PRESENT CONDITIONS AND FUTURE POSSIBILITIES OF THE WATER SYSTEM OF SAN DIEGO.

BY H. A. WHITNEY.

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The water system outside the city limits of San Diego consists of four reservoirs, twenty miles of wood pipe line, thirteen and one-half miles of concrete conduit already built and six and one-half miles of conduit which is nearing completion.

Morena reservoir which is about forty-four miles from San Diego in a direct line has an area of something over thirteen hundred acres when filled and will hold thirteen and one-quarter billion gallons at the bottom of the spillway. The Upper Otay reservoir is rated as holding about one billion gallons. The Lower Otay reservoir will hold a little over eleven and one-half billion gallons at the spillway elevation. The reservoir at Chollas Heights is merely a regulating reservoir and only holds ninety million gallons.

Morena has over one hundred and thirty square miles of watershed and the water is conveyed from this reservoir at the present time by means of the Cottonwood Creek for eight miles, from thence by way of the Dulzura Conduit for thirteen and one-half miles and from the Dulzura Conduit it flows for fifteen miles through the Dulzura Creek and eventually reaches the Lower Otay reservoir.

The object of the Dulzura Conduit is not only to take care of the water that is stored during the flood season in Morena but to receive the drainage of the Pine Creek and divert it by way

of the Dulzura Creek into the Lower Otay reservoir. At the present time the greater part of the Morena water is lost in transit before it reaches the Dulzura Conduit on account of its being passed through a sandy valley and a stretch of swamp land. This will be overcome to a great extent when the conduit which is now being built along Cottonwood Creek is finished and put in commission.

The capacity of the Dulzura Conduit being only abot forty million gallons daily a large part of the flood waters of Pine Creek go to waste in the year that is above normal on account of the conduit not being able to convey same in sufficient quantities to the Lower Otay Reservoir. To overcome this loss a small dam, sixty-five feet high, will be placed at the entrance of the Pine Creek branch of the Dulzura Conduit in order to back up any flood that may rush down the canyon and in this way, by keeping the Dulzura Conduit flowing forty million gallons daily, there will be very few years that any floods will get away. By this method the Lower Otay will be used as an impounding reservoir for the Pine Creek and the water from Morena will be let out only at such times as the Otay gets low. The cost of constructing a regulating reservoir as outlined above will be not more than seventy-five thousand dollars if the bed rock continues to be as is indicated by the core drill which is being operated on this damsite. It is intended to realize enough out of the water receipts to pay for the dam out of the Water Fund without having to resort to bond issue.

The following is a tabulation showing the amount of water used each year, the average amount per day and the number of taps in service. This will give an idea of the rapid growth of San Diego in the years from 1902 to 1914.

Year	Amount used per year in Gallons	Avg.per Day in Gallons	No. of Taps	Gals. per Tap Daily
1902	588,597,892	1,612,598	3,593	449
1903	734,405,550	2,012,070	3,774	541
1904	771,049,665	2,112,443	4,044	522
1905	761,022,655	2,085,000	4,505	463
1906	944,079,932	2,586,520	5,070	510
1907	1,222,030,325	3,380,010	6,331	534
1908	1,386,390,000	3,798,328	7,085	536
1909	1,387,000,000	3,800,000	8,264	461
1910	1,653,815,000	4,531,000	9,388	493
1911	1,862,230,000	5,102,000	10,282	496
1912	2,141,120,000	5,869,000	12,681	462
1913	2,503,962,800	6,860,000	14,153	483
1914	2,668,000,000	7,309,589	14,630	499

In the first of January, 1909, the Dulzura Conduit was put into commission and the water system, with the exception of Morena being added, has not been changed since that date. The season of 1908 and 1909 produced an unusually large runoff and the water impounded in Lower Otay reservoir at the beginning of 1909 was 4,279,070,430 gallons with approximately one billion gallons in Upper Otay reservoir. The amount of water now impounded in Upper and Lower Otay reservoirs is less than 1,800,000,000 gallons.

We have consumed in the last six years about thirteen and one-half billion gallons, including the amounts supplied to consumers outside the City of San Diego, the water used during 1914 being approximately double the quantity used during 1909. The figures above readily show that we are drawing water from our reservoirs from year to year faster than we are impounding same and without costly improvements we cannot keep pace with the growth of the city.

Since January, 1909, as stated above, we have run through the Dulzura Conduit eleven and one-half billion gallons, although twenty-five billion gallons of water have run from the watershed into the Cottonwood Creek, showing that more than one-half the water has gone to waste. Morena was not finished until the early part of 1912. If the Morena reservoir had been in commission in January, 1909, and we had had a small dam built at the Pine Creek entrance of the Dulzura Conduit we would have been able to save five billion gallons by means of the Pine Creek regulating dam and four billion gallons would have been saved by the Morena dam in the last six years.

As the matter stands now we have only realized an average of five million gallons daily and have been using six and one-half million gallons daily since 1909, including the consumers outside the city. Had we had the improvements in at the beginning of 1906 and had been able to utilize the runoff to the best advantage we would have been able to realize an average of twelve million gallons daily up to January, 1915. On the other hand had the conditions existed in a manner similar to what they were from 1893 to 1903, Morena and Lower Otay reservoirs would have been filled to practically overflowing and yet we would not have been able to realize over five and

one-half million gallons daily average during these ten years. However, if a large impounding reservoir had been built on the Lower Cottonwood at that time the average would have gone up to a little less than eight million gallons daily.

Besides the holdings of the City of San Diego on the Cottonwood Creek above the old Barrett Dam Site the City owns several hundred acres of land and a portion of a damsite at the mouth of the Cottonwood River where same enters the north branch of the Tia Juana at the international boundary between Baja California and United States. A reservoir formed by a dam one hundred and ten feet high built at this location would cover 835 acres and would impound twelve billion gallons of water. The elevation of the spillway would be six hundred and sixteen feet. It would drain an area, in addition to the three hundred and seventy square miles on the Cottonwood above Barrett, of two hundred and fifty square miles, a portion of this reservoir being in Mexican territory. The dam would be partly in Mexican territory and partly in the United States, as well as the reservoir site. Some concession or understanding would have to be entered into with the Mexican government before this proposition could be carried through. Surveys and drawings have been made for this reservoir and damsite but no survey has been made showing what the location of the proposed conduit would be from Marron Valley reservoir to the Lower Otay reservoir.

With the present system developed as outlined above, a dam built in Marron Valley and a conduit leading from this dam into the Lower Otay reservoir the system can be developed so that

thirteen and one-half million gallons daily may be realized during a ten year period of dry years, as enumerated above, and in normal years sixteen million gallons could be averaged daily.

On the north of San Diego, much nearer than our present system, is the San Diego River which can be developed to average thirteen million gallons daily and to the northwest of the San Diego River is the San Luis Rey which, above the Warner's Dam Site, can be developed to average fifteen million gallons daily according to the reports of Mr. Philip M. Harroun. Between the San Luis Rey and the San Diego Rivers is the Santa Ysabel River which can be developed to the point of realizing nine and one-half million gallons daily.

If these various rivers, taken one at a time as the needs of the city require, could be brought into service they would give within San Diego County a total development of fifty-one million gallons of water daily, or equivalent, at the present rate of consumption, to a supply for five-hundred thousand people.

To the south of the United States border line in the northern part of Baja California is what is known as the Tia Juana River with over one thousand square miles of drainage area and excellant possibilities of dam and reservoir sites with elevations sufficient to deliver large quantities of water cheaply into the United States. No rain gage or runoff records have ever been kept on this river and all the information at hand is meager but from calculations which I have entered into it is safe to say that a daily average of over twenty million gallons could be realized from this source of supply, with a cost of development, exclusive of rights of way and concessions which would have to be entered into

with the Mexican government, of about $4,000,000.00.

By building a regulating reservoir, as mentioned above, at the entrance of the Pine Creek branch of the Dulzura Conduit and the completion of the present extension to the Cottonwood branch of the Dulzura Conduit I have figured that in a ten year critical period we would have been enabled to average about five and one-half million gallons daily into San Diego, allowing for evaporation losses, etc. The new pumping station in Mission Valley will average two and one-half million gallons daily additional. The addition of these improvements will probably tide the City over for the next three years until it can acquire a system of sufficient size to keep the worry of a water famine from its doors for a number of years to come.

It is my recommendation, and it is based upon the demands of the Board of Fire Underwriters, that a city situated as San Diego and growing at the rate that San Diego is and expects to in the future, have a water supply of not less than double the present average daily consumption, together with transmission and distributing mains accordingly.