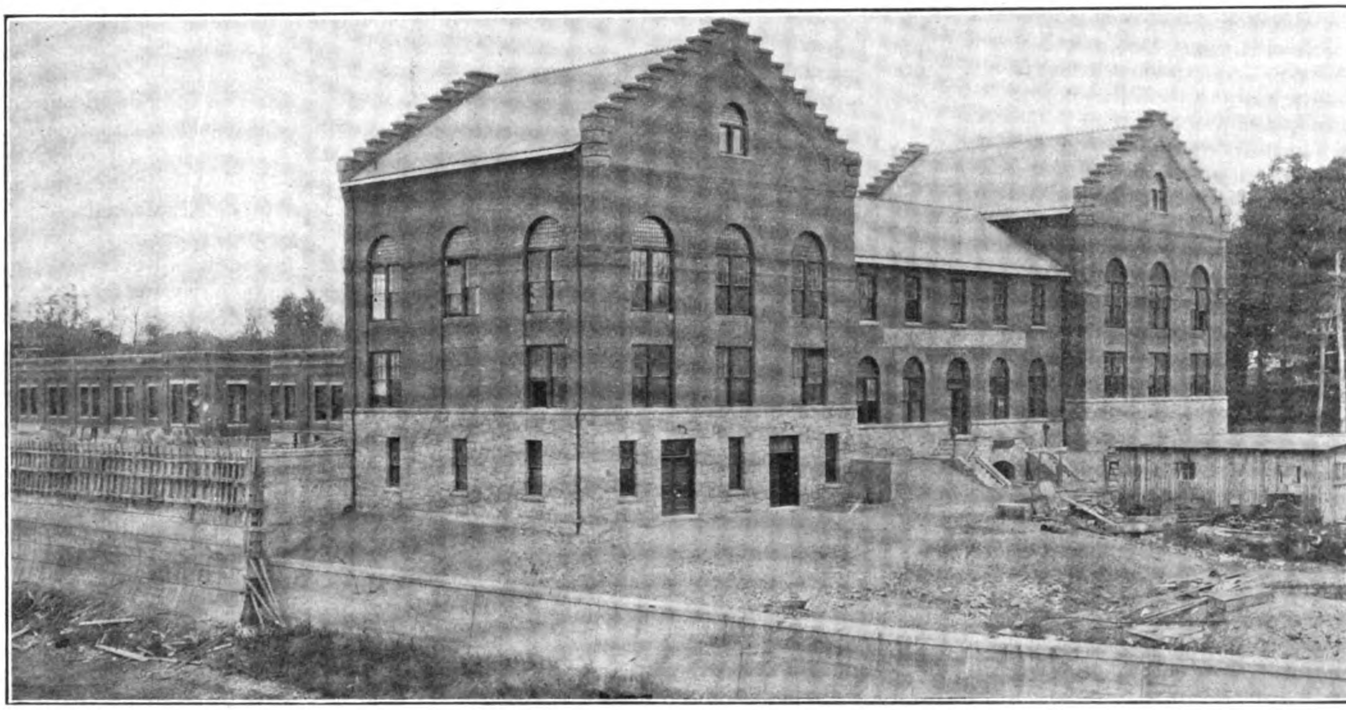
Municipal Journal

Volume XXXVII NEW YORK, OCTOBER 22, 1914. No. 17



GENERAL VIEW OF FILTER BUILDINGS, FROM RIVER.

WATER PURIFICATION AT TRENTON

Rapid Filters of Thirty Million Gallons Capacity Located at River—Low Lift Pumps and Filter Machinery Operated by Electricity—Combined Wash Water and Air Tank.

For fifteen years the improvement of the public water supply at Trenton, N. J., which was drawn from the Delaware River without treatment, has been a question that has received much consideration. During this time there has been under consideration but two sources of supply, namely, ground water from wells and water from the Delaware River. The former received a most careful study but its adoption was out of the question, according to reports from the engineers, on account of both its quantity and its quality, and it was decided to use river water and to purify it. Johnson and Fuller, consulting engineers, of New York City, who were retained to design a plant, in 1912 presented plans for rapid sand filters with a capacity of 30,000,000 gallons per day. This plant is now practically completed.

Many factors influenced the engineers in their decision against the use of ground water. A large part of the city overlies a deep crystalline rock and borings for water through this stratum have resulted in failure. Therefore it seemed that, in order to secure a sufficient supply, it would be necessary to go far from the city and the expense of this would be heavy. Moreover, the most favorable location from which the supply could be secured is overlaid with a yellowish sand and gravel formation, the color being due to the presence of iron. Water from this source would be hard, would contain iron and the cost would be greater than that for filtered water from the Delaware River.

On the other hand, the water of the Delaware is soft and, aside from the mud it contains at times, is considered an excellent supply from a physical and chemical point of view. It does not possess a marked color and the periods of high turbidity are short. The supply is plentiful.

For several years past, the typhoid death rate in Trenton has shown the need of a modern filtration plant. The average death rate from that cause for the ten years ending 1900 was 28, while for the years 1908, 1909 and 1910 it was 54, 36 and 53, respectively. In 1911 the use of hypochlorite was adopted and was effective in reducing the typhoid death rate, but the unfiltered water is very unsatisfactory, especially in appearance.

Various advantages in operation and maintenance led to the location of the plant on the river bank just above the pumping station, in preference to placing it near the reservoir. Cost of construction, ease of supervision, saving in repairs and economy of operation were among the reasons for selecting the river bank location.

With a population of 100,000, Trenton in 1911 was using over 20,000,000 gallons of water per day, the maximum for any one day reaching the high mark of 31,400,000 gallons. This was exceptional, and it was thought that the pumping capacity could be kept within this limit for many years by pumping at a uniform rate, by taking advantage of the storage offered the reservoir and by the reduction of water waste. The works were therefore designed for a capacity of 30,000,000 gallons per day and arranged for an extension to 45 million gallons per day when required.

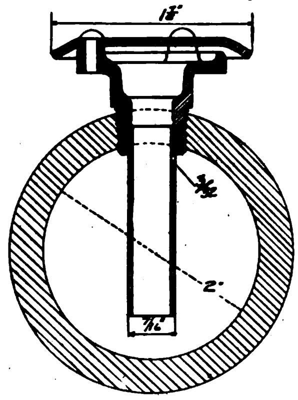
The plant, which is located at the foot of Calhoun street, just above the present pumping works, consists of two covered sedimentation basins, sixteen filters, a clear water basin, a low-lift pumping plant, a head house, conduits and complete filter equipment.

The low-lift pumps, which will operate against a total head of about twenty-five feet, as a maximum, consist of two vertical centrifugal pumps, each having a capacity of 20,000,000 gallons per day. These are driven by direct-current motors, which are automatically controlled by devices actuated through floats by slight variations in the water level in the sedimentation tanks. Two 200-k.w. steam turbo-generators furnish the current, and these are amply large for furnishing all the power required for low-lift pumping, for operating the filter machinery and for lighting the pumping and filter plants. All the machinery at the filter plant is motor driven.

Remodelling the arrangement of the old pump well and improving the arrangement of the screens was necessary. The well is now divided into two parts, one to supply raw water to the low-lift pump, the other to receive filtered water for the present main pumps. The water is conducted to and from the filter plant in two 60-inch mains, each 320 feet long.

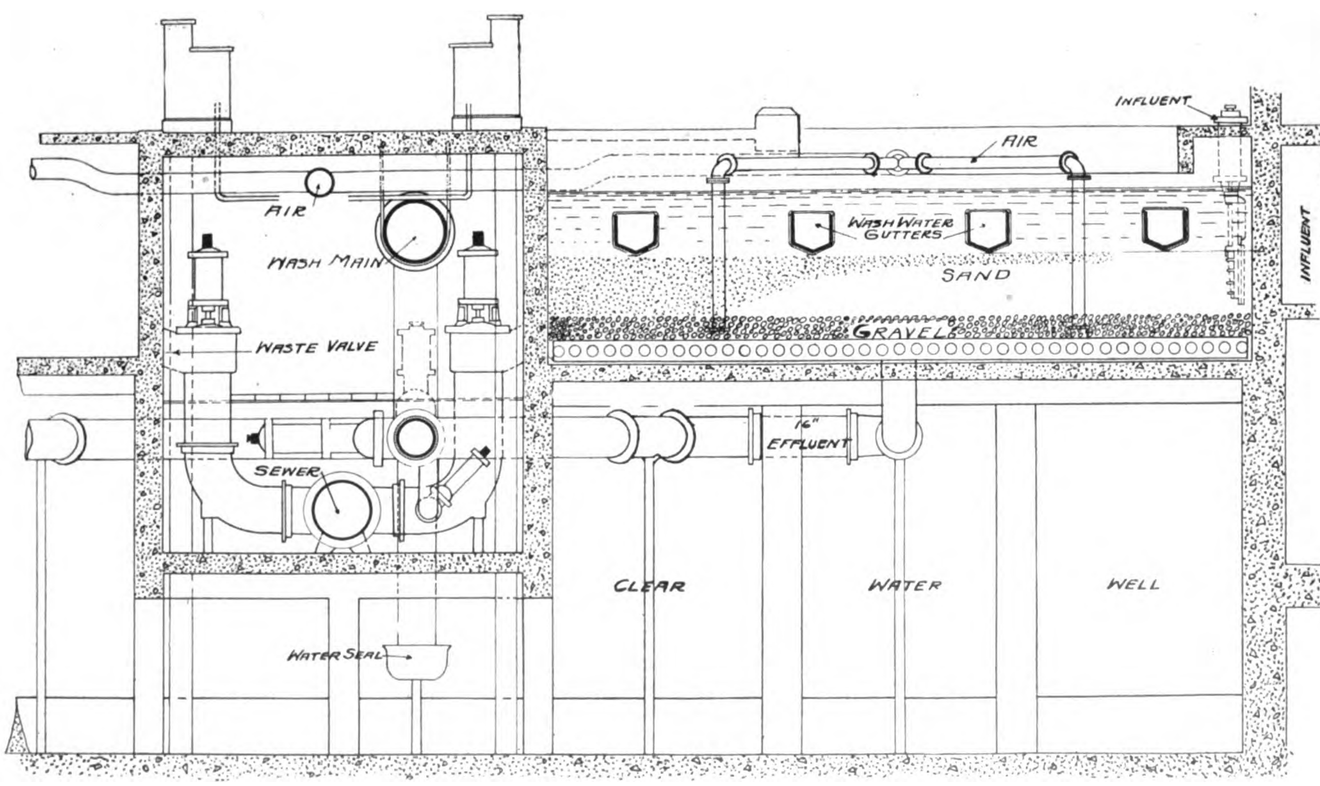
The two sedimentation basins are of equal size, each being 210 feet long, 62 feet wide and 19 feet 6 inches deep. They hold about 1,900,000 gallons each, this capacity being equivalent, with both basins in operation and the filters running at full capacity, to a retention period of nearly three hours. The basins are so arranged that either or both can be used.

Arranged in two rows on either side of the pipe gallery and between the two sedimentation basins are the sixteen filters. These are rectangular in shape, 24 feet by 30 feet 6 inches, and each has a filtering area of 652 square feet, giving a capacity of 1,875,000 gallons daily when filtering at the rate of two gallons per square foot per minute. The filter bed consists of thirty inches of sand supported on ten inches of graded gravel. The sand is specified to have an effective size of from 0.35 mm. to 0.44 mm. and a uniformity coefficient of about 1.65.

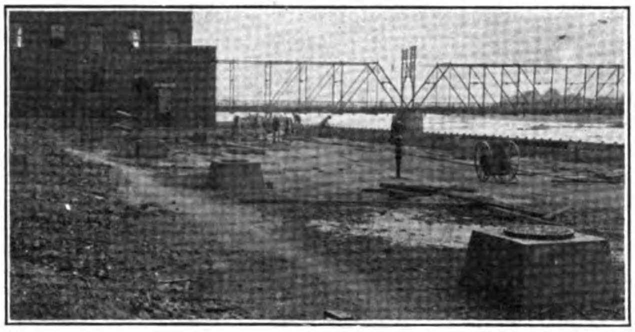


SECTION OF STRAINER.

The strainer system consists of two cast-iron headers, one in each half of the filter, and a series of 2-inch cast-iron laterals, 6 feet 1½ inches long, spaced 7 inches apart, into which are screwed a number of brass strainers, spaced at 6⅝-inch intervals. The strainers have the trap tube inlet, which is the essential feature of the Continental type; but instead of the perforated cap, they are provided with a flat top, turned down slightly at the edges, under which the wash water issues from an annular space of such width as to permit only a very low velocity. As it leaves the strainer, the wash water is deflected downward to the floor into the filter, the purpose of the design being to admit wash water into the filter bed at such low velocity that there will be no tendency to disturb the gravel and also to permit rust scale or other particles, that may enter the strainer, to pass through it. The inlet tube provides all the restriction of flow necessary to insure uniform distribution of wash water.



CROSS SECTION OF PIPE GALLERY AND BEDS ON ONE SIDE OF SAME.



TOP OF SEDIMENTATION BASIN, SHOWING MANHOLES.

Between the two rows of filters and extending the length of the plant is the pipe gallery, 12 ft. 4 in. wide by 15 feet deep. It contains the wash water supply pipe, sewer, pressure pipe, air main, controllers and valves, and is accessible throughout. A platform covers the gallery and on this platform, opposite each filter, are the operating tables and gauges. All valves are operated by hydraulic pressure and controlled from the tables.

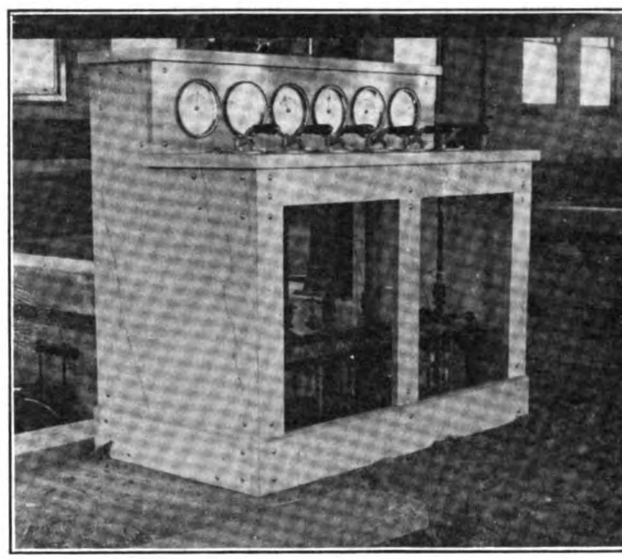
Underneath the filters and extending across one end of the southerly sedimentation chamber, is the clear water basin. The available depth of water in this is about 10 feet, corresponding to a capacity of about 1,200,000 gallons, which is sufficient, without inflow, to supply water to the main pumps for almost one hour at a rate of pumpage of 30,000,000 gallons daily.

In one wing of the head house is located a steel wash water and air tank combined. This tank, which telescopes in a manner similar to that of a gas holder, is 40 feet in diameter and provides water under a head of 24 feet and air under a pressure of 4 pounds per square inch for washing the filters. To produce the required air pressure, the tank is loaded with 300 tons of concrete. The tank provides uniform pressure of air and approximately uniform pressure of water without the necessity of installing a large wash water pump and blower. Because of the storage provided by this tank, the capacities necessary for the wash water pump and blower are only one-tenth of that which would be necessary in case of direct delivery to the filter beds. The tank will supply sufficient water and air, without replenishing, for washing two filters in immediate succession, but it is so arranged in connection with the wash pump and blower that it automatically begins to receive air and water as soon as the wash begins. A connection to the city force main is also provided, so that a supply of wash water is assured in case it is necessary to put the pump out of service. In washing the filters, air and water are applied alternately, the water at the rate equivalent to about 19 inches vertical rise per minute, which is twelve gallons per square foot per minute. The dirty wash water is collected at the top of each filter unit in four cast-iron gutters spaced 6 feet apart.

In the purification process, river water is pumped through a 60-inch cast-iron main to a point between the sedimentation basins, where it divides and may be passed to either basin or to both, entering over a weir extending along the end of the basin at the flow line. The coagulant—sulphate of alumina—is applied through a grid of perforated pipe in a well at the entrance to each sedimentation basin. The coagulated water enters the basins over the weirs and is then forced down nearly to the bottom by a baffle, flowing thence through the basins and over similar weirs at the outlet end into channels which lead to and along the back ends of the filters. From these channels the water is admitted freely to the filters through hydraulically operated sluice gates. It then passes through the filter beds, into a manifold strainer system and thence through registering rate controllers into the clear water basin below. At the outlet of the clear water basin the filtered water may receive, through a Wallace and Tiernan type solution feeder, a small quantity of chlorine gas in solution. The original design provided for the use of hypochlorite of lime as a germicide, but during construction it was decided to change to chlorine gas.

During periods of excessive floods when, as records show, the alkalinity of the water will be insufficient, a solution of soda ash will be added to the water at a point in the 60-inch main, 80 feet ahead of the point of application of the alum, in order to insure complete decomposition of the coagulant. This treatment will be required at infrequent intervals and then only for short times.

The chemical handling apparatus for coagulant and soda ash consists in each case of a pair of solution tanks, mixing devices and accurate adjustable orifices. Piping for sulphate of alumina solution is lead or hard rubber with valves of acid-resisting bronze. The piping for the soda ash is wrought iron with brass valves.



FILTER OPERATING STAND.

The head house, which, like the filter house, is built of red brick, is located across the ends of the sedimentation basins and over two of the filters and encloses in one wing the wash water and air tank. The other wing contains on four floors the office and laboratory equipment for handling and applying chemicals, wash water pumps and blowers and space for the storage of the chemicals.

The general contractor for the work is the J. S. Rogers Company, of Moorestown, N. J. The filter equipment is being installed by the Roberts Filter Manufacturing Company, of Darby, Philadelphia, Pa., and the low-lift pumping equipment by the De Laval Steam Turbine Company, of Trenton, N. J. Fred W. Daggett is resident engineer for Johnson & Fuller, consulting engineers.

FREE PORCH LIGHTS IN LONGMONT.

In Longmont, Colorado, the municipal lighting plant grants each customer free current for one 40-watt lamp on each porch directly facing a street. There are about 550 of these free porch lights in the city and they are regarded as valuable additions to the street lighting in the residence district.

In the efforts to develop the offpeak load, very low prices are made for cooking rates. From April to October, inclusive, three cents per k.w. hour with a minimum of $1.00 per month, or two cents per k.w. hour with a minimum of $2.50 per month, is charged. From November to March a rate of ten cents per k.w. hour is charged, however.