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REPORT

OF THE

CHIEF ENGINEER OF THE WATER DEPARTMENT

OF THE CITY OF PHILADELPHIA.

To the Committee on Water.

GENTLEMEN :—I beg leave to present to your attention the following report in relation to the projected reservoirs in the Twenty-fourth Ward.

As you are aware two appropriations have been granted by Councils for the erection of reservoirs, one May 5, 1865, amounting to \$110,000, intended for the wants of the Ward alone; and one November, 1866, devised for a large storage basin for the supply of the higher parts of the Fifteenth, Twentieth, and Twenty-first Wards, as well as the Twenty-fourth,—amounting to \$140,000 additional, or \$250,000 in the aggregate.

The consideration of the smaller of these will occupy our attention first.

I assume that the uncertain character of the supply from the stand-pipe and the rapidly increasing demands of the Ward make it imperative upon the City to provide for the wants of the citizens, and that there can be no doubt of the propriety of meeting these wants by the erection of a suitable reservoir.

It will, therefore, be necessary only to investigate some of the facts connected with the situation selected for it, the details of cost, &c., &c., pertaining to its construction.

The ground purchased upon which the reservoir has been commenced, is not bounded by public streets on all sides; the north line being a diagonal across the square. When the streets are opened the property will have a length of about 1,063 feet on Montgomery avenue, a width of 500 feet on Forty-eighth street, and 146 feet on Belmont avenue. If it is decided not to build the large reservoir proposed, it may be desirable to purchase the land between that already owned and Berks street, making the reservoir almost a regular parallelogram, and bounding it by streets on all sides, thereby avoiding the risk of near neighbors, who might not prove desirable.

Should ground be purchased to square up the reservoir as above proposed, some modification of the estimate herewith submitted will be required, time has not permitted the making of such a change; it can soon be done, if Councils decide to make the purchase indicated.

The land required contained between the south line of Berks street, west line of Belmont avenue, east line of Forty-eighth street, and the ground already owned by the City will be about four acres.

By this proposed change in the form of the reservoir, 25,000,000 of gallons can be stored, and leave some surplus ground which may be occupied hereafter for a pumping station, the probable necessity for which will appear presently.

The water level of this reservoir decided upon by the former Chief Engineer, is 180 feet above Fairmount Dam, equal to $184\frac{5}{10}\frac{17}{100}$ feet above established City datum; a quite considerable portion of the district to be supplied is higher than this water level.

I am informed by the City Surveyor that there is a proposed curb height within 2,000 feet of the reservoir, 230 feet above datum, and one not very much further off of 297 feet, and at least 2,500 square acres of the district has curb heights of 150 feet and over.

It is therefore evident that at some future day, probably not very remote, a considerable supply of water will be required at a much higher point than can be properly obtained from the proposed reservoir. The plan will then be the erection of pumping machinery, taking its supply from this point and raising it to the altitude required by the higher ground; in this event the surplus ground can, probably, be made available.

Some delay in making this report has occurred from the necessity of obtaining data from which the quantities of materials to be moved could be calculated. This has been done with great care from the contour levels of the ground found in the office, and is believed to be reliable, a detailed estimate based upon these calculations will be found appended, the prices named for the different kinds of work have been obtained from the experience of those accustomed to such work, and are believed to be very low, as low as is possible when the perfect and careful manner in which earth-work for the retention of large bodies of water has to be done, is considered.

I regret to say that the estimates show clearly that neither the large or small reservoir can be erected for the sums appropriated for the purpose.

We will now turn our attention to the large reservoir considered as a storage basin for the supply of the Fifteenth, Twentieth, and Twenty-first Wards.

In selecting a site for a reservoir, the conditions to be sought after are,

First.—Proximity to the supplying power.

Second.—Nearness to, and facility of reaching the centre of densest population to be supplied.

Third.—Sufficient altitude to supply the highest houses in the district.

Fourth.—A locality where the excavation of earth may supply material for the construction of the embankments without a large amount of surplus.

It is, of course, but rarely that all these favorable conditions can be combined; we will see how nearly they are reached in our own case.

The first condition is nearly but not entirely met, if the pumping main be carried directly from the works to the reservoir, it will be rather more than two and one-quarter miles in length; this length is exceeded in several works in Europe, and I believe in two at least in this country, besides our own Delaware Works, where we know well the disadvantages it occasions; the friction in that case producing a virtual increase of head which has been estimated at as much as fifty-eight feet; it is true, however, that the ascending main there is both too small and too long. A site for a pumping station could be obtained nearer to the reservoir if it should be considered expedient to build a new engine house and machinery.

The second condition, nearness to the centre of supply, is probably more rarely obtained than the first.

In the report of the former Chief Engineer, made to Councils November 1st, 1866, we find the following words: "And "as it will be higher than those now in use, the water could "be drawn from it into them, or furnished to the higher "parts of the City. It will require but about four thousand "feet of main to connect the main that will be laid from the "Twenty-fourth Ward Works to the reservoir, with the main "connecting the Spring Garden reservoir and Corinthian "avenue reservoir."

It is quite evident that if the suggestions contained in the above extract be adopted, all the advantages to be expected from the greater height of the proposed reservoir, will be lost; it being necessary by such plan, to first pump the water to the height of the new reservoir, one hundred and eighty-four feet, to let it down into the old ones which are only one hundred and twenty-three feet high; the cost of raising the water sixty-one feet additional being thereby incurred without any advantage whatever.

The only plan by which the advantage of head can be obtained upon the high grounds of Fifteenth, Twentieth and Twenty-first Wards, is by carrying large mains across the Schuylkill, and arranging for those Wards an entirely distinct system of service mains and pipes.

To reach the centre of such a system, will require not less than seventeen thousand feet of main, and a large expenditure in re-arranging the distribution; this latter work would be required for any higher source than now used, and is only mentioned, that all the points connected with the subject may be brought to your notice.

The population of the Wards named, is probably not less than one hundred and twenty-two thousand three hundred and fifty persons, requiring a maximum supply of about seven million gallons per day; this demand will possibly be doubled in the next ten years, a main of less than thirty inches would not supply the district referred to; the cost of this will not be far from \$190,000, without adding the cost of re-arranging the distribution.

By making a new high service system of distribution as here proposed, the third condition can be met by the new reservoir, and the ability to supply the highest houses be secured.

The last requisite has not been met in the site selected, the amount of surplus excavation being excessive, amounting to four hundred and fifty-six thousand seven hundred and thirty-four cubic yards, which will cost to remove not less than \$182,693, an amount as will be seen, greater than the whole sum set down in the report quoted from above, as sufficient to increase the contents of the reservoir from twenty-five to two hundred million gallons.

It will not be necessary to go further into the consideration of the subject, as there is one fact which deters me from recommending the erection of the large reservoir at this time, which is, that Councils have authorized the creation of a commission of eminent hydraulic engineers, to investigate the whole subject of water supply. Should those gentlemen decide upon the Perkiomen or the Delaware as a proper source, it would be exceedingly inconvenient, and very expensive to have the storage reservoir upon the west side of the Schuylkill, as such a situation would involve the carrying of from seventy-five to one hundred and fifty million gallons a day across the river twice.

The densest population will be for many years, if not forever, upon this side of the Schuylkill; therefore the most desirable place for a storage reservoir of large size, must be on this side also.

The average daily supply to the population on the east side of the river (excluding Germantown), being twenty-nine millions four hundred and seventy-five thousand five hundred and seventy-seven gallons last year, whilst that on the west side was but one million six hundred and sixty-two thousand and ninety-nine gallons.

Pending the action of the commission, and for other reasons given above, I cannot believe it prudent to go to so large an expenditure at this time, as is involved in the construction of a reservoir of the capacity of two hundred million gallons, upon the site selected.

ESTIMATE FOR RESERVOIR TO SUPPLY TWENTY-FOURTH WARD ONLY.

Capacity about 25,000,000 gallons.

Level of the top of the embankment above Fairmount Dam, 183 feet.

Level of surface of water when full above Fairmount Dam, 180 feet.

Level of bottom of reservoir above Fairmount Dam, 153 feet.

	QUANTITIES.	PRICES.	COST.
Embankment laid up in six inch layers.....	12,672 cubic yds.	45	\$5,702 40
Surplus excavation, carried to spoil bank probably 2,000 feet distant..	221,937 " "	40	88,774 80
Puddle lining on the sides, 18 inches deep.....	5,506 " "	2 25	12,888 50
Puddle lining on the bottom, 12 inches deep.....	5,934 " "	2 00	11,868 00
Slope wall of stone, on sides, 16 feet deep.....	4,820 " "	4 00	19,280 00
Pavement on bottom 12 inches deep	5,711 " "	3 50	19,988 50
Broken stone backing under slope wall, 8 inches thick.....	2,358 " "	2 00	4,716 00
Retaining wall on Montgomery av... " " Forty-eighth st., to support street.....	854 perches.	6 00	5,124 00
Retaining wall on north side of reservoir.....	2,100 " "	6 00	12,960 00
Copeing on retaining walls.....	1,657 lineal ft.	2 00	3,314 00
Gravel road on embankment 10 in. deep.....	991 cubic yds.	50	495 50
Removing top-soil and replacing on embankment 9 feet deep.....	934 " "	40	373 60
Sodding outside slopes.....	3,735 sqr. yds.	20	747 00
Puddle wall in the embankment 8 by 10 feet.....	2,791 cubic yds.	80	2,282 80
Inlet and outlet gate chambers, with screws, sluice gates, extra mains and connections.....			25,000 00
Fences.....			1,200 00
			\$214,165 10
Add 15 per cent. for contingencies and omissions.....			32,124 76
			\$246,289 86
Total cost of Reservoir			\$246,289 86
12,000 feet of main, from engines to Reservoirs, 30 inch diameter \$10 50.	126,000 00		
Add 10 per cent. for contingencies...	12,600 00		138,600 00
			\$384,889 86
Total cost of Reservoir and pumping main.....			\$384,889 86

No estimate is made above for a descending or service main, it being contemplated to use the connections now existing between the stand pipe and service for the present; this course is however not recommended. A main, not less than twenty inches, should be laid to Haverford street and Belmont avenue; this would increase the cost of reservoir and ascending and descending mains to \$470,139 86.

The retaining wall on Forty-eighth street cannot be omitted, as the street there will be higher than the top of the reservoir, and must be supported. Those on Montgomery avenue and the north line of the reservoir, may possibly be dispensed with.

No estimate is made for the cost of removing a considerable amount of bank erected last fall, now found to be located partly upon Montgomery avenue, and therefore requiring to be rehailed.

Estimate for large Reservoir to supply Twenty-fourth Ward and the high ground on the east side of the Schuylkill. Contents about 200,000,000 gallons.

Embankments above Fairmount Mount Dam,	-	183 feet.	
Water level when full,	“ “ “	- 180 “	
Bottom of Reservoir,	“ “ “	- 153 “	
	QUANTITIES.	PRICES.	COST.
Embankment laid in six inch layers.....	101,769 cub. yds.	45 cts. p. yd.	\$45,796 05
Filling of depressions to level the bottom ...	127,902 “ “	40 “ “ “	51,160 80
Surplus excavation to be carried to spoil bank, 2,000 feet distant.....	456,734 “ “	40 “ “ “	182,693 60
Puddle lining on sides 18 in.	11,584 “ “	\$2 25 “ “	26,064 00
“ bottom, 12 inches....	29,071 “ “	2 00 “ “	58,142 30
Slope wall on sides, 16 inches deep.....	10,198 “ “	4 00 “ “	40,792 00
Pavement on bottom, 12 in. deep.....	29,071 “ “	3 50 “ “	101,748 50
Broken stone under the slope wall	5,100 “ “	2 00 “ “	10,200 00
Retaining wall on Montgomery avenue.....	4,062 perches.		
Retaining wall on Belmont avenue.....	6,456 “		
	Amount carried forward.....		\$516,597 25

	Amount brought forward.....				\$516,597 25
Retaining wall on Forty-eighth street.....	3,141	"			
Retaining wall on Peters st..	2,009	15,668	6 00	" "	94,008 00
Copeing on retaining walls...	3,737	lineal ft.	2 00	" "	7,474 00
Gravel road on embankment.	1,849	cub. yds.	50	" "	924 50
Removing top soil and placing it on embankment 9 inches deep.....	2,275	" "	40	" "	910 00
Sodding embankments.....	9,093	sq. yds.	20	" "	1,818 60
Puddle wall in foot of embankment.....	6,847	cu. yds.	80	" "	5,477 60
Puddle on division wall.....	2,261	" "	1 50	" "	3,891 00
Slope wall do.....	2,261	" "	4 00	" "	9,044 00
Inlet and outlet gate houses, screws, gates, &c.....					30,000 00
Fences					2,500 00
					<u>\$672,144 65</u>
Add fifteen per cent. for contingencies and omissions.....					100,821 69
					<u>\$772,966 34</u>
Total cost of Reservoir.....					\$126,000
30 inch main to engines, 12,000 feet, \$10 50					178,500
30 " " to Master st., 17,000 " 10 50.....					<u>304,500</u>
Add 10 per cent. for contingencies.....					30,450
					<u>334,950 00</u>
Total cost of Reservoirs and Mains.....					<u>\$1,107,916 34</u>

This does not estimate for any separate descending or service main for the use of Twenty-fourth Ward; if such be added of 20 inch diameter to Belmont and Haverford streets, the total cost of Reservoir and Mains will be..... \$1,193,166 34

The estimate is based upon the supposed ability to carry the main across Girard avenue Bridge.

By omitting the retaining wall on Montgomery and Belmont avenues, the estimate would be reduced to..... \$1,126,644 34

In making the estimates for both the reservoirs, the prices for excavation have been calculated with the supposition that it is all earth. It is almost certain, however, that much of it will be rock, which would, of course, materially increase the cost, and probably more than absorb the amount set aside to cover contingencies and omissions.

Very respectfully your ob't serv't,

FRED. GRAFF,

Chief Engineer Water Department.

April 16, 1867.