June 14, 1917.

PUMPING IN THE METROPOLITAN WATER DISTRICT OF MASSACHUSETTS.*

By A. O. Doane,

Division Engineer, Metropolitan Water Board, Boston.

THE Metropolitan Water District of Massachusetts was established by an act of legislature in 1895. It includes the city of Boston and seventéen other neighboring cities and towns, and had an estimated population in 1916 of 1,190,220. The average daily consumption of water in the district for 1916, of which half was supplied by gravity, was 103,876,000 gallons or 87.3 per capita.

The water supply is obtained from the old Boston reservoir No. 3 on the Sudbury River, the Sudbury reservoir (commenced by the city of Boston and completed by the Metropolitan Water Board), and from the Wachusett reservoir, constructed by the board on the south branch of the Nashua River at Clinton. 'Lake Cochituate, from which the first large supply for Boston was obtained, and the old Boston reservoirs on the Sudbury River, except reservoir No. 3, are now held in reserve.

Half of the water drawn from the Wachusett and Sudbury reservoirs is brought to a point in Weston, through the Weston aqueduct. It then flows through 60-inch and 48-inch cast-iron pipes and furnishes the gravity supply to the lower parts of the district. Spot Pond, in the extreme northerly part of the district, is connected with this pipe system and acts as a storage and compensating reservoir. The remainder of the water drawn from these reservoirs, together with the water from the old Boston reservoir No. 3, is conveyed by the Sudbury aqueduct to Chestnut Hill reservoir. All this water is pumped at the Chestnut Hill pumping stations. When water from Lake Cochituate is used, it comes to Chestnut Hill Reservoir through the Cochituate aqueduct.

On January 1, 1898, the city of Boston pumping stations came under the control of the Metropolitan Water Board, and the Mystic pumping station and several of the smaller stations in the district were shut down. When the new Metropolitan pumping stations were completed, all of the small pumping plants were abandoned, and all the pumping for the district is now done at five stations by high duty pumping engines instead of at seventeen widely separated stations by low duty pumping machines of a type now obsolete.

All the water delivered to the Chestnut Hill reservoir is pumped at two pumping stations located on the southeasterly side of the reservoir. The older building, known as Chestnut Hill pumping station No. 1, was built by the city of Boston in 1887.

The pumping plant consists of two 8,000,000-gallon Gaskill 'horizontal fly-wheel engines, built by the Holly Manufacturing Co. in 1887; one 20,000,000-gallon vertical triple expansion crank and fly-wheel engine, designed by the late E. D. Leavitt and built by the Quintard Iron Works in 1895 (this engine has Riedler mechanically operated valves in water end); and one 30,000,000-gallon vertical triple expansion crank and fly-wheel engine, built by the E. P. Allis Company in 1898.

The boiler plant consists of one Belpaire boiler, 90 inches in diameter and 34 feet long; two vertical Dean boilers, 98 inches in diameter and 24 feet long; and three horizontal tubular boilers 64 inches in diameter and $18\frac{1}{2}$ feet long. There is also a 168-tube Sturtevant economizer.

*Paper read before the American Water Works Association, May 8th, 1917. Only a comparatively small quantity of water is now pumped at this station, as most of the water for the supply of the higher portion of the southerly part of the district is pumped at pumping station No. 2 by the 40,000,000gallon Holly pumping engine.

Chestnut Hill Pumping Station No. 2.—This station was built by the Metropolitan Water Board in 1900. The pumping plant consists of four vertical triple expansion crank and fly-wheel engines, all built by the Holly Manufacturing Co.; three of these engines are of 35,000,000gallon capacity each and were installed in 1900, and the fourth is of 40,000,000-gallon capacity and was erected in 1911.

The boiler room contains five boilers, all of the vertical fire tube type, designed by F. W. Dean. The three older boilers are 98 inches in diameter, $29\frac{1}{2}$ feet high over all, and each contains 384 2-inch tubes 15 feet long. The other two boilers are 109 inches in diameter and $29\frac{1}{2}$ feet high over all, and each contains 484 2-inch tubes 15 feet long.

There are two 144-tube economizers, one a Sturtevant and the other a Green.

The coal house has a capacity of 1,000 tons, and the loaded cars come into it on a trestle about 15 feet high. An ash tunnel extends under the boilers, and the ashes are dumped through an opening in the floor into a car in the tunnel. The loaded ash cars are raised to tracks outside the building leading to a dump, by means of a hydraulic elevator.

The 40,000,000-gallon engine is used for supplying the southern high-service district and operates against an average head of 124.54 feet. The three older engines pump water for the lower parts of the district, including the low-lying portion of the city of Boston.

Owing to a large increase in the amount of water supplied by gravity, the pumping to this service has been much reduced and the pumps are now largely used to regulate the pressure in the mains by supplying water during periods of maximum draft and to raise the pressure during large fires.

The combined daily average high service pumping at both of the Chestnut Hill pumping stations was 34,371,300 gallons in 1916; the average lift was 124.13 feet; the cost per million gallons pumped, based on pumping station expenses, was \$3.0682.

The low-service pumping was done at station No. 2, and amounted to a daily average of 33,875,000 gallons from January 1 to February 7, 1916. On February 8 a large main supplying water by gravity from the Weston aqueduct was put in service, and the daily average pumping for the remainder of the year was 15,365,000 gallons. The average lift was also reduced from 41.51 feet to 33.70 feet. The change, while reducing the total cost of water pumped about \$4,000, raised the cost of pumping per million gallons to \$4.14, of \$1.80 more than in 1915.

The Spot Pond pumping station is situated on the shore of Spot Pond. The engine room contains a Holly 20,000,000-gallon vertical triple expansion crank and flywheel engine and a 10,000,000-gallon vertical compound crank and fly-wheel engine designed by the late E. D. Leavitt and built by the Blake Manufacturing Co. This engine was erected at the Mystic Pumping Station of the city of Boston and was transferred to Spot Pond in 1899, after the Mystic station was abandoned.

The boiler room contains three. Dean vertical internally fired fire tube boilers 92 inches in diameter, 29 feet 4 inches long over all, each containing 256 2¹/₄-inch tubes 15 feet long.

any 15 ace the is ted

n a

to

he

72/3

at

ese

the

ub-

and the second second

li-

he

nd

SS

ne

he

off

se

UT

se

55

m

2đ

07