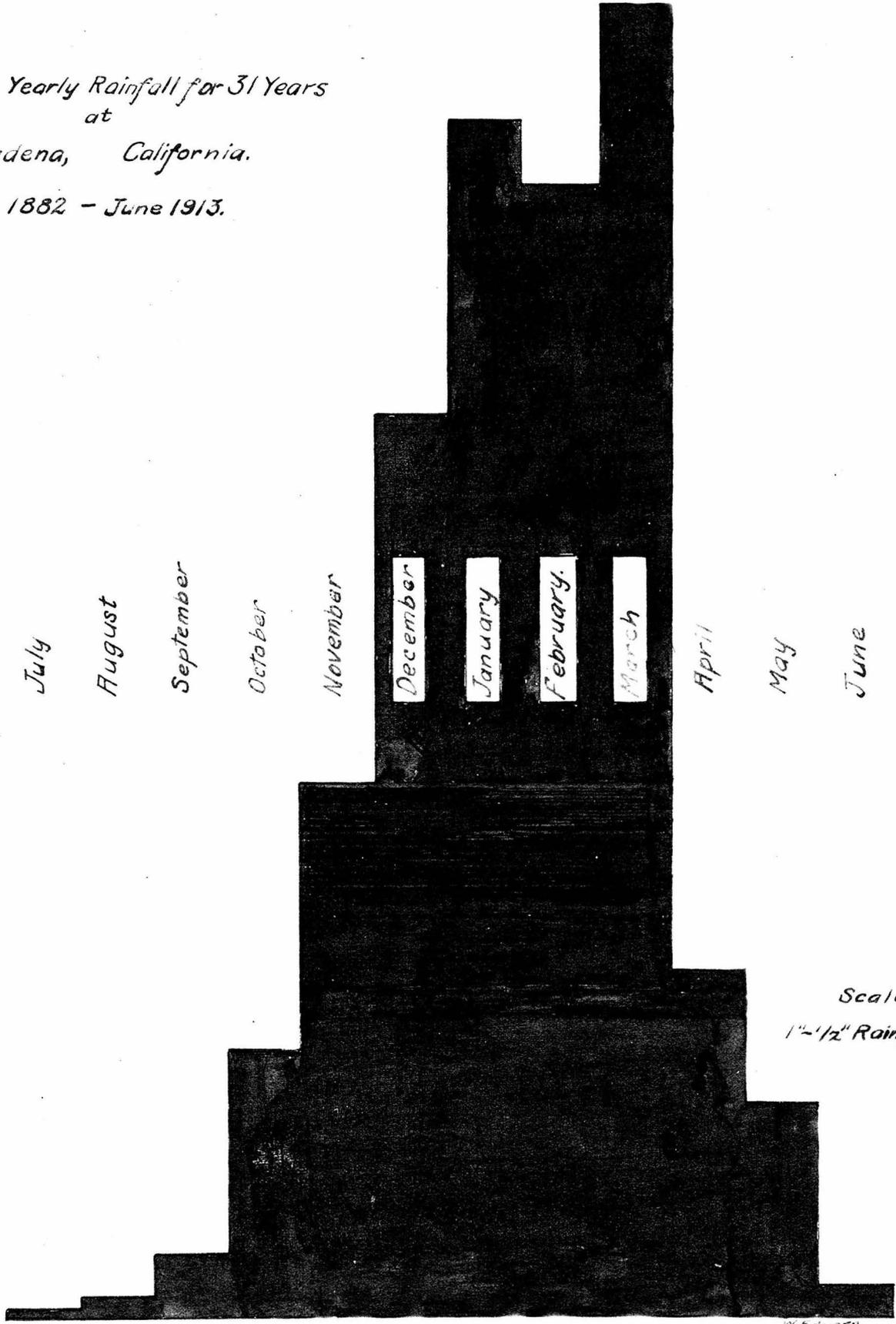
William F. Hyatt,
Mar. 3, 1914



THE SIS.
 PASADENA RAINFALL CHART
 THROOP COLLEGE OF TECHNOLOGY
 Pasadena, California.
 1"-10" Rainfall. Feb. 18, 1914.
 Drawn by Wm. F. Hyars. Traced by Wm. F. Hyars.

THE SIS.

Average Yearly Rainfall for 31 Years
at
Pasadena, California.
July 1882 - June 1913.



Scale
1" = 1/2" Rainfall.

Total 26 3/4 inches

W. H. Myers.

This holds approximately true for the entire period of 31 years. The years from 1893 to 1904, however, were 11 exceptionally low years, seven of these being below average by about 10 inches and the four years which were above average, averaged only 4 inches in excess of normal.

Another chart was also prepared for an average year, showing the average distribution per month for the past 31 years. Upon examination, one will find that the heaviest average monthly rainfall for Pasadena occurs during March when 4.43 inches is the average amount that is precipitated, while in January 4.03 inches is the average. From statistics gathered by the Security Trust and Savings Bank of Los Angeles, it appears that during the past 37 years, January showed the heaviest average rainfall for the entire Los Angeles County.

The monthly averages for 37 years taken in various parts of Los Angeles County, compared with the average during 31 years taken in Pasadena, is shown in the following table:

Month	Inches of Rainfall	
	Pasadena	Los Angeles County
July	0.04	0.01
August	0.08	0.03
September	0.22	0.12
October	0.91	0.70
November	1.80	1.36
December	3.04	2.82
January	4.03	3.17
February	3.82	3.11
March	4.43	2.88
April	1.18	1.00
May	0.73	0.45
June	0.11	0.07
Total	20.39	15.72

Part V.

Under Ground Water Level In Pasadena Basin.

No data as to the water level in Pasadena's Under Ground Basin could be obtained from February 1912 to January 1913. Curves of the nine different Pasadena wells have been plotted from what data could be obtained and these are shown on the accompanying curve-sheet. The majority of the data used was very kindly furnished by Engineer Morris of the Water Department of Pasadena, and the complete table of data is given in Appendix C of this thesis.

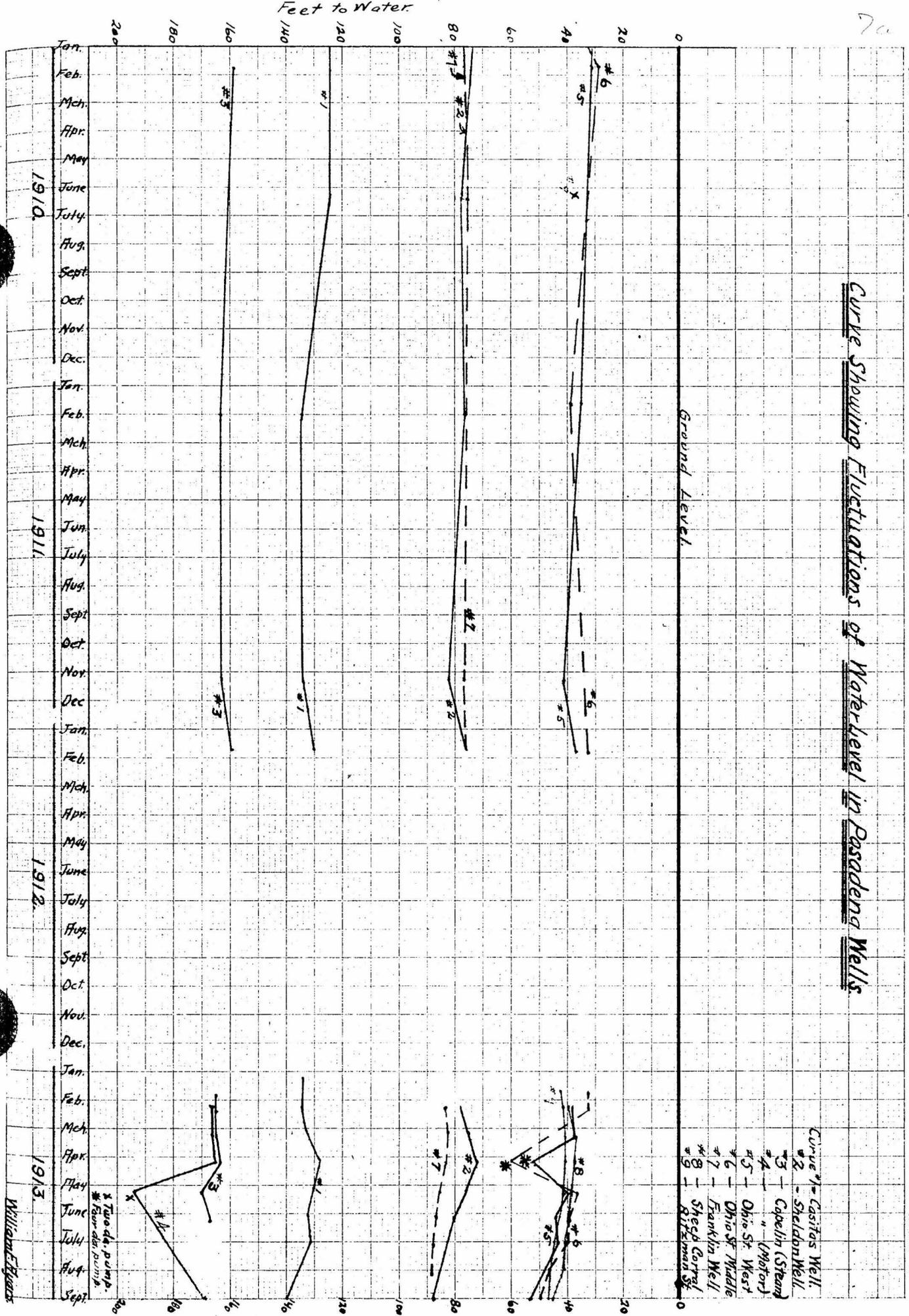
It will be noticed that, in general, the curves are ascending during the period from January to April and that from then until December, when the majority of pumping occurs, they drop appreciably. An instance of what may be expected from a normal gravity flow is cited on a subsequent page of this thesis.

The water level of Pasadena Basin took a drop of 15 feet in three years and nine months. The area of the land over the Pasadena basin, as scaled from Government maps, is about 18,500 acres. Assuming that it takes 0.3 cubic feet of water to saturate 1 cubic foot of soil then the excess of water removed from the basin in 1 year over that which flowed in was

$$\frac{7.48 \times 18500 \times 43560 \times 15 \times 0.3}{3.75} = 7,240,000,000 \text{ gals. per year.}$$

which is equivalent to a continuous flow of about 1230 miner's inches.

Curve Showing Fluctuations of Water-level in Pasadena Wells



- Curve #1 - Castles Well.
- #2 - Sheldon Well.
- #3 - Capelin (Steam)
- #4 - " (Motor)
- #5 - Ohio St. West
- #6 - Ohio St. Middle
- #7 - Franklin Well
- #8 - Speck Corral
- #9 - Ritzman St.

x Turbine pump.
 * Reverse pump.

Williams & Blyden

Part VI.

Methods of Lifting Water in and near the Pasadena Basins.

The following table gives the kind of lift used and the quantity of water pumped from wells in and near the Pasadena Basin. The well number and map location refers to Plate IX, of the United States Geological Survey, Water Paper No. 219, which will be found in Appendix A of this thesis. The complete paper above mentioned is on file at the Library of Throop College of Technology in Pasadena and contains additional information concerning these wells and their equipment which will be found on Pages 165 - 175 inclusive.

No.	Map Location	Method of Lift	Quantity Miner's Inch. (California)	Standard Miner's Inch
1	I - 8	Wind	---	---
2	"	"	---	---
3	"	Gas engine	3	2.4
4	"	"	5	4.0
5	H, I - 8	"	3	2.4
6	H - 8	"	---	---
8	"	"	---	---
12	"	Wind	---	---
14	"	Wind - gas	2	1.6
15	"	Gas engine	2	1.6
16	"	"	4	3.2
21	I - 7	"	---	---
22	"	Wind	---	---
28	H - 7	Gas engine	11	8.8
30	I - 8	"	2	1.6
31	"	Comp. air	15	12.0
35	"	Wind	---	---
37	I - 9	Elec. motor	---	---
41	"	Flows into tunnel	15	12.0
42	"	Siphon	16.	12.8

No.	Map Location	Method of Lift	Quantity Miner's Inch (California)	Standard Miner's Inches
43	I - 9	Siphon	10	3.
47	"	Tunnel	6	4.8
48	F - 8	Wind	-----	-----
49	"	"	-----	-----
50	F - 9	Hand	-----	-----
53	"	Elec. motor	26	20.8
54	G - 9	"	43	38.4
55	"	Gas engine	15	12.
58	H - 9	"	30	24
59	"	Elec. motor	-----	-----
60	"	"	-----	-----
66	E - 9	"	8	6.4
68	F - 8	Gas engine	9	7.2
70	E - 7	Wind	-----	-----
73	E - 6	"	-----	-----
76	F - 5	Gas engine	8	6.4
78	G - 5	"	23	19.4
82	I - 6	"	22	17.6
83	H - 7	Elec. motor	20	16.0
85	H - 2	Gas engine	10	8.
259	G - 9	Tunnel	-----	-----
260	"	"	20	16.
269	G - 11	Gas engine	12	9.6
272	F - 8	Wind	-----	-----
432	F - 6	Steam, P.L.V.L. & W.Co.	-----	-----
433	E - 5	Gas engine	25	20.0
434	"	Comp. air	154	123.2
435	"	Steam	30	24.
436	E, F - 4	"	25	20
437	E - 6	"	50	40
438	I - 8	Elec. motor	18	14.4
448	G - 9	Steam	90	72
449	"	Tunnel	60	48
450	"	Gas engine	2	1.6
451	"	Comp. air	100	80
452	G - 9	Elec. motor	68	54.4
453	I - 9	" "	20	16
454	"	" "	100	80
462	G - 9	Steam	-----	-----
466	E - 7	Gas - steam	65	68
467	G - 10	Steam	75	60
468	G - 8	"	100	80
471	H - 9	Elec. motor	100	80
469	F - 9	Gas - elec. motor)	120	96
470	G - 9	Gas		
472	H, I - 9	Elec. motor	7	5.6
473	E - 9	" "	-----	-----
474	I - 8	Gas Engine	-----	-----

The total equivalent continuous flow, as shown by the records above, was 1574 old California miner's inches, or 1262.6 standard miner's inches.

Out of a total of 69 installations situated in the Pasadena Basin and near vicinity, the methods of lift are as follows:

Gas Engine	25
Electric Motor	15
Wind	10
Steam	9
Tunnel	4
Compressed Air	3
Siphon	2
Hand	<u>1</u>
Total	69

Assuming that in the systems that lift their water by means of hand, wind, gasoline engine and steam, the pumps are positive lift piston pumps, and that those driven by electric motor are centrifugal pumps, then, in the vicinity of the Pasadena Basin,

45/69 or 65.22 % of the installations are positive-lift pumps,
 15/69 or 21.74 % " " " " centrifugal pumps,
 4/69 or 5.79 % flow from tunnels by gravity,
 3/69 or 4.35 % are air-lift installations,
 2/69 or 2.90 % are siphon installations over Raymond Dyke.
 Total -- 100.00 %

The above figures are not an indication of the amount of water pumped by these various methods, but simply of the relative number of the various types of installations.

Part VII.

Data on Pumping Costs.

An effort has been made to secure data concerning the kilowatt consumption per 1,000 gallons of water pumped. These efforts have only been partly successful owing to the fact that the majority of water companies in the vicinity of Pasadena have not regarded the keeping of such data as an essential part of the efficient operation of a pumping plant.

A word might be said, however, in the companies' favor. The cost of purchasing and installing apparatus suitable for measuring the output of water is necessarily heavy. Very little time would be needed to take a series of systematic readings and to keep a log of the output.

Nearly all of the estimating and calculating, in regard to the quantity of water taken into the East and West Side systems, could have been eliminated, and the leakage accurately determined, by the use of a large Venturi water meter set in place at an approximate cost of about \$1200. The leakage, which could be checked up by use of such a meter, would make a considerable saving and would warrant such an installation.

An especial effort was made to obtain pumping data for the various wells now owned and operated by the City of Pasadena. Old records have been thoroughly searched at the Municipal Light Offices and the Edison Company, and also some of the records of the City Recorder. Much valuable information has also been given by Engineer Morris and others of the City Water Department. Records of

electrical consumption for various periods of time were found, but as the water companies had no means of measuring their output, there was nothing to judge this from, except estimates of former City Engineer Moody, as found in his report of the water situation to the Mayor and Board of Water Commissioners, May 3, 1913. (This report, in its entirety, will be found in Appendix D of this thesis). The following table shows the pumping operation at the various plants during a six months period from November 1912 to April 1913, giving the number of hours pumped and the quantity in million gallons.

Water Supply --- Pump.

Pump	November		December		January	
	Hrs.	M. G.	Hrs.	M. G.	Hrs.	M. G.
Ohio Street	198	15.91	159	11.45	55.5	3.55
Copelin Steam			232	28.19		
Copelin Motor	406	54.81	176	23.76	148	19.90
Corral Spring	36	1.95				
Casitas Ave.	212	12.12				

Pump	February		March		April		Total	
	Hrs.	M. G.	Hrs.	M. G.	Hrs.	M. G.	Hrs.	M. G.
Ohio Street			10	0.65	245.5	15.9	668	47.46
Copelin Steam							232	28.19
Copelin Motor					100.	13.5		
Corral Spring					41	2.21	77	4.16
Casitas Ave.							212	12.12

No pumping was done during this period either at the Sheldon Avenue plant or at Devil's Gate.

The data concerning amounts of water pumped and that concerning the kilowatt-hour consumption did not happen to be for the same periods; consequently not even an approximate cost of pumping could be obtained. Another variable quantity is the head pumped against, as the water is pumped at times directly into the City mains and at other times into the various reservoirs.

A table of pumping costs for plants in the vicinity of Pasadena is given in Appendix B. This gives the relative cost of pumping with positive-lift pumps, centrifugal pumps both single and double stage, and also gives some figures on another installation using compressed air as a means for lifting the water. There are also costs on pumping at Redondo Beach using a double-stage centrifugal pump.

It is the intention of the engineers in charge of the City Water Department to install suitable Venturi meters at the various plants in order to accurately determine the amounts pumped. In this way, it will be possible to check up the amount of leakage in the system, a factor which is at present an unknown quantity. Commissioner Allin stated that engineers at one time (not long ago) estimated the local systems were losing, from all causes, about 23 per cent. of the water put into their reservoirs. On December 9, 1910, Mr. Mulholland of Los Angeles, stated that he would consider an allowance of 5 per cent. for leakage from ordinary causes as a liberal

estimate in accounting for water that is lost in the distribution of water by water companies. Mr. Goble, of the San Gabriel Valley Water Company, states that shrinkage in a good piping system will average 10 per cent., while 25 per cent. is not infrequent. The exact amount will never be accurately determined until some reliable meter is installed to measure the water put into the system by the various pumping plants.

Part VIII.

Gravity Flow.

The month of January 1914 was an especially wet month, the precipitation amounting to 15.07 inches. The month of February of the same year will go down into history as being that of the most damaging floods since December 1890, although only 11.44 inches of water fell. March was unusually dry, only 0.82 inches of water falling, so that this amount did not replenish the gravity flow enough to speak of. In order to show how the gravity flow falls off, allow me to take from the Pasadena Star of April 21, 1914 part of the report of Assistant Superintendent Carpenter.

"Assistant Superintendent Carpenter of the water department this morning submitted his report showing exactly what water conditions are in Pasadena. This report shows that the gravity flow in the Arroyo Seco has decreased to a few hundred miner's inches whereas it was 7200 miner's inches at the opening of the

month of March. A new pipe has been installed which will delay the necessity of pumping the Copelin and Corral Springs wells for a considerable time and will, therefore, save the city a large sum of money. The report also shows a large amount of constructive work done. It is, in essential details, as follows:

Gravity System.

OPERATING -- The water flow in the Arroyo the first of the month was about 7200 miner's inches, on the 9th it was about 2400 inches, and the last of the month it was 800 inches. During the early part of the month we were receiving 160 inches through the 24-inch pipe line, increasing to 200 inches as the draught became heavier. About 800 miner's inches were diverted from the stream channel through the flume and spread over the Arroyo throughout the month. The flow from the main tunnel at Devil's Gate during March was 14,621,000 cubic feet.

REPAIRS -- The most important work done during the month was the repairing and replacing of the thirty-inch gravity main at Devil's Gate. This pipe was re-dipped and straightened and relaid in practically the same place as before, the main difference being in the grade. The damaged twenty-two-inch main was also repaired during the month. A relocation of the twenty-four-inch main at Millard's canyon was made necessary by the washing out of the old trestle at that point.

CONSTRUCTION -- An eight-inch riveted steel main was laid on Windsor Avenue, tapping the twenty-four-inch gravity line and running south 686 feet to the Devil's Gate tunnel shaft into which 135

feet of eight-inch flanged pipe was installed. The purpose of this was to postpone pumping until absolutely necessary. Heretofore we have had to start pumping at Copelin well and Corral Springs when a fair stress was flowing in the Arroyo. As it is now, we can take more water through the twenty-four-inch line and from there through the eight-inch line just installed into the shaft and then through the tunnel at Devil's Gate to the twenty-two and thirty-inch lines. This will do away with early pumping, as the surplus water from the twenty-four-inch line can be diverted to the Mountain Street and Orange Grove Avenue reservoirs.

Pumping System

OPERATION -- The steam plant at Copelin well was started on March 11 and operated until March 26, for a total of 225 hours. The plant at Corral Springs was started on March 17 and operated until March 23, for a total of 95 hours. This operation was necessary on account of the break in the thirty-inch main and the inability of the twenty-two-inch main to supply sufficient water.

CONSTRUCTION -- The enlarging and recurbing of Sheldon Avenue well was completed during the month. The depth of this well is 136.5 feet. A test was made and with the surface of the water at 128.5 ft. 69.15 miner's inches, or 1.363 second feet, was found to be the capacity.

A pump house was erected over the well and pump at Corral Springs. This structure is 16 x 26 feet, and nine feet high."

Part IX.

Dam at Devil's Gate.

It has been proposed, at various times in the past and by various persons, that a dam should be built across the Arroyo Seco at Devil's Gate, in order to conserve flood-waters which at present run to waste. The idea held by many was that the bed of the Arroyo and the low country just north of Devil's Gate would make a fine storage reservoir. Apparently such is not the case, for the east bank of the Arroyo is composed chiefly of gravel which would allow the escape of any water which might be backed up by such a dam. A dam at this point would undoubtedly be a good thing, as it would hold back flood-water long enough for it to run into the underground basin, the water-level of which would be raised. Other communities beside Pasadena would be benefited by such a construction and should therefore pay part of the cost. It behooves Pasadena and other communities drawing part of their water supply from the Pasadena Basin, to get together and finance a project which would be mutually beneficial.

APPENDIX A

M A F E

APPENDIX B

DATA ON PUMPING COSTS.

Pumping Data

The following pumping data has been gathered from various pumping plants in and near the Pasadena Basin.

Total Head Pumped Against	Type of Pump.	Miner's Inches.	K.W. Hrs. Consumed	Cost of Power	Thousand Gallons Produced	Cost per M. Gal.	Cost of Lifting 1000 gals. 100 ft.	Efficiency
61'	Centrifugal	12	3,774	53.21	3,480	.0191	.0313	16.8%
70'	"	39	7,925	132.74	14,963	.0088	.01256	41.8%
70'	"	54	10,803	180.95	20,995	.0086	.0123	42.7%
103'	"	52	9,169	145.20	9,308	.0157	.01525	32.4%
107'	"	22	216	3.55	119	.0307	.0287	18.5%
110'	"	46.35	15,969	235.96	15,850	.0147	.01536	39.8%
170'	Area Jack.	12	1,585	23.20	318	.0283	.01665	31.5%
134'	Cent. 2-stage	76	2,234	37.42	2,565	.0145	.0108	48.5%

The average cost of power per K.W. hour in the above cases is about \$0.01675. With an efficiency of 100% and cost of power of \$0.01675 per K. W. hr., the cost of pumping 1,000 gallons against a head of 100 feet is \$.00525. The K. W. hours consumed are .513.

The Redondo Water Company has two duplex pumps lifting water 211 feet at a cost per 1,000 gallons of 1-1/2 cents. The cost of lifting 1,000 gal. 100 ft. is .0071, with 74% efficiency.

The following data is from a typical air compressor installation.

Total Head	Miner's Inches	K. W. Hours Consumed	Cost of Power	Thousand Gallons Produced	Cost per M. Gallons	Cost of lifting 1000 gallons 100 feet.	Efficiency
43'							
43'							
40'	149	1,5300	193.13	12,149	.0158	.0298	17.6%
68'							
80'							

Average head pumped against = 53'

PUMPING COSTS FURNISHED BY BYRON-JACKSON CO.

Test made by So. Cal. Edison Co. - J. H. Fritz Plant.
Lankershim, Cal.

MOTOR --- G. E. Vertical, Form K, 75 H.P., 2200 volt, 1200 R.P.M.,
60 cycle, direct connected to pump. Measured R.P.M. = 970.

PUMP --- Byron Jackson #7, single stage vertical.

METER --- T.P.D. #2578326, 5 A., 110 volts, Disk K = 1. Current trans-
former ratio 5:1, potential transformer ratio 20:1. With
transformer ratio Disk K equals 100. Measured speed of disk
equals 6 revolutions - 34.6 seconds equals 62.4 K.W. input.
The head was 23.5" vacuum plus 92' = 110.6' total. The flow
meter showed 223 miner's inches or 3.58 miner's inches per
K.W. The overall efficiency is 71.8 per cent. and based on
a motor efficiency of 91 per cent. the pump efficiency is 79
per cent. which is highest pump efficiency we have obtained
on any centrifugal pump of similar size on our system.

The pump was mounted on a steel frame at the bottom of
a 95' concrete pit. The vertical motor was on the top of this
frame and was connected to the pump with about 25' of shaft-
ing and a flexible coupling.

(Signed) R. H. Cates, Power Engineer.

This is equivalent to .436 k.w. hr. per 1000 gallons, for 100' lift.
Cost = .436 x .01675 = \$.0073 per 1000 gallons with 100' lift.
Efficiency = 72%

TEST ON GAGE CANAL, SAN BERNARDINO, CAL.

Data furnished by Byron Jackson Co. of Los Angeles.

PUMP --- Byron Jackson #6, vertical type. Pits - 18' deep, vacuum
15", total head pumped against 33'

Results - 156 miner's inches. Meter reading -- 14-1/2 H. P.
There is an error in this data as it
gives over 100% efficiency.

PUMP --- L. & B. Total lift probably 35'

Results - 178 miner's inches. Meter reading - 48 H. P.

Mr. Shedden, Supt.

This is equivalent to .657 k.w. hr. per 1000 gallons for 100' lift.
Cost = .657 x .01675 = \$.011435 to lift 1000 gal. against 100' lift.
Efficiency = 36.6%

PUMPING DATA

2-stage centrifugal pump located at Covina. The horse power required is 450, pumping an equivalent flow of 600 miner's inches against a head of 180 feet.

$$\frac{450 \times 33000}{1.3415 \times 33000} = 335.5 \text{ K. W.}$$

Amount lifted. $600 \times 11.22 = 6732$ gallons per minute.

$$\frac{335.5}{6.732 \times 1.8 \times 60} = .46152 \text{ K.W. hr. per 1000 gal. with 100' lift.}$$

$$\frac{.313}{.4615} = 67.83\% \text{ efficiency.}$$

2-stage centrifugal pump located at Covina, using 200 H.P. and pumping 250 miner's inches against a head of 180 feet.

$$\frac{200 \times 1000}{1.3415 \times 1.8 \times 250 \times 673.2} = .4926 \text{ K.W. hr. per 1000 gallons with 100 ft. lift.}$$

$$\frac{.313}{.492} = 63.6\% \text{ efficiency.}$$

Meter Readings on Pasadena Wells

Well	Kilowatt Consumption by Months					
	Nov.	Dec.	Jan.	Feb.	March	April
Ohio Street	13520	5480	---	---	---	---
Copelin Motor	---	24060	22000	540	14220	---
Corral Springs (1012)*	644	---	---	---	---	---
Casitas Ave.	16160	720	---	600	---	---

City reading on Ohio Street well from 12-10-12 - 4-23-13 was 18250 K. W., which should be added to above readings.

* Reading as furnished by Edison Company.

Above consumptions furnished by City Auditor from bills rendered.

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Electric Power rates for Pasadena, as furnished by Mr. Barrett,
April, 1914.

First	100	K.W. Hr.	-	\$.04
Next	400	" "	-	.024
"	1000	" "	-	.02
"	500	" "	-	.019
"	500	" "	-	.018

To lift 1000 gallons against 100' head.

100% Efficiency - .315 K.W. hr. required.

Location	Page in Thesis.	% Eff.	Actual K.W. Hrs.	Cost per K.W. Hr. as given in original data.
Near Pasadena	Appendix B Page 1	16.8	1.87	\$.01675
"	"	41.8	.750	.01675
"	"	42.7	.734	.01675
"	"	32.4	.962	.01585
"	"	16.3	1.715	.01675
"	"	39.3	.797	.01675
"	"	31.6	.994	.01675
"	"	48.5	.645	.01675
Redondo	"	74.0	.423	.01675
Air Compressor plant near Pasadena	"	17.6	1.780	.01675
Lankershim	Page 2	72.0	.436	Rates vary
San Bernardino	"	36.6	.857	in different
Covina	Page 3	67.8	.4615	localities
Covina	"	63.6	.4926	
AVERAGE		33.9	.923	

Average K. W. hours required to lift 1000 gallons against 100'
head = .923

Pump to deliver 500 miner's inches against 200' head with an overall efficiency of 33-1/3%, 50%, and 66-2/3%.

	33-1/3%	50%	66-2/3%	Efficiency
$\frac{8.33 \times 500 \times 11.22 \times 200}{33000 \times \text{eff.}} =$	850	637	425	H.P. Required
	634	475	317	K.W. Required

Well required = 6' x 10' x 170'. Contains 2 - 10" pumps. Lining - \$7.00 per ft. Digging - \$3.00 per ft.

K.W. required per year = 317 x 24 x 360 = 2,740,000 at .01 K.W. hr. = \$27,400. (66-2/3% efficiency)

Gallons produced per year = 500 x 673.2 x 24 x 360 = 2,910,000,000 gallons.

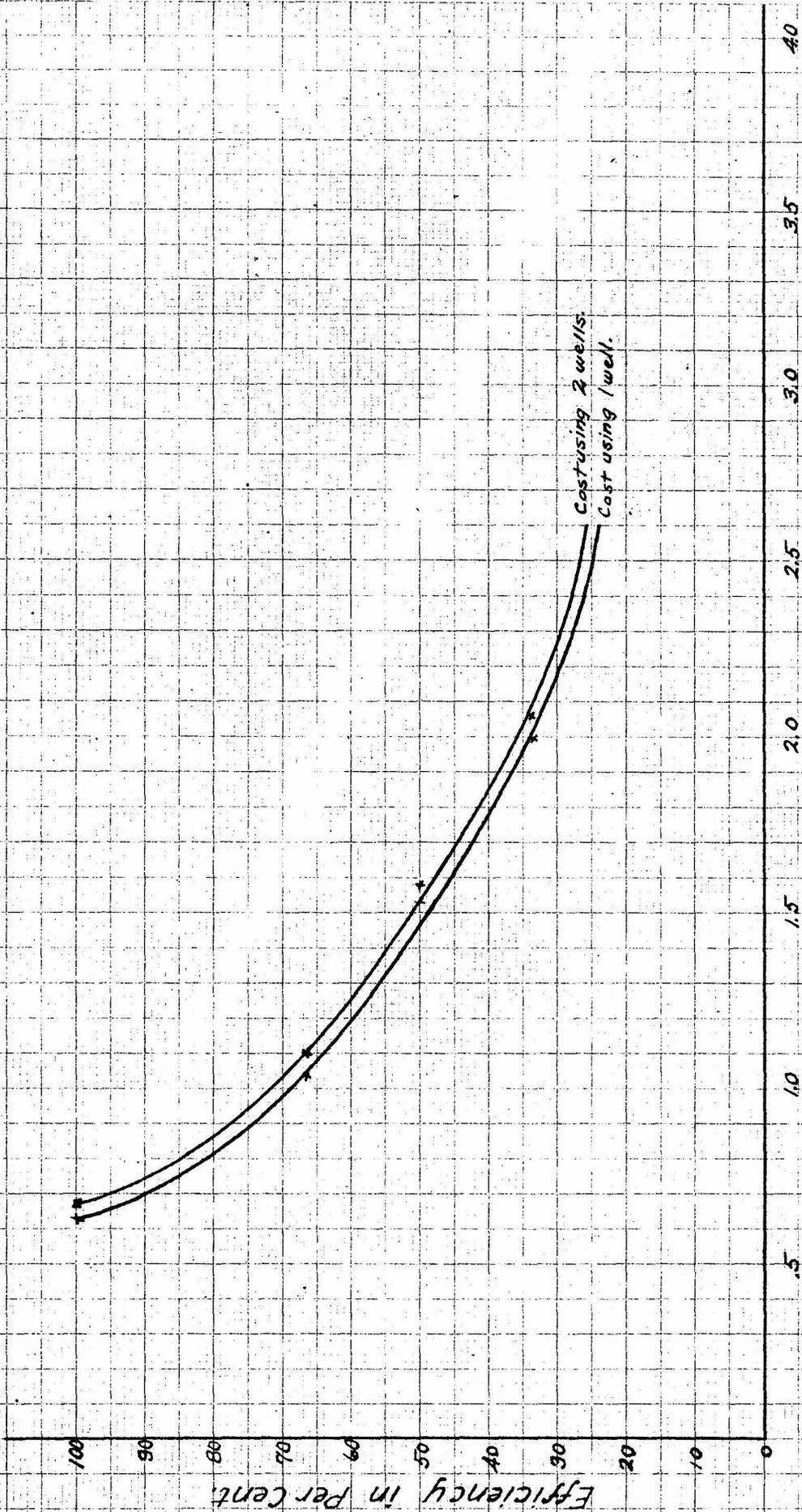
Operating expenses per year	1 man	\$1,000.00
	Assistant	200.00
	Oil, waste, etc.	25.00
	Overhead	400.00
	Incidentals	175.00
	Total	\$1,800.00

Costs, using one well	33-1/3% Eff.	50% Eff.	66-2/3% Eff.
Building	\$1,000.00	\$1,000.00	\$1,000.00
Well	1,700.00	1,700.00	1,700.00
Pumps	1,600.00	1,600.00	1,600.00
Transformers	3,000.00	2,250.00	1,500.00
Motors	4,400.00	3,000.00	2,400.00
Total Investment	\$11,700.00	\$9,550.00	\$8,200.00
Interest and taxes at 7%	819.00	668.50	574.00
Depreciation at 5%	585.00	477.50	410.00
Operation, exclusive of power	1,800.00	1,800.00	1,800.00
Cost of power required at \$.01 per K.W. Hr.	54,800.00	41,100.00	27,400.00
Total yearly expenses	\$58,004.00	\$44,046.00	\$30,184.00
Total yearly expenses	58,004.00	44,046.00	30,184.00
Thousand gallons produced	2,910,000	2,910,000	2,910,000
Total cost per 1000 gallons	.01995	.01514	.01037

Costs, using two wells	33-1/3% Eff.	50% Effic.	66-2/3% Eff.
Buildings	2,000.00	2,000.00	2,000.00
Wells - 6'x5'x170', \$5.00 lining - \$3.00 digging	2,400.00	2,400.00	2,400.00
Pumps	1,600.00	1,600.00	1,600.00
Transformers	3,000.00	2,250.00	1,500.00
Motors	4,400.00	3,000.00	2,400.00
<u>Total Investment</u>	<u>\$13,400.00</u>	<u>\$11,250.00</u>	<u>\$9,900.00</u>
Interest and taxes at 7%	938.00	787.50	693.00
Depreciation at 5%	670.00	562.50	495.00
Operation exclusive of power, \$1800 each	3,600.00	3,600.00	3,600.00
Cost of power at \$.01 per K.W. hr.	54,800.00	41,100.00	27,400.00
<u>Total yearly expenses</u>	<u>\$60,008.00</u>	<u>\$46,050.00</u>	<u>\$32,188.00</u>
Thousand gallons produced	2,910,000	2,910,000	2,910,000
Cost per 1000 gallons	\$.0206	\$.0158	\$.01106

Curve Showing Variation of Cost of Pumping with Efficiency

Drawn from Data on Previous Page.



Total Pumping Costs per 1000 gallons against a Head of 200 feet.

APPENDIX C

DATA ON UNDERGROUND WATER LEVEL.

Pasadena Underground Water Level

Date	1	2	3	4	5	6	7	8	9
1-22-10	973.95	965.93	750.40		712.16	712.14	692.26		
6-17-10	973.95	962.43					693.76		
11-10-11	963.95	957.93	745.40		701.68		692.26		
1-20-12	967.65	964.03	749.10	750.71	706.71	707.67	692.56	746.37	
1-21-13	963.98		743.1			707.8			
2-13-13	963.75	961.13	743.5	743.66	705.18	707.8	686.	741.52	
3- 4-13	966.75	964.88	744.1	744.21	706.28		686.8	743.81	
4-3- 13	969.55	967.93	744.7	745.01	690.98	680.1	685.7	743.02	
5- 7-13	967.63	963.63	738.4	716.61	703.48	703.8	683.8	742.22	
6- 4-13	965.65	959.73	741.4		698.98	700.8	683.1	741.42	
7- 2-13	964.15				698.18	699.1	681.8	740.07	
8- 4-13				742.01	688.18	692.1	681.2	739.22	
9- 2-13	959.15	952.23				695.1		735.32	
10- 3-13	957.75	940.13						733.12	

Elevations are above sea level.

Date	9
6-17-10	719.53
11-10-11	715.73
1-2-12	718.03
1-21-13	714.13
2-13-13	714.83
3- 4-13	715.73
4-3-13	715.83
5-7-13	714.73
6-4-13	713.43
7-2-13	712.43
8-4-13	710.93
9-2-13	710.63
10-3-13	708.73

1 - Casitas Ave. Upper Well, North Pasadena Land and Water Co.
 2 - Sheldon Lower Well, North Pasadena Land and Water Co.
 3 - Copelin Steam Well, No. 1
 4 - Copelin Motor Well, No. 2
 5 - Ohio Street West Well
 6 - Ohio Street Middle Well
 7 - Franklin Well
 8 - Sheep Corral Well
 9 - Ritzman Well

Water-Level of Pasadena's Underground Basin
 Compiled from data furnished by Mr. Morris of City
 Water Department.

Date	Feet to water									
	1	2	3	4	5	6	7	8	9	
1-22-10	124	74	158	---	31	28.9	76.5	---	---	---
6-17-10	124	77.5	---	---	---	---	75.3	---	---	37.1
11-10-11	134	82.0	163	---	41.5	---	76.5	---	---	40.9
1-20-12	130	75.9	159.3	159.7	36.5	32.4	76.3	34.5	---	38.6
1-21-13	134	---	165.3	---	---	32.3	---	---	---	42.5
2-13-13	134.2	78.8	164.9	166.8	38.	32.3	83.3	39.1	---	41.8
3-4-13	133.2	75.1	164.3	166.2	36.9	---	82.5	36.8	---	40.9
4-3-13	128.4	72.	163.7	165.4	*60.	*60.	83.6	37.6	---	40.8
5-7-13	130.1	76.3	170.	+193.8	39.7	36.3	95.5	38.4	---	41.9
6-4-13	132.3	80.2	167.	---	44.2	39.3	86.2	39.2	---	43.2
7-2-13	130.8	---	---	---	43.4	39.6	87.5	40.6	---	44.2
8-4-13	---	---	---	---	---	46.6	88.1	41.4	---	45.7
9-2-13	136.8	87.7	---	168.4	53.4	49.6	---	45.3	---	46.
10-3-13	140.2	99.8	---	---	---	---	---	47.5	---	47.9
2-1-11	134	76.1	165.1	---	---	---	---	---	---	---
12-18-09						36.6	---	---	---	---
1-27-11					34.6	39.2	---	---	---	---
Elevating										
Bench Marks	1097.95	1039.93	908.40	910.41	743.18	740.10	769.30	760.62		756.63

Feet above sea level

+ Two days pumping
 * Four " "

- 1 - Casitas Well
- 2 - Sheldon Well
- 3 - Steam Copelin Well
- 4 - Motor Copelin Well
- 5 - Ohio Street West Well
- 6 - Ohio Street Middle Well
- 7 - Franklin Well
- 8 - Sheep Corral Test Well
- 9 - Ritzman Well

APPENDIX D

COMPLETE DETAILED REPORT OF THE WATER
SITUATION, BY FORMER CITY ENGINEER MOODY,
MADE TO THE MAYOR AND BOARD OF WATER COM-
MISSIONERS, MAY 3rd, 1913.

Office of Chief Engineer,
Water Department, Pasadena,
May 3rd, 1913.

To the Honorable Mayor and Board of Water Commissioners,
Pasadena, California.

Sirs:

On the first of November, 1912 when the hopes and efforts of a decade and a half were realized, and the people finally owned and had come into possession of the waterworks and water supply, it marked an epoch in community history of Pasadena.

EARLY CONDITIONS AND PROBLEMS.

The Board of Water Commissioners were then confronted with a great and grave responsibility. The systems as acquired while worth the money paid, were without many of the essentials of a waterworks fit to serve a community of 40,000 people, to say nothing of keeping pace with the constant needs of the growth of population.

Many problems involving financial, constructive and engineering principles immediately pressed for solution.

The systems were without constructive harmony, either collectively or individually.

The distribution system was exclusively makeshift in kind -- where expediency alone governed.

There was no such thing as system, either as a whole or in detail.

Ordinary repairs, replacements and betterments had been

neglected for a long period pending settlement of the future.

Only patience, stamina and a courageous regard for ultimate benefit to the people as a whole, with a clear, keen vision of the future, has characterized the policy and attitude of the Board of Water Commissioners.

This has made it possible, as nothing else could, to carefully, patiently and persistently bend every effort,

First: to whip into effective shape, or lay foundation for, a keen efficient business and operating organization--to follow conscientiously the plan of so carrying on the work that at all times there shall be a proper accounting of the public funds. While we are carrying the cost keeping and accounting as far as seems to be proper now, as the work enlarges, additions to our accounting system can be made from time to time.

Second: To keep up with the ordinary demands of the day for improvements and extensions designed to relieve waiting needs.

Third: To concentrate at once every force and every item of available funds to correct, stop or permanently eliminate the gross errors which cost annually so much to maintain or operate.

Fourth: To conserve water, effort, money, labor, everything. To correct abuses, to eliminate sources of complaint, to cut out special privileges of a few, the expense of which privilege is met by the balance of the consumers, to point out to consumers ways of saving and to otherwise attempt to make the Department a truly co-operative community business.

To do these things successfully has called for unusual and great expense. But business judgement will confirm the fact that this should have been the first and earliest investment and at almost any cost, because the benefit to the net revenue is for all time.

Large sums have been spent to save water, which is wasted expense. This item alone has cost large sums of course, and with no apparent benefit as yet, because the winter months is the season of gravity water. The direct saving during the coming pumping season will return large amounts for the funds invested.

Fifth: To unify the three systems thus inherited so as to equitably distribute the benefits of the municipally owned system among all customers.

Sixth: To safeguard our supply. This has taken many forms of activity, like cleaning up the arroyo and other grounds, to remove possible sources of contamination, to conserve the water and water shed, to repair and "trim up" for the season's use the pumps and wells.

The demands for water have now grown to such proportions that for many months in the year, the pumped water supply is the important source of supply and the gravity supply becomes an auxiliary. The annual operating expense for pumped water has grown to enormous proportions, and it took but a preliminary view to determine that the responsibility of the Water Commissioners in respect to safeguarding the supply by placing these plants in proper condition must be met.

Seventh: To immediately initiate such proceedings as would furnish all essential data regarding the sufficiency of our present supply. Certain data now being collected, as well as a cold dispassionate review of the physical facts concerning the past two years production of water, early indicated and now proves beyond doubt that a calm study of the entire question, without prejudice, and without bias, should be undertaken and pressed to conclusion.

FUTURE PROBLEMS.

When a thoughtful engineer talks of water supply for a municipality in any state or locality, he does not speak in terms of today or tomorrow or of a year or ten years. Especially must this be so in a locality semi arid in character.

Water supply does not mean "what are we using today?" It means supply, - not immediate use. What, then is our supply, speaking of course in terms of all time?

The very insistence of an adequate supply by some of our people, and the denial by others has now raised a doubt or created a disturbance of the public mind. It is due as a very first duty to our city that the Department continue the study and initiate new investigation to present in detail to the people, all and every essential data, carefully and painstakingly collected and collated, to the end that they, the people themselves, can know the truth and form their own conclusions. All these things enumerated have been initiated by the department already.

The review of activities above indicates, in a degree, the problems for the future. But still other problems are of such extent and so involve the future success of the department and the prosperity of our city that a statement covering this may await another opportunity.

However, the greatest problem has been and will continue to be the administrative work of the Department itself. It is one thing to care for a completed modern water works system in a city without progressive history. It is a far more serious responsibility

to carry forward the work in this department. To take hold of a "sheet pipe" system, insufficient in capacity, and almost indecent in character, consisting of 165 miles of mains, and with but limited funds available; to gradually rebuild and reconstruct a little here and a little there, each month made to show an advance in character of construction as well as in improved service, so as to finally realize the fruits of a steady purposeful policy, surely calls for stamina, broad judgement and engineering vision.

POLICIES ESTABLISHED BY THE
BOARD OF WATER COMMISSIONERS

To sum up the broad general policies adopted by this Board of Water Commissioners there is offered the following:

1. A schedule of rates was devised which was recommended to and passed by the City Council wherein without any material, if any increase in the gross revenue obtained, the burden of supplying these revenues by the rate payers was shifted with the object in view of providing a uniform water rate throughout the city and to distribute the burden in a more equitable manner as between the different classes of consumers.

2. The establishment of the policy of preserving the water supply from contamination at all hazards; and cleaning up the sources of supply both gravity and pumped water, in order that the appearance of the premises may be maintained cleanly in appearance as well as in fact.

3. The initiation of the policy of opening the lands controlled by the water department for the use of the people

as recreation parks as far as the same can be done consistent with the primary purpose of controlling the lands, which is the preservation of the water supply from contamination or diminution.

4. The endeavor to make an income in as large a degree as possible from the lands that could be properly spared for purposes of lease, etc.,

5. The establishment as early as possible of the practice of gathering data which will have a bearing on our future water supply -- its possibilities and its limitations.

6. The carrying out in definite and concrete form the and at/least possible expense consistent with using **such** improvement as a part of the permanent distribution system, the equalization of pressure and unification of the three water systems acquired.

7. The establishment on a firm basis, the principle that all work done and performed shall, in its specifications and practice, work in and be a portion of a modern distributing system for the city of Pasadena.

8. Meeting the demands for extensions as far as possible and without denying the needs of present customers.

9. Repairing or replacing such structures as may need replacing, such as the pumping plants and wells, with work of a permanent nature and with the end in view of economical operating.

10. Establishment of the principle that where replacements of old or inadequate mains are demanded in certain streets and the lack of funds or promise of immediate revenue does not justify the expense, to allow the property holders living on such

streets to advance to the Department funds necessary for such improvement, the same to be returned to them through crediting water rentals.

11. Establishing the principle that in unsubdivided areas not now served with water by the water department, the city will furnish water to such tract provided the mains were installed in conformity with the requirements, specifications and the practice of the water department, in order that such additions to the system may not become a liability rather than an asset to the city.

12. To recognize the principle that to provide fire protection is not absolutely the function of the water department but that such duty belongs to the department of fire service and that as fast as funds derived from rate payers alone are spent for the purpose of installing new mains and providing the diameter of such mains is increased by reason of the desire to furnish fire protection that the increased cost due to such protective measure should be returned to the department through the means of hydrant rental or otherwise, and through the agency of the general fund instead of having all of this expense met by the rate payers alone.

13. To establish the water works as a modern business organization, efficient in character and with methods of accounting such that the citizens may have a full knowledge of the expenditures of the public funds.

With this preliminary review of the problems confronting the Board of Water Commissioners on November 1, 1912, there is handed you the Classified Cumulative Summary of Receipts and Transfers -- Water Department from October 31, 1912 to March 31, 1913.

Following this is a statement prepared by Mr. W. Selbie, Chief Accountant, after a full and exhaustive analysis by him and by the Chief Engineer of the accounts from the inception of the transfer of the properties of the three water companies on November 5, 1912 and entitled SPECIAL STATEMENT of Actual Working Expenses and Fixed Charges for Operation Only.

CUMULATIVE CLASSIFIED SUMMARY OF RECEIPTS AND TRANSFERS -

WATER DEPARTMENT

From October 31, 1912, to March 31, 1913.

COLLECTED:

Water revenue	\$62,272.94
Permits	165.17
Services	1,362.47
Service and meter changes	47.50
Sand and Gravel sold at Devil's Gate ..	327.79
Rents	48.90
Sundry sales and receipt	19.21
On and off charges	2.50
Total collections on ordinary operations	<u>64,246.38</u>
Accounts collected labor and material .	623.16
Realized March 28 from sale of part of South Pasadena Reservoir site	7,330.50
Collected from Washington Street Extension, Contract #1	284.14
Collected from Rio Grande Extension Contract #2	<u>425.27</u>
Total deposits with city treasurer	72,909.45
Transfer from "Bonds Funds" by order City Council March 11, 1913, to cover cost Raymond Ave. extension	6461.60
Transfer from City General Fund Dec. 5	5,000.00
Credit Old Dry Tract Account	<u>2,902.37</u>
	87,273.42
Accounts payable not yet due	1,176.27
Transfers, Miscellaneous	<u>60.47</u>
	88,510.16

CUMULATIVE CLASSIFIED SUMMARY OF DISBURSEMENTS AND TRANSFERS

WATER DEPARTMENT.

From October 31, 1912, to March 31, 1913, as detailed on P. 3

Demands No. 1 to 289 inclusive, - Pay rolls 1 to 53 inclusive

GENERAL EXPENSE ACCOUNTS, Detail Page 3 \$14,016.30

OPERATION

Gravity	1,068.73	
Pumping	3,319.48	
Distribution	<u>3,760.01</u>	
Total	8,148.22	8,148.22

RENEWALS AND REPAIRS

Gravity	1,301.00	
Pumping	3,721.07	
Distribution	<u>5,810.84</u>	
Total	10,832.91	10,832.91

NEW CONSTRUCTION

Gravity	55.02	
Pumping	314.52	
Distribution	<u>18,103.79</u>	
Total	18,473.33	18,473.33

EQUIPMENT

Office	1,352.77	
Engineering	297.75	
Vehicle	488.34	
Gravity	1.40	
Pumping	20.70	
Distribution	<u>238.16</u>	
Total	2,399.12	2,399.12

Material in warehouse not distributed ... 5,636.75

Total ad detailed on page 3 59,506.63

CUMULATIVE STATEMENT WATER DEPARTMENT
DISTRIBUTION, OPERATION, RENEWALS AND REPAIRS
 From Oct. 31, 1912, to March 31, 1913.

<u>GENERAL EXPENSE ACCOUNTS</u>	<u>Labor</u>	<u>Material</u>	<u>Total</u>
Office salaries	3,605.81		
Office indidentals		568.61	
Stationery and printing		886.64	
Engineering and maps	1,809.58	107.29	
Collection expense	1,189.03	535.33	
Commissioners' salaries and exp.	670.00	232.30	
Management	1,770.00		
Live stock	98.30	150.40	
Auto and motorcycle maintenance and operation	203.77	990.64	
Warehouse expense	564.91	50.99	
Fire and liability insurance ..		582.70	
	<u>9,911.40</u>	<u>4,104.90</u>	14,016.30
 <u>WATER SUPPLY - GRAVITY</u>			
Operation	1,040.20	28.53	
Renewals and repairs	1,248.20	52.80	
New construction	36.90	18.12	
Equipment		1.40	
	<u>2,325.30</u>	<u>100.85</u>	2,426.15
 <u>WATER SUPPLY - PUMPING</u>			
Operation	1,238.72	2,080.76	
Renewals and repairs	2,413.74	1,307.33	
New construction	74.86	239.66	
Equipment		20.70	
	<u>3,727.32</u>	<u>3,648.45</u>	7,375.77
 <u>WATER DISTRIBUTION</u>			
Operation	3,632.53	127.48	
Renewals and repairs	4,238.67	1,572.17	
Construction, street mains	3,539.98	6,955.22	
" services	1,546.83	3,641.92	
" fire hydrants ...	28.97	262.64	
" buildings	849.15	1,278.88	
Equipment		238.16	
	<u>13,836.13</u>	<u>14,076.67</u>	27,912.80
 <u>EQUIPMENT - GENERAL</u>			
Office		1,352.77	
Engineering		297.75	
Vehicle		488.34	
		<u>2,138.86</u>	
WAREHOUSE STOCK ON HAND			<u>5,636.75</u>
			59,506.63

SPECIAL STATEMENT OF ACTUAL WORKING EXPENSES AND

FIXED CHARGES ON OPERATION ONLY.

For November and December, 1912, and January, February, and March, 1913.

This embraces all the actual operating expenses for the above period of five months; also flat rate water earnings for same time, but owing to the Department changing time of commencing meter reading from 26th to 10th of the month, the meter water receipts in this statement fall short about 10 days of being for full five months, or about \$3,500.00.

RECEIPTS.

Collections as per cumulative report of March 31st on ordinary operation		\$64,246.38
Later bills as charged on meter reading (average date March 15) and entered on ledger in April	12,324.95	
Uncollected water bills March 31 ...	<u>2,389.87</u>	
	14,714.82	
Deduct estimate for bad or vacant accounts	<u>350.00</u>	<u>14,364.82</u>
		78,611.20
Less refund on services and permits		<u>89.16</u>
Gross earnings for five months less 10 days on meter water as detailed above ..		78,522.04

EXPENSES.

These cover all the items chargeable to this statement in the Cumulative Report of March 31st, and also all disbursements made on these accounts in April for material furnished in March.

EXPENSES ON GENERAL ACCOUNT.

These include all salaries and incidentals of the office, of the Engineering and Collection Departments, Commissioners and Superintendent,

maintenance of vehicles, and live stock, as also proper proportion of money paid for stationery and printing, and for in- surance, fire liability	13,122.66	
All expenses in full of the gravity, pumping and distribution systems,		
For operation	8,561.09	
For renewal and maintenance	10,858.59	
Also proper pro rata expense of the new equipment purchased for all departments .	<u>394.89</u>	32,937.23
Surplus earnings on operation for period above stated		45,584.81
From which deduct		
Interest on bonds for five months	23,437.50	
Sinking fund " A/c " " "	<u>4,166.66</u>	<u>27,604.16</u>
Net earnings		17,980.65

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It will be noted by the statement preceeding, en-
titled "Special Statement of Actual Working Expenses and Fixed
Charges for Operation Only", that the gross income for the five
months period less the ten days of metered water as noted in
. \$ 78,522.04
and that the expenses aggregate 32,937.23
leaving the surplus earnings on operation for the period 45,584.81.
After deducting interest on bonds for 5 months as well as sinking
fund amounting to \$27,604.16, there is a net earning of \$17,980.65.

RATIO OF SURPLUS EARNINGS TO GROSS INCOME

It is particularly interesting to note that the ratio of the surplus earnings of operation to gross income thus far is 58% which is about 12% greater profit than was assumed under private ownership in the early analysis of the entire question prior to the acquirement of the plants. It was expected at that time that the gross earnings would be \$225,000 with a net earning of \$103,000, the ratio of profit to income being 46%. While it is true that the operating expenses due to pumping water during the summer will be somewhat heavier than during the past five months the necessary expenses for repairs and renewals will be considerably less. In other words the ratio of the net profits to gross income will probably be somewhat higher than in the past.

DISCUSSION OF "SURPLUS EARNINGS ACCOUNT".

You will readily understand that the book account exhibited herewith cannot represent accurately the true financial result of the operations of the department for the period named for the following reasons. The properties of the three water companies now making up the municipal system, together with the dry tract division were taken over upon a valuation of the physical and other properties and as a preliminary in so doing and as a basis for the purchase price paid, detailed study was made of all the elements entering into the valuation of such properties, and

there was determined in general: (a) The present worth or cost, (b) the estimated total depreciation of the systems up to the time of taking over such plants, (c) the present valuation based upon the elements above named.

Any proper account of the net results of operations for the period set out in this report, namely five months, ending March 31st, must necessarily take into account the expenditures for Operating the System, Renewals and Repairs, Interest and Redemption Fund and Depreciation of System. Operating the system is very liberally accounted for in the above, leaving no doubtful accounts out. Renewals and Repairs Account is presumed to cover the depreciation which the system suffers from day to day and from month to month from various causes as well as ordinary repairs. Based upon the purchase price in the, at that time, "present worth of the property", any accurate statement of the result of municipal ownership for the period named can be obtained only by revaluing the same property to take account of the depreciation which the plant has suffered since the time of purchase but crediting thereto all sums expended for Renewals and Repairs, the same being in the nature of things the sum expended to check further depreciation or replace such portions as may be required by reason of such depreciation. If the revaluation of the properties were made with the result that the funds spent by the department during this period of operating have, in the net, lessened the normal depreciation for the period, a proper credit should be made and the true financial result would in a degree show more profit than the mere book profit exhibited.

It is now known of course that the rate of depreciation as determined last year and as assumed herein is set at an exceedingly liberal figure, especially in view of certain constructive work undertaken within this last three months. It should also be remembered that the character of the construction and other class of work done, chargeable to "Renewals and Repairs" during the past six months have been such, that, in some item, not only has the actual accumulated depreciation to date been corrected and the property brought back to its value new, but also in some important respects, the annual rate of depreciation for all future time has been lessened because of the high grade of work performed. It should likewise be remembered that in determining the true result of ownership and operation of the property for the past six months, if the depreciation for the elapsed period has been charged against the account there should be taken into account also the appreciation of such portions of the investment as have actually enjoyed that benefit. That there has been a distinct and decided appreciation in some of the properties is evinced by the sale of the portion of the South Orange Grove Avenue reservoir site. This property was valued and purchased on a basis of \$5,000. A little over half of the reservoir site, a portion useless for such purposes, to the department, was sold for \$7330.50, a very striking instance of appreciation in contrast to depreciation experienced in some perishable portions of this system. However, it does not seem wise at this time to take account of any unrealized

appreciation due to rise in land or other valuation, although it might be assumed that the realized profits could be used. However, the statement and estimate of the Chief Accountant does not credit to profits the realized appreciation noted above. On the other hand from our knowledge acquired during the period when studying the water system, it can be assumed that the maximum depreciation which the system has suffered for the five months is well covered by the Repairs and Renewals account for the period, being over 3% per annum on all classes of property except real estate. Specific account has not been taken of "Loss of Taxes" to the city, which is a proper charge. On the other hand it should be noted that the mean average time of meter reading has been advanced ten days for convenience in operating, and therefore the gross income does not cover a period of full five calendar months -- the deficiency in revenue on that account being about \$3500.00.

It is not possible to embrace these earnings for the corresponding charges at this time so as to cover the full period of six months. The collectible revenue in May from Water earnings is that due to April consumption and likewise it becomes impossible to embrace the April earnings so as to make the report cover six months. It may be stated however, that the gross collectible revenues from water sales for the month of April will make a somewhat better showing than for the five months covered by this statement. The increased consumption for the month of April is 30% over the preceding months. In addition to the above there is also due the Water Department by the City Fire

Department an unadjusted chargeable account of about \$4000 for fire hydrant service.

In summing up the entire analysis of the account we are of the opinion that the financial result of operation for the period named as estimated is closely shown by the result above.

EXTRAORDINARY EXPENSES.

In discussing further the statement showing the net operating profit for the period of 5 months it must not be forgotten that this period covers the first organization of the department with all the attendant expenses naturally incident thereto. This period of 5 months also covers a time within which the department has, by the expense shown, caught up with over a year's neglected repairs. This 5 months period likewise covers a time when what may be called "seasonal repairs" must be met no matter what sacrifice is made, as it is the only time of year when such things can be done -- repairs on pumps and wells, reservoirs and conduits and the like. It is also a period for making repairs to the gravity works generally. It also covers the period of low income.

For instance, it will be noted that the gross income during the period named -- that is, from November 1, to March 31, which is five months, is \$78,522.04, which are the months of low consumption of water. A total gross annual income for a period of 12 months will, it is estimated, aggregate over \$230,000. based on the present rate and the increase in

consumption over the preceeding year. At the same time that the months of heavy income arrive there will also come a period when these heavy seasonal repairs will have been completed and the expense met. In other words, had the department taken possession of the three water plants in the spring it would have had the enjoyment of several months of heavy income which could have been conserved to use during the period of uncommon and heavy seasonal expense. It should be further remembered that very considerable sums of money have been spent and charged to repairs and renewals which because of the character of such repairs and renewals will result during the summer pump season in considerable larger net income over and above expenses than would have been possible had these repairs not been made. The heavy seasonal expenses have now drawn to a close at the end of this month and it is now possible and entirely proper that a surplus be laid up during the coming seven months to make up for the use of revenues which it was absolutely necessary to spend during the past five months and thereby have the funds during the next low income-heavy repair-season, to care for such work.

Unusual expenditures have been and must continue to be made for some weeks yet to obtain proper records of the property in the Engineer's office. The absence of such records adds to the expense of operating as well as renewals and repairs.

BOND FUNDS ACCOUNT

Attached hereto and following this explanatory statement is a statement as to bond fund, Water Department, April 28, 1913. In explanation of this, please allow us to say that to the funds realized from the sale of the bonds, it is shown there has been added the sum of \$7330.50 being for the sale of a part of the South Pasadena reservoir site. Further, these bond funds have been held strictly for the purpose for which they were intended, namely: to unify and make a good working unit of the three water systems as purchased; to correct certain low pressure zones characteristic of operations under private ownership and to improve so far as possible the northeast section of the city. No part of the funds derived from the bond issue or added thereto by sales of property have been used for any other purpose but have been held solely for the purpose mentioned above. But from this account there has properly been withdrawn the sum of \$6461.60 as a transfer for the payment of the Raymond Avenue extension, to improve the Mountain Street low pressure zone of the Lake Vineyard system. All other betterments designed to effect relief have so far been paid out of the operating funds for the reason that the sum seemed small at best for the purpose intended. However, a further improvement has now been authorized which will cost approximately \$20,000. and which will increase the pressure zone of the old west side system and afford

the much needed relief to that territory. Still a third sum has been recommended by the Board of Water Commissioners, amounting to about \$1500 for the relief of the northwest section by the purchase of that portion of the Las Flores Water Company that lies within the city limits. These improvements were specifically promised to be made and the payment for same was to be made out of the funds in excess of requirements for purchase of the old water companies. Please note again that the Water Department did not use any of these funds for the working capital but borrowed from the general fund of the city for that purpose and it has in whole, or in part, been paid back at the present time.

Not all the interest on the bonds or sinking fund have been met out of current revenue during the period named for the reason that certain repairs and replacements were absolutely demanded at this season of the year and which could not be deferred. You who are acquainted with the condition of some of the pumps and wells can strongly appreciate that fact. Also the period named covered the extraordinary expense incident to outfitting and organizing the Department, to catching up with long neglected repairs and of working fund for operating duties. Referring again to the bond statement also attached hereto, it will be noted that the sum actually set aside for the same period amounts to \$11,041.66. The difference between these sums set aside and that applicable as fixed charge has been spent for

extraordinary repairs, renewals and in part for new construction which was made necessary by reason of certain conditions impossible to avoid by the department. The great activity in street improvement during the past period of five months resulted in a number of cases, in so changing the grades of the streets in South Pasadena, in the county north of the city limits and in Pasadena that the water pipes were left ploughed out of the grounds. In spite of any inclination on the part of the Board of Water Commissioners to defer all unnecessary expense, this condition per force had to be met, and with the result that the deficiency above stated is expected to be made out of the greatly increased gross earnings for the coming 7 months. There will be no difficulty in doing this unless something very unusual and unexpected arises. However, the appended tables and other statistics will show for what improvements or accounts these monies have been spent.

Here follows the Bond Statement:

STATEMENT AS TO BOND FUND

WATER DEPARTMENT, APRIL 28, 1913.

Amount realized from sale of Bonds:

Face of Bonds	\$ 1,250,000.	
Accrued interest	3,125.	
Premium	511.	
Total charged to Auditor a/c Bond sales		<u>1,253,636.</u>

and same is charged to various accounts with Auditor, as follows:

To "BOND FUNDS" account with Auditor \$1,250,000.00		
"BOND FUNDS" account is then credited with amounts paid for "ORIGINAL PURCHASE" and additions thereto from May 1, to Oct. 31, '12, amounting to		1,219,572.04
And with Transfer to Department "GENERAL ACCOUNT" with Auditor for Raymond Ave. Extension as per order of City Council March 11, '13.		6,461.60
On March 28 there is a further charge to this account for amount realized from sales of part of South Pasadena Reservoir site and credited to "ORIGINAL PURCHASE", same being transferred from General account ...		
	<u>7,330.50</u>	
	1,257,330.50	<u>1,226,033.64</u>
Leaving a balance at Water Department credit in "BOND FUNDS" a/c with Auditor		31,296.86
"PREMIUM ON BONDS" a/c is with Auditor charged with premium realized on bond and Water Department has credit on this account	<u>511.00</u>	<u>511.00</u>
"BOND INTEREST" a/c with Auditor is charged with amount realized for accrued interest	3,125.00	

And this account is further charged for transfers from "GENERAL ACCOUNT" c/o Water Board, Feb. 24 and March 24	<u>9,375.00</u>	
Making a total credit for Department in "BOND INTEREST FUND" of		12,500.00
Department "BOND SINKING FUND" a/c with Auditor has a credit also for transfers from Auditor's "GENERAL ACCOUNT" by order of Water Board Feb. 24 & March 24		1,666.66

It is to be regretted that the costs of all the various items and departmental work, as well as cost analysis cannot be given at this time. But the limited time available before the present Board of Water Commissioners retire will not permit.

Such matters can better be developed at the end of the fiscal year.

Respectfully submitted,

Superintendent and Chief
Engineer.

The following tables show

NEW CONSTRUCTION

embracing

INSTALLATION OF SERVICES AND METERS

"	"	FIRE HYDRANTS
"	"	STREET DEPARTMENT SERVICES
"	"	SEWER FLUSH TANK SERVICES
"	"	BUILDINGS AND OTHER STRUCTURES
"	"	MAINS

Together with other statistics showing volume and character of
business for operating period November 1 to April 28, 1913.

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Note:- Other construction work and expense paid out of Bond Funds
to various companies as "betterments" not included.

ENGINEERING DEPARTMENT.

This Department is energetically supplying missing records of the underground and other properties of the Department. This was never carried on in any adequate way by the private companies, and for this reason all of the work has to be done now, for the years in the past when no records were kept of construction placed beneath the ground.

A map of the territory served by the Water Department is being compiled on 76 district sheets, 24" x 36" in size, to a scale of 100 feet to the inch. All of the above have been drawn.

Traced 49.

Yet to be traced 27.

On these maps the exact size and location of every main, valve, fire hydrant, flush tank, and service will/^{be} shown. Also the house number and service number of each service, and the job number of each main, thus serving as an index to the foreman's reports which are filed away and give all materials, labor and costs for each job.

When this work is completed, both field and office work will be carried on with a greater degree of efficiency and economy. The man in the office will be able to tell a customer the exact conditions for which he may be inquiring, and the man in the field will know just where to dig to make a connection.

Levels have been taken at the different wells in the Pasadena basin, and a systematic record of water levels kept.

Inventories have been made of the Woodbury water system, the Nazarene University water system, the El Molino Terrace water system, and the Las Flores water system.

A reinforced concrete garage, among other structures, has been built, following plans made by this Department, the details of which are given in another part of this report.

Beside the above special work this Department has carried on the regular routine work in mapping and surveying, and other reports.

Property lines have been run out in some instances for purposes of special information.

As soon as funds and time can be spared for the purpose, the remainder of property lines of lands belonging to the Department will be run out and the boundaries monumented. This is very important work, because of the confusion and discrepancies in old records and surveys.

Upon recommendation of the Chief Engineer the City Council has, by ordinance, required all utility companies to file maps showing the position of underground construction with all physical features included in detail, to the end that the City will hereafter require each utility company to occupy only certain specified portions of the street, while the City will reserve to itself, and for its own use, the south and west sides of every street. The result will be that the city will always have its own right of way for public uses, and the private utilities will benefit by a more orderly arrangement among themselves.

GRAVITY WATER DEPARTMENT.

The primary functions of the Gravity Department are the preservation of our gravity water supply from contamination, and protection of shrubbery which tends to retain the storm waters.

During the last six months this department has been very busy cleaning up grounds, tunnels, and reservoirs. The first work started was the cleaning up of the premises about Devil's Gate Supply, and doing away with underbrush which was a menace to pumping plant and other property. Signs and posters have been placed warning the public of the fact that our water supply is derived from this source and asking their co-operation in keeping grounds clear of papers and rubbish and in protection from fires.

Shrubbery was cleared away, roads and fire-breaks constructed and, as an incident, a park created at Devil's Gate, which makes an ideal roadside picnic spot.

During January and February a thorough cleaning was given the grounds around reservoirs, and flowers and shrubbery planted which will tend to beautify these places, although intended primarily to prevent washing of embankments.

The Bradford Street and Grand Avenue wells being no longer in use on account of contamination by cesspools, were filled and machinery and buildings removed. The lumber was used in the construction of a cabin in the mountains for use of our rangers.

It is the duty of these rangers to patrol the entire water-shed keeping the source of water clear of all rubbish and contamination, and warning all campers of the danger of forest fires.

During the month of April the cleaning of the Villa Street reservoir was accomplished. This reservoir, the largest of our system, had not been cleaned for the past seven years, and the Department realized the necessity of a thorough cleaning in order to keep the quality of our water up to the high standard now obtained.

This Department records each month the measurement of gravity flow and all other information available pertaining to the gravity water supply, its protection and preservation. It is hoped that complete sets of self-recording instruments for measuring our supply can be obtained this season.

The following table gives some statistics regarding the gravity water flow out of the canyon during the rain in the latter part of February up to, and including, March 3rd. This table indicates the volume of absorption by the sand and gravel from the time the water flows over the Upper Arroyo Dam until it passes the Sheep Corral Springs. You will note the remarkable diminution in the measurements at the upper and lower points.

FLOW OVER DAMS NAMED BELOW IN GALLONS PER MINUTE.

Feb.	24	at Devil's Gate, 5 P.M.	48,600
"	25	" " 9 A.M.	26,100
"	25	Arroyo 10 A.M.	34,300
"	26	Arroyo Upper Dam	21,200
"	26	Devil's Gate	18,630
"	26	Corral Springs	17,181
"	28	Corral Springs	7,380
"	28	Devil's Gate	11,079
"	28	Arroyo Upper Dam	16,281
"	28	Millard Canyon	3,240
March	1	Corral Springs	4,150
"	1	Devil's Gate	6,219
"	1	Arroyo Upper Dam	11,700
"	1	Millard Canyon	2,743
"	2	Corral Springs	3,105
"	2	Devil's Gate	4,383
"	2	Arroyo Upper Dam	7,560
"	2	Millard Canyon	2,265

March 3	Corral Springs	2,840
" 3	Devil's Gate	4,060
" 3	Arroyo Upper Dam	5,840
" 3	Millard Canyon	1,935

The sale of sand and gravel from the Arroyo lands belonging to the Water Department is also under the supervision of the Gravity system.

There has been \$336.79 collected.

PUMPING SYSTEM.

A resume of the work done on the Pumping System during the past six months shows a period of extraordinary repairs and renewals. Heavy pumping was done during November and December and part of January. In February and March practically no pumping was done, the Ohio Plant starting on the last day of March and working continuously during April. The following table shows clearly the pumping operation at the various plants during this six months' period, giving the number of hours pumped and the quantity in million gallons.

Pump	WATER SUPPLY - PUMP.									
	1912					1913				
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.				
	Hrs.	M.G.	H.	M.G.	H.	M.G.	H.	M.G.	H.	M.G.
Ohio Street	198	15.91	159	11.45	55.5	3.55	10	.65	245.5	15.9
Copelin Steam			232	28.19						
Copelin Motor	406	54.81	176	23.76	148	19.90			100.	13.5
Corral Spring	36	1.95							41.	2.21
Casitas Ave.	212	12.12								
Sheldon Ave.										
Devil's Gate										
	852	84.79	567	63.40	203.5	23.45	10	.65	386.5	31.61

SIX MONTHS

	<u>Hrs.</u>	<u>M. G.</u>
Ohio Street	668	47.46
Copelin - Steam	232	28.19
Copelin - Motor	830	111.97
Corral Springs	77	4.16
Casitas Avenue	<u>212</u>	<u>12.12</u>
	2019	203.90

The following table shows the maximum ten days' pumping during the six months just past.

"WATER SUPPLY-PUMP" MAXIMUM TEN - DAY PUMPING.

OHIO STREET WELL.

<u>Date</u>	<u>Hours</u>	<u>Gallons</u>
Nov. 20	2.5 ..	189,000
" 21	3.5 ..	264,600
" 22	7.	529,200
" 23	5.	378,000
" 24	8.	604,800
" 25	9.	680,400
" 26	9.	680,400
" 27	10.	756,000
" 28	7.	529,200
" 29	9.	680,400
	<u>70.</u>	<u>5,292,000</u>

COPELIN WELL

" 20	18	2,187,000
" 21	23	2,794,500
" 22	24	2,916,000
" 23	24	2,916,000
" 24	24	2,916,000
" 25	24	2,916,000
" 26	24	2,916,000
" 27	18	2,187,000
" 28	23	2,794,000
" 29	<u>24</u>	<u>2,916,000</u>
	<u>226</u>	<u>27,458,500</u>

CASITAS WELL

" 20	11	629,640
" 21	18	1,030,320
" 22	24	1,373,760
" 23	16 $\frac{1}{2}$	954,460
" 24	--	-----
" 25	18	1,030,320
" 26	24	1,373,760
" 27	24	1,373,760
" 28	17	973,080
" 29	<u>10$\frac{1}{2}$</u>	<u>601,020</u>
	<u>163</u>	<u>9,340,120</u>

Total 42,090,620 gallons, or 5,060,000 cubic feet.

Equal to 240 hours' continuous flow of 5.86 sec. ft.

" " 240 " " " 293 miner's inches.

The maximum 48 hours' pumping is shown in the following report.

"WATER SUPPLY-PUMP" - MAXIMUM 48 HRS. PUMPING.

			<u>OHIO STREET</u>	
<u>Date</u>		<u>Hours</u>		<u>Gallons</u>
Nov. 25	.....	9	.....	680,400
" 26	.....	9	.....	680,400
		18		1,360,800
			<u>COPELIN</u>	
Nov. 25	.....	24	.....	2,916,300
" 26	.....	24	.....	2,916,300
		48		5,832,600
			<u>CASITAS</u>	
Nov. 25	.....	18	.....	1,030,320
" 26	.....	24	.....	1,373,760
		42		2,404,080
			<u>CORRAL SPRINGS</u>	
Nov. 25	.....	18	.....	972,000
" 26	.....	12	.....	648,000
		30		1,620,000

Total 11,217,480 gallons or 1,495,664 cubic feet.

Equal to 48 hours' continuous flow of 8.6 second feet.

" " 48 " " " " 430 miner's inches.

As stated before, the renewals and repairs on the pumping system have been very heavy. This was due to the fact that very little work was done on the plants by the old companies. On account of lack of time and necessity for holding some plants in readiness in case of emergency, the heaviest repairing was confined to one plant, namely, the Copelin Steam Plant. This plant was given a complete overhauling and is now in shape to guarantee efficiency and safety. The boiler was relined and repaired and the engine was gone over thoroughly and put in first class condition. A new smoke stack was erected as the old stack had blown down because of weakness due to rust and age.

The old covering over belt was torn down and new belt house erected. A new derrick was erected of sufficient size and strength to handle the work required. On inspection the pump frame was found to be rotten in many sections and it was deemed advisable to replace the entire frame while the pump was being repaired by the makers. This work has been finished and pump replaced and it is now in first class condition.

The grounds adjoining the plant were cleared of all brush and rubbish and leveled. Water pipes were laid and the grounds are now in shape for planting or other work which will make this plant very attractive at a small expense.

An effort was made to recurb the Dry tunnel well, but efforts to dry this well proved futile and work had to be abandoned until a more propitious time.

The pump at Casitas Avenue was found to be out of line and in need of repairs and was taken out, repaired and put back in good condition.

The Corral Springs plant was also put in good condition and everything is now in readiness for the pumping season.

With the exception of a few minor repairs the Ohio Street plant was in good condition, and has been giving good service.

The advent of the pumping season finds all out plants in good serviceable condition and in readiness for heavy pumping, which is anticipated.

MACHINE SHOP.

The machine shop for general repairs is located at the Villa Street Reservoir. Most of the work is handled by one machinist, but at times when work is rushed, a helper is employed.

The machine shop has proven a convenient and valuable asset during the past few months. The machinist is also an expert auto repair man, and has given much satisfaction in repairing our machines. Besides the convenience, this has also resulted in a great saving of repair bills.

After the repair work was found to be successful, and had resulted in cutting down the cost of repairs, at request of the City Council, arrangements were made whereby this Department repairs the machines of all other City Departments, billing such Departments with the cost of the work. This arrangement has proven satisfactory to all concerned.

NUMBER OF SERVICES
FOR CONSUMERS IN SYSTEM.

Total number of domestic services April 30	10,532
Number of irrigation services	<u>105</u>
Total number of services April 30	10,637
Number of inactive services account of vacant houses, lots, etc.....	<u>414</u>
Total number of active consumers	10,223
Number of services Nov. 1, 1912	10,196
" " new services placed	188
Number of services not of record when taking over old companies	<u>253</u>
Total number of services April 30	10,637
Number of services being taken over from Las Flores System	<u>165</u>
Total number	10,802

Note:- Above table does not include special services for contractors, for flush-tanks, for fire or street hydrants, for other public or special uses.

Number of fire hydrants	475
" " street Department hydrants	38
" " flush-tanks	388
" " services for Park Department	76

NEW MAIN CONSTRUCTION

Since November 1st, 1912.

<u>Class of pipe.</u>	<u>No. ft.</u>	<u>Location.</u>
2" std. dipped	761 ft.	Idaho East of Lincoln to Crescent Ave.
"	309 "	Wyoming, West of Lincoln.
"	152 "	Summit, South of Grand View.
"	231 $\frac{1}{2}$ "	Fillmore, between Euclid and Los Robles.
"	280 "	Acacia, West of Glen Ave.
"	537 $\frac{1}{2}$ "	Kirkwood, North of Mountain.
"	277 $\frac{1}{2}$ "	Penn, West of El Molino.
"	255 "	Washington, West of Lincoln.
"	971 "	Washington, East of Lincoln.
	<u>3,774$\frac{1}{2}$</u> "	Total of 2" Std.
4" S. R.	72 "	Morton, North of Montana.
"	<u>75</u> "	Kirkwood, " " "
	147 "	Total of 4" steel riveted pipe.
4" Std. dipped	1245 "	South Orange Grove Ave.
"	358 "	Grevalia between Meridian and Prospect.
"	1880 "	Lincoln between Fair Oaks and Orange Grove.
"	1070' 7"	W. Washington between Forrest and Sheldon.
"	477' 8"	Kirkwood between Mountain and Hammond.
"	<u>325</u>	South Hudson South of Washington.
	5356' 3"	Total of 4" Std. Dipped.
4" Cast iron	610 Ft.	Lincoln from Forrest Ave. south.
4" " "	<u>514</u> "	Herkimer between Los Robles and El Molino.
	1164 "	

6"	cast iron	3957	ft.	Marengo Ave. between Dakota and Woodbury.
8"	"	1929	"	San Pasqual " Wilson and Hill.
12"	"	3264	"	North Raymond.

SUMMARY

2" Std. dipped screw pipe	3774 $\frac{1}{2}$ feet.
4" S. R. steel riveted	147 "
4" dipped Standard screw	5356' 3"
4" cast iron	1124 feet
6" cast iron	3957 "
8" cast iron	1929 "
12" cast iron	<u>3264</u> "
Total in feet	19,551 $\frac{3}{4}$ "
Total in miles	3.70

MAINS ACQUIRED BY PURCHASE, ETC.

<u>Street</u>	<u>Between</u>	<u>Size</u>	<u>Kind</u>	<u>Length</u>
Denver	Lake & E. City Bdy.	1½"	Std.	1000 ft.
Rio Grande	" " " " "	1½"	"	1075 "
Washington	Palm Ter. & Lake Ave.	1 "	"	700 "
Washington	Lake Ave. & Holliston.	2"	"	2800 "
Jackson	Madison & El Molino	1½"	"	300 "
Private prop.	El Molino & Lake Ave.	2 "	"	1400 "
Bell	Lake Ave. & Michigan	2 "	"	2100 "
Private prop.	Mich. & Bell & Hill	2 "	"	1400 "
Mountain	Wilson & Michigan Ave.	2 "	"	850 "
Mountain	Michigan & Hill Ave.	2 "	"	1200 "
Mountain	East of Hill Ave.	2 "	"	200 "
E. Orange Grove	Hill Ave. to Sierra Bonita	2 "	"	925 "
Private prop.	N. of Orange Grove, W. from Stevenson	1½"	"	200 "
El Molino	Jackson St. Alley, south of	2 "	"	200 "
Palm Ter.	S. of Belvidere	1½"	"	270 "
Hudson	Belvidere & Mountain	1½"	"	800 "
Hudson	S. from Washington	1½"	"	300 "
Lake	Bell & Mountain St.	1½"	"	550 "
Lake	Washington & Claremont	1½"	"	750 "
Lake	Curtis & Rio Grande	1½"	"	270 "
Mentor	Washington to N. end	1½"	"	830 "
Mentor	Bell St. & Mountain	1½"	"	600 "
Catalina	Denver & Washington	1½"	"	620 "
Catalina	Bell St. north	1½"	"	550 "

<u>Street</u>	<u>Between</u>	<u>Size</u>	<u>Kind</u>	<u>Length</u>	
Wilson	North from Bell St.	1½"	Std.	550	Ft.
Wilson	Bell St. to Mountain	2 "	"	650	"
Between Wilson and Stevenson	South from Mountain	1½"	"	780	"
"	" " "	1½"	"	270	"
Stevenson Ave.	" " Bell	2 "	"	500	"
Stevenson Ave.	Mountain & E. Orange Grove	2 "	"	1300	"
Mar Vista Ave.	N. of Washington St.	1½"	"	200	"
Chester Ave.	S. from Mountain St.	1 "	"	700	"
Holliston Ave.	N. of Washington St.	2 "	"	200	"
"	S. from " "	2 "	"	1650	"
Hill Ave.	N. of Washington St.	2 "	"	200	"
" "	Washington St. South	2 "	"	1400	"
" "	S. to Orange Grove	2 "	"	1330	"
E. City Bdy.	Mountain St. & Villa St.	2 "	"	2550	"
E. of Hamilton	S. of E. Orange Grove	1½"	"	500	"
Feed to Res.	Atchison & Fisk to Holliston & LaFayette	4 "	Riv.	4200	"
" " "	Holliston & LaFayette to reservoir and tank	3 "	Riv.		
	Reservoir to Washington and Wesley Ave.	2 "	Std.	1400	"
		6 "	Riv.	1700	"
Washington	Hill to Sierra Bonita	4 "	"	1093	"
Inskip St.	Sierra Bonita to Allen	4 "	"	520	"
" "	" " " "	1½"	Std.	290	"
Whitefield St.	Hill to Allen Ave.	4 "	Riv.	2080	"
" "	" " " "	1½"	Std.	250	"

<u>Street</u>	<u>Between</u>	<u>Size</u>	<u>Kind</u>	<u>Length</u>
Hill Ave.	Washington to Whitefield	4 "	Riv.	1675 ft.
Wesley Ave.	" " "	4 "	"	1675 "
Bresee Ave.	" " "	4 "	"	1675 "
Sierra Bonita	" " "	4 "	"	1675 "

SUMMARY

, 1" Standard pipe	1400 ft.
1½" " "	10955 "
2" and 3" " "	22255 "
4" Riveted "	14593 "
6" " "	<u>1700 "</u>
Grand total, all sizes	50903 " = 9.64 miles

D I S T R I B U T I O N S Y S T E M .MAINS LOWERED

1½"	std.	509	ft.	Kirkwood
2"	"	250	"	Marengo, north of Washington.
2"	"	60	"	Pepper St., west of Lincoln
2"	"	1324	"	Douglas between Los Robles and El Molino
2"	"	538	"	Kirkwood between Mountain and Hammond.
4"	riv.	250	"	Glen Ave.
4"	"	400	"	San Pasqual.
4"	std.	478	"	Kirkwood, between Mountain and Hammond.
4"	"	1300	"	Flower, Los Robles to Marengo.
4"	"	2500	"	Hill, between Villa and Colorado.

MAINS REMOVED

1½"	std.	509	ft.	from West Washington St.
2"	"	597	"	" Herkimer
2"	"	173	"	" Hill, north of Locust
4"	"	1324	"	" Lincoln, Fair Oaks to Orange Grove.

NEW BUILDING CONSTRUCTION

Concrete Garage	20' x 43"
Pipe Shed	12' x 24'
Addition to Warehouse	10' x 16'
Cabin in Mountains	12 x 14
Wagon Shed	18' x 32'
	Base.....
	10' x 12'
New Derrick - Copelin Well #1 Height	40 feet
	Top
	5' x 5'
Fence around Caretaker's house, Villa reservoir	

NEW SERVICE INSTALLATIONNov. 1, 1912, to April 28, 1913

Month	Meter and Service				New service unmetered	Meters on Old Services			
	5/8"	1"	1½"	2"		5/8"	1"	2"	4"
Nov. 1912	25	2		1	15	78			
Dec. 1912	18	1			4	12	2		
Jan. 1913	8				5	8	1	1	
Feb. 1913	27	1		1	2	25	2	1	
Mar. 1913	28	3		3		17	4	5	3
To Apr. 28, '13	21	7	1	3	5	4	3	6	1
Totals	127	14	1	8	29	154	12	13	4

Month	Contractor's Services			Fire Hydrants Installed	Flush Tanks Connected
	5/8"	1"	Fire Hydrant		
Nov. 1912	5				5
Dec. 1912	11		7		
Jan. 1913	6		6	5	1
Feb. 1913	1		1	3	3
Mar. 1913	3	1	1	1	3
To Apr. 28, '13	12		6	6	1
Totals	38	1	21	15	13

Number of 2" fire-hydrant connections for Street Dept 38

Of the above meter installations the following are solely
for irrigation purposes:

Eleven 1"

One $1\frac{1}{2}$ "

Fourteen 2"

Four 4"

Note:- To this should be added 225 new services acquired through purchase of other systems or mains, of which 155 are metered.

O P E R A T I O N

	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Total
Meter Tests		41	43	12	20	4	120
Inspections and trips by Trouble Inspectors	207	341	839	484	435	319	2625
Sealed Services				1	4	14	19
Fire Hydrants Moved	3	2	1	1		5	12

Special investigation for leaks in business district made during February revealed 66 bad leaks in business district resulting in a loss of water amounting to about \$200.00 per month.

This Department has a party of men locating all services, gates and mains of the entire system. This has been necessary on account of insufficient and erroneous records kept by the old water companies. During the months of November, December and January this Department was kept very busy answering calls and straightening out errors due to these faulty records. Over 3000 stencils had to be re-cut on account of errors in names and addresses taken from old companies' books.

D I S T R I B U T I O N S Y S T E MRENEWALS AND REPAIRS

	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Total
Main Leaks Repaired	35	47	44	25	41	49	241
Service Leaks Repaired	61	108	111	91	116	73	560
Fire Hydrants Leaks Repaired		13	34	13	10	13	83
Meter Repairs Not at Shop		60	254	131	41	26	512
Meter Repairs at Shop	60	70	58	67	78	62	395
Meter Boxes Repaired		14			13	21	48
Meter Changes	29	55	68	63	66	62	343
Meter Removals	1	10	15	7	13	15	61