

acre of sand surface, and a clear water reservoir with a capacity of 600,000 gallons. There will also be provided an office building containing fully equipped chemical and bacteriological laboratories. The price for the sand and gravel included the necessary screening, washing and putting in place. The sand washer is of the ejector type. The bids are as follows:

acre, depending upon the wages paid. At Mount Vernon, N.Y., the shovellers and barrow wheelers are paid \$1.10 per day, and the scrapers \$1.25. Chas. Fowler, for many years in charge of the filters in Poughkeepsie, N.Y., says that one man working one hour is required for every 150 square foot of surface cleaned and removed. This would cost at \$1.50 per day, about \$43.50 per

Material.	Quantities.	—Prices of—			Engineer's estimates.
		Successful Bidder.	Other Bidders.		
Shale rock excavation	5,000 cubic yards	\$ 1.20	\$ 0.30 to \$ 1.50		\$ 0.80
Earth excavation (above grade).....	60,000 cubic yards	.27	.13 1/4 to .476		.20
Earth excavation (below grade).....	3,000 cubic yards	.30	.20 to .60		.40
Rolled clay and gravel embankments.....	21,000 cubic yards	.52	.45 to .90		.50
Silt and loam filling	23,000 cubic yards	.15	.15 to .50		.30
General filling (rolled)	18,000 cubic yards	.18	.07 to .40		.20
Puddle in place	13,000 cubic yards	71 1/2	.67 to 1.07		1.00
Broken stone or gravel for lining.....	1,900 cubic yards	.85	.99 to 1.40		1.25
Sodding	3,000 square yards	.15	.15 to .60		.15
Seeding	8 acres	25.00	12.50 to 70.00		50.00
Gravel in roadway rolled.....	800 cubic yards	.60	1.00 to 1.50		1.00
Vitrified brick laid as paving.....	120 M	20 00	18.00 to 30.00		20.00
Stone curbing	800 lineal feet	.60	.75 to 1.50		.50
*Concrete in floors	11,000 cubic yards	2.31	2.34 to 3.50		3.00
*Concrete in vaulting	7,000 cubic yards	3.85	3.90 to 7.50		5.00
Other concrete	3,000 cubic yards	2.13	2.50 to 4.30		3.00
*Brick work	4,500 cubic yards	8.12 1/2	7.00 to 10.00		6.00
Imported Portland cement	500 bbls.	3.12 1/2	2.35 to 3.00		2.75
American Portland cement.....	14,000 bbls.	2.14 1/2	1.90 to 2.21		2.15
Rosendale cement	1,500 bbls.	.97 1/2	.85 to 1.95		1.00
Furnishing and placing 2-inch drain pipe in piers		525.00	300.00 to 1,318.00		700.00
2-inch agricultural drain pipe	2,000 lineal feet	.04	.05 to .10		.05
*6-inch drain pipe, open joints.....	16,000 lineal feet	.11	.10 to .12 1/2		.10
Furnishing and laying all vitrified pipe cement joints		5,337.00	3,850.00 to 5,933.00		6,000.00
*Placing all gates, etc., furnished by board...		1,140.00	700.00 to 2,000.00		470.00
*Furnishing and placing all cast-iron pipe and specials		20,701.25	14,750.00 to 20,000.00		15,000.00
*Iron filter covers	672 each	4.40	5.00 to 6.50		5.00
*Sand washing apparatus	2 sets	393.00	250.00 to 1,000.00		800.00
*Sand run fixtures	8 each	407.50	100.00 to 511.00		200.00
*Regulator houses	8 each	862.24	175.00 to 900.00		500.00
*Office and laboratory building.....		4,881.00	2,700.00 to 10,200.00		3,000.00
*Filter gravel in place.....	7,000 cubic yards	1.05	1.00 to 2.00		1.50
*Filter sand in place.....	36,000 cubic yards	1.00	.90 to 1.78		1.25
Split stone lining	2,000 square yards	.82	1.03 to 3.60		2.00
Rough stone paving	200 square yards	.82	.93 to 2.50		.80
Fasteners furnished and placed in concrete vaulting	3,000	200.00	150.00 to 225.00		100.00
Iron fence	850 lineal feet	2.00	1.00 to 2.00		1.00
Connection with pump-well and closing old intake		3,000.00	1,000.00 to 4,000.00		3,500.00
Total		\$309,866.00	\$322,358.00 to \$387,345.00		\$322,440.00

The items of special interest are marked thus *

It will thus be seen that a covered filter plant of this area (5.6 acres) with settling basin, clear water basin, and all other appurtenances complete can be built for less than \$56,000 per acre. For further details and information concerning this plant see Engineering News, Feb. 10th and Oct. 20th, 1898.

The total cost of maintenance of a filtration plant is made up of the operating expenses, and the interest and sinking fund charges. The former—the operating expenses—comprise: (a) The cost of superintendence, and of attendants to look after the regulation, etc.; (b) the cost of scraping and removing the sand; (c) the cost of washing the sand; (d) the cost of replacing the washed sand when renewal of the bed becomes necessary.

It is only in very large plants that a special superintendent is required, so that the expense for that purpose would not form a very large part of the total cost. The proper handling of the gates, and the running of the plant in general requires a degree of intelligence considerably above that of the ordinary laborer. The wages of the gatemen therefore will be from \$2 to \$3 per day. Scraping and removing the sand by wheelbarrows seems to cost, under ordinary circumstances, between \$40 and \$50 per

acre. Lindley gives 30 days at 10 hours each for every acre, which at the same rate is \$45 per acre. In the small plants at Ilion, N.Y., and Ashland, Wisconsin, the cost is at the rate of about \$50 per acre. The cost of sand washing varies with the method employed. In Poughkeepsie, when they used a simple inclined trough and water jet, it cost as high as \$1.50 per yard. By improving their methods they reduced this cost, till to-day it is only 27 cents per yard. In Hudson, the cost is 20 cents per yard, and in Ilion 18 cents. In Germany it varies from 14 to 20 cents per yard.

The periodical replacing of the sand in the bed must be done carefully of course, but should not cost, including whatever is necessary to be done to the permanent layer, more than 40 cents per cubic yard. The cost of these various operations will of course depend upon the scale on which they are carried on. It will obviously be easier to keep the price low with a large plant than a small one. In the case of the former a force of gatemen and laborers can be permanently employed. In the smaller plants the operations of scraping and sand washing only take place at intervals, and are performed by laborers hired temporarily for the purpose, or by employees from other parts