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COMMUNICATION

FROM

FREDERIC GRAFF,

CHIEF ENGINEER

OF THE

DEPARTMENT

FOR

Supplying the City with Water.



PHILADELPHIA:

E. C. MARKLEY & SON, PRINTERS, 422 LIBRARY ST., OPPOSITE POST OFFICE.

1869.

November 30th, 1869.

To the Presidents and Members of
Select and Common Councils.

GENTLEMEN :—The recent unprecedented drought has directed attention to the most important deficiencies in the works now supplying the City with water.

When Water Works depend for their supply upon a single line of aqueduct of great length, it is positively necessary that the reservoirs at the terminus of the conduit should be large enough to retain sufficient water to admit of repairs being made to the line, should accident occur to it.

When mechanical power is employed, very large distributing reservoirs are not so essential, for if the works are provided with a superabundance of entirely reliable power, they may answer with a limited amount of storage capacity (or in fact where stand-pipes are used without any storage at all); but if the power be limited, or uncertain, the reservoir area must be increased accordingly.

Unfortunately, our works are suffering from both these deficiencies.

When I had the honor in March, 1867, to again take charge of the works, I found that during the eleven years which had elapsed since my former connection with the department, the only material changes to supply the deficiencies referred to, was the addition of three turbines at Fairmount, the increase in the contents of Corinthian Avenue Reservoir, and the erection of a Stand-pipe at Delaware Works, intended to assist and increase the capacity of the engines there.

Much of the power of the works was found to be in the most dilapidated condition. At Fairmount, only one of the breast-wheels and its pump (wheel No. 1) could be said to be in reasonably good order,—the pumps were cracked, patched, leaky and inefficient; the wheels, breastings and head-gates were rotted, unsafe, and required daily attention and repair to keep them moving at all.

Three years previously, Mr. Birkinbine, in his report for 1864, states, “that all the pumps require renewal, and that wheels Nos. 4, 5, 6, 7 and 8 should be taken out and replaced by others. Some repairs were made to No. 9 (turbine wheel), this season, it is now in good working order, and is the only wheel and pump in satisfactory condition in the old mill house.” It is not likely that they had improved by three years more work, and in fact Mr. Birkinbine, in his last report for the year 1866, says, “it is almost impossible to keep some of the old pumps in running order.”

At the Schuylkill Works, engine No. 1 had not been used at all for more than a year, and was so much dilapidated as to make it impolitic to expend money upon it. The other engines were in moderately good order, but much over-taxed on account of their limited power.

One engine and pump, at the Delaware Works, was in excellent order, the other engine was in fair condition, but its pump was entirely disabled by a broken valve chamber, which had been removed, and its place not then supplied.

The engines at Twenty-fourth Ward Works, were in the most dilapidated condition. It will be remembered that at these works there is no reservoir, a stand-pipe being used as a substitute, it is therefore necessary that one engine should be kept constantly at work, or the supply to the ward immediately ceases; on this account, and the broken and useless condition of the stops intended to divide the two engines, no

adequate repairs could be effected, except by depriving the entire ward of water for a number of days.

The whole of the reservoirs connected with the works, were found to be in good order.

It was obvious that my first efforts should be directed to the most defective part of the works, the power, and all my energies have been used to get that in such condition as would enable us to keep up the actual daily wants of our citizens.

With this view, I asked for and obtained an appropriation for renewing the power at Fairmount by the substitution of turbine wheels, for the dilapidated and almost useless breast-wheels. The appropriation for the first turbine and pumps was promptly granted, and it has been doing good duty since February 9th, 1869.

The appropriation for the second wheel was, however, arrested in its passage through Select Councils, and a delay of over eight months occurred. This delay also affected the improvement of the Schuylkill Works, and prevented the erection of the boilers and boiler-house required there.

Engine No. 1, at these works, referred to above as being useless, has been removed, and its place supplied by a Cornish engine of more than double its capacity.

At the Twenty-fourth Ward Works, the purchase and erection of a ready-made Worthington Duplex engine has enabled us to make the necessary repairs to the old engines, without depriving the ward of water, and also to keep up an ample supply during the summer, which would have been utterly impossible to have done without the aid of the auxiliary engine.

The unprecedented drought of the summer has developed the want of an auxiliary to our ordinarily reliable water-power, which I believe may yet be implicitly depended upon for at least eight, and probably ten months of any year, par-

ticularly if it is improved by raising the dam in the manner hereafter referred to.

In considering the subject of auxiliary steam-power, we are somewhat embarrassed by a doubt as to the proper location of the engines, that they may be available for all of the present reservoirs, and any new and larger ones that may be erected.

Fairmount has been named as the proper position for them, under the supposition that they should be so arranged as to be useful to pump from below the dam should that structure meet with disaster.

Whilst that position would have that single advantage, it would have the following objections:

First. The water below the dam is contaminated by the tide bringing up upon its rise much of the sewerage of the City on the Schuylkill side, and the waste from the City Gas Works.

Second. If the engines were ordinarily made to take their supply from the forebay which now supplies the wheels, it would be a serious disadvantage to the latter by drawing down the level of the water in the forebay.

Third. If Cornish engines are employed, they could not be arranged to pump from both above or below the dam, as occasion might require, without great disadvantage.

Fourth. If the engines are placed in or upon the site of the old engine-house (the only available place if they are to raise the water from both above and below the dam), the inconvenience of supplying them with coal except by boats would be considerable.

Fifth. It would be difficult and expensive to carry the pumping mains to the highest, largest and most important of our reservoirs, or to any new ones, to be built.

Sixth. To provide for such a contingency as the destruction of the dam, would require the erection and keeping in

order of a considerable number of engines and boilers of the largest class.

That some idea may be formed of the number of engines required to supply all the water now wanted on the east side of the Schuylkill, the following statement is submitted.

The supply of July last from the Schuylkill, delivered on the east side of the river, was an average of 37,875,710 gallons daily—the capacity of the largest of our Cornish engines (the one just erected) is 7,000,000 gallons per day, it would therefore require more than five engines of the same size to do the work; as it would not answer to be without reserve power, seven engines would be necessary to meet the present demand, and within two years at least one more; all of which would have to be constantly kept in perfect running order, waiting the destruction of the dam, a catastrophe which may never and which should never occur.

The dam has withstood the force of all the freshets in the river for nearly fifty years, and I believe with proper precautions and the rebuilding of that part of it above low tide we may feel safe from fear of destruction.

I therefore recommend the erection of auxiliary steam-power at the Schuylkill Works;

For the reasons that it is a great advantage to have all the steam-power concentrated at one point.

The works are now provided with an ample forebay which only requires a new inlet from the river to make it suitable for the supply of double the number of engines now drawing from it.

The coal can be delivered to great advantage, as it is now, from the Reading Railway, by dropping it from the bottom of the cars directly into the coal shutes, close to the boiler-house doors; or, if any accident occurs to the railway, it can be put upon the wharf from boats.

From this point the highest of our reservoirs can be easily reached by mains of moderate length, and the larger reservoir proposed to be built can also be readily supplied.

And finally, auxiliary power can be erected here and made available very much sooner than at Fairmount.

It is proposed to take out Engine No. 2, which with its boilers have been in almost constant use for over twenty-four years, and erect in its place a duplicate of the side-lever Cornish engine just erected, and as soon thereafter as possible, remove Engine No. 3, and replace it by one of much increased power and improved construction; this will fill the old engine-house, and will probably be sufficient for several years.

It is then proposed to erect a new engine and boiler-house on the western side of the forebay, between the present coal shutes and the river, and place therein engines of adequate power to pump through a stand-pipe to be placed upon the rocky bluff behind the proposed house, into any new reservoir which may be erected within a reasonable distance.

A new engine is positively necessary at the Delaware Works, as the supply to the section of the City fed from them could not have been kept up this summer, except by considerable aid from Fairmount Works; this will require a new ascending main and the raising of the stand-pipe erected here four years since, which was unfortunately through error made too short, and is now only partially useful, as an assistant to the engines.

The west side of the river will have ample engine-power and reservoir storage when the new works now erecting are finished.

The water-power at Fairmount may be improved should the dam be rebuilt at a level of say two feet above its present height, the wheels could then be run with the expenditure of about twenty-five per cent. less water than at present. Such raising of the dam would also be of great value to the Navi-

gation Company, by enabling them to abandon their towing path, and use steam tugs to bring their boats down from Manayunk; and would also save them very large annual expense for dredging out the channel of the river, now absolutely necessary—they should therefore join in the expense.

The third turbine should be erected in the mill-house, completing all the large turbines contemplated at the works.

The providing of additional reservoirs presents some difficulties; what we have to seek for is, positions whereon they can be erected of sufficient size, at the proper altitude, to supply the highest ground, within as short a distance as possible of the pumping power, and yet not too far removed from the centre of distribution; to find a site combining these four requisites is no easy matter.

The City owns lots of ground adjoining the Schuylkill, Corinthian avenue and Delaware Works, upon which additional reservoirs may be built, of about the same capacity as the present ones, but would be very expensive, as it is difficult to obtain earth in sufficient quantities to form the embankments, within a reasonable distance of either of them; this method of increasing our storage is therefore not recommended, except in the case of the Delaware Works.

Neither of them is high enough to command the high ground of the Twentieth and Twenty-eighth Wards, which are improving with great rapidity, and call loudly for a better supply than can now be furnished them; as these wards are suffering the most, the means of supplying them will be first considered.

The following plans have been suggested to effect the desired end:

First. To continue the 20-inch main now laid from the Roxborough Reservoir to near Green Lane, Manayunk, to say Ridge avenue and Jefferson street, which may be con-

sidered as the centre of distribution of the ward, and is near the highest curb in it.

Second. To lay mains from the reservoir now building near George's Hill, across either the Girard avenue or the old Columbia Railroad bridge.

Third. To construct a reservoir upon some point on the west side of the Schuylkill, for the special supply of the high ground on this side of the river.

Fourth. To construct a new reservoir at Strawberry Mansion, upon the east park.

Fifth. To use engines to pump into stand-pipes, taking their supply from the present or new reservoirs.

The total area of ground covered by the Twentieth Ward, is eleven hundred and seventy-four square acres, and the Twenty-eighth about thirty-seven hundred acres, together forty-eight hundred and seventy-four square acres. Of the Twentieth Ward, about five hundred and seventy-four acres are at a lower level than forty feet below the surface of the reservoirs, which at present supply that part of the City, and can therefore be fully supplied now—leaving six hundred acres above that level, of which one hundred and seventy-five acres are above a level of one hundred feet. Twenty-eighth Ward has nearly twenty-eight hundred acres above one hundred feet, and some thousand acres in the immediate vicinity of Germantown, are at a level exceeding one hundred and twenty feet.

To supply the upper stories of a first-class dwelling, requires an altitude above the curbs of from 32 to 39 feet.

The highest regulation curb in the Twentieth Ward, is at Twenty-first and Sharswood streets, $111\frac{81}{100}$ feet, and the highest in the Twenty-eighth Ward at Twenty-eighth and Indiana street, 143 feet, the minimum height of water in our reservoir should therefore be for the Twentieth Ward $143\frac{81}{100}$ feet, for the Twenty-eighth Ward 175 feet.

The next consideration is the quantity of water required for the wards.

The average amount supplied to the whole City in the month of July, 1869, reached 41,715,088 gallons, about 54 gallons per day for each man, woman and child of the population, as the amount named is the average supply for the whole month, it is evident that on some days in the month it must have been considerably greater.

The consumption of water increases in greater ratio than the population, and is demanded at higher level than formerly, the appliances necessary for modern convenience have multiplied considerably in the past twenty years; then wash-pavement pipes were almost unknown, baths were seldom placed higher than the second story of the back buildings, and stationary wash-basins and water closets were but seldom found. Now it is quite usual for houses to have three or four baths and water-closets, sometimes in the very uppermost stories of the houses, wash-basins in every chamber, stationary wash-tubs in the kitchens, and the universal wash-pave.

It will therefore be safe to assume that the maximum demand will in a few years reach at least 75 gallons per head per day, at which rate the Twentieth Ward will require 4,500,000 gallons, assuming its population now to be 60,000; and the Twenty-eighth Ward will consume 225,000 gallons, taking its population at 3,000.

In view of the rapid increase and probable future wants of these wards, we should calculate for a supply of 10,000,000 gallons per day, and our distributing main from the reservoir should be large enough to deliver this quantity.

With this basis, we now take up the plans proposed in the order they have been named.

First. That proposed by my immediate predecessor, the extension of the 20-inch main intended to supply Mana-

yunk, from its present termination near Green Lane, to Ridge avenue and Jefferson street.

The objections to this plan are—

The great distance of the reservoir from the point to be supplied.

The inadequacy in the size of the main proposed.

The great loss of head produced by the friction in so long a line of main, and the necessity of raising the water high enough to overcome it.

The limited amount of steam-power in use at the works.

The small size of the reservoir.

The great waste of power and fuel to raise the water to a height which would be unnecessary, if the reservoir were situate nearer the centre of distribution.

The distance from the reservoir to Ridge avenue and Jefferson street, is 36,151 feet, nearly $6\frac{7}{8}$ miles, and the fall from the surface of the water in the reservoir to the highest curb in Twentieth Ward, is 257 feet; but even with this great fall, on account of its length, it would only discharge 7,690,494 gallons per day, and therefore be too small to deliver the amount we have assumed as being finally necessary.

If a reservoir is placed at Strawberry Mansion, a head of about $59\frac{1}{2}$ feet, would produce the same daily flow through the same sized main; it will, therefore, be seen that to supply from Roxborough will require the water to be raised $197\frac{1}{2}$ feet higher than if the reservoir be placed at Strawberry Mansion.

Again, the height to which the water will be raised to supply the last named reservoir will be about 145 feet, whilst at Roxborough it is raised 334 feet. An engine capable of raising 10,000,000 gallons per day into the reservoir at Strawberry Mansion, would only be able to lift 4,341,317 gallons into Roxborough.

The unnecessary increase of the annual cost for fuel for pumping (more than double), and the greater strength, weight and cost of machinery required for this additional lift must be obvious.

The present engine at the Roxborough works is only capable of raising about 2,500,000 gallons per day, all of which will soon be required by Roxborough, Manayunk, and Germantown.

Four additional engines of the same size would therefore be required to raise 10,000,000 gallons.

The Roxborough reservoir will contain, when full, 11,407,567 gallons, or a little more than one day of the assumed supply.

I think it will be seen from the above statement that this plan need not be further considered.

The plan of supplying from the new reservoir now erecting for the west side of the river, is open to some of the same objections, but to a much less extent, the distance to the centre of distribution is but 18,000 feet, and the height of the water level above the curb at Ridge avenue and Jefferson street but 101 feet.

In other respects it is more feasible, the pumping power will be 10,000,000 gallons per day—the engine house is calculated to receive one more engine capable of raising 5,000,000 additional per day, with which, and an additional ascending main, we should have sufficient power to supply the Twenty-fourth, Twenty-seventh, Twentieth, and Twenty-eighth Wards for several years.

The capacity of the reservoir will be over 40,000,000 of gallons, which can be somewhat enlarged, or a new reservoir can be erected upon a site near the present one, by placing a dam across a valley, situate somewhat nearer to the engine house than the reservoir now building, and capable of holding at least 80,000,000 gallons.

A serious objection to using reservoirs upon the west side of the river, at present is, that the mains would require to be carried over the river upon either the Girard avenue or Reading Railroad bridge, both of wood, and of course much exposed to destruction by fire, thus jeopardizing the whole supply to the ward. A special bridge would therefore have to be built to make this source of supply certain.

If permission can be obtained from the Reading Railroad Company, a main can be suspended upon cast-iron brackets extended upon the up-stream side of the stone piers of the bridge, but detached from the wooden superstructure where it would be comparatively safe from injury should the wooden bridge be burned.

The high ground in the Twentieth and Twenty-eighth Wards can be supplied sooner and at a higher level by this reservoir than by the plan next proposed, and in this respect the plan is more desirable than reservoirs on the east side of the river, but would not afford as much storage unless a new reservoir be erected in the valley before named.

The next plan is the construction of an embankment reservoir at Strawberry Mansion.

For the Twentieth Ward, this point is high enough, but there are parts of the Twenty-eighth Ward adjacent to Germantown, that are too high to be reached from this point; these may, however, be supplied from Germantown, or by small engines placed at the Strawberry Mansion Reservoir, pumping their supply from it through a stand-pipe. This latter plan would be cheaper than to raise all the water required for the whole of the two wards to a height only necessary for a small population, occupying the high ground above named; a considerable portion of which is now farms, gardens and cemeteries. The proper plan by which a supply may be insured to the highest localities is to provide for them a distinct system of distributing pipes; otherwise if the re-

servoir is placed high enough to supply the highest points, the lower section of the City will draw the supply away from the higher, for the reason that the additional head at the low points will cause every running hydrant to discharge a much larger quantity of water in the same time, than those upon the high points; therefore when the differences in level are considerable, they can only be equalized by separate systems of pipes.

A storage capacity on Strawberry Mansion property of about 89,130,000 gallons, can be secured at a point much nearer the centre of distribution than by any other plan proposed, but a little further removed from the pumping power than either of the reservoirs just named, on the west side of the river, a water level of 150 feet above City datum; can be obtained, which will give a head when the reservoir is full, of 39 feet above the highest curb in the Twentieth Ward.

The position selected for this reservoir is otherwise satisfactory; it lies within the limits of the Park, the ground is therefore the property of the City; it can readily be supplied from the Schuylkill Works by a main of about seven thousand five hundred feet in length, and the distributing main to the centre of the ward will be about eight thousand five hundred feet.

No reservoir of the same size could be built outside the limits of the Park without the vacation of a considerable number of the public streets running in both directions, which would of course be very objectionable. A reservoir at a higher level could be obtained if it was not for this objection, and another more serious, that is, it would be too far removed from the pumping power; and to build new pumping stations nearer to it would not be advisable, for the reason that they would have to be situated at a point much too near the contaminations thrown into the river from Manayunk and Wisahickon.

As the balance of the City must be provided for, it is proposed to erect a reservoir capable of storing 635,704,200 gallons upon the eastern Park, having a water level of at least 130 feet above datum, and therefore high enough to supply the whole of the City, except the Twentieth, Twenty-first, Twenty-second, and Twenty-eighth Wards; it will be ten feet higher than Corinthian avenue and Schuylkill Reservoirs, and can be supplied from the Schuylkill Works through ascending mains not exceeding three thousand feet long. For the present, it could be connected with the distributing mains now leading from Corinthian avenue Reservoir, this position is the most desirable within the limits of the City, it is recommended that a reservoir of the capacity named be erected here.

The plan of supplying all the ground in Twentieth and Twenty-eighth Wards (too high to be fed now), by engines and stand pipes placed at the present reservoirs, would not be advisable on account of the small amount of storage in them, and for other reasons. But for supplying comparatively small areas of very high ground, in the Twenty-eighth Ward, such method is admissible, and can be employed with economy for situations not readily reached from the Germantown mains. New York, Boston and Cambridge, Mass., have adopted this method of supplying their high service.

A reservoir, capable of holding 13,398,475 gallons, may be erected upon the lot of ground owned by the City, west of the Delaware Reservoirs, the district now supplied from the Delaware Works, which includes Frankford, is rapidly increasing and requires attention, as it contains a large manufacturing interest.

It is believed that earth for the construction of the embankment can now be obtained from the high ground at no very considerable distance, as the lots in the neighborhood are being rapidly built upon, this will soon be impossible, the commencement of the work should therefore not be delayed.

If all the reservoirs described are built, the entire storage capacity in them and the old ones on the east side of the river, excepting Roxborough and Gemantown, will be 821,603,311 gallons, equal to about 24 day's supply at the average rate of delivery in July, 1869, or 22 days longer than at present.

The erection of two new engines in the old engine house of the Schuylkill Works, will make the maximum capacity then 30,096,000 gallons per day, being 20,746,080 gallons more than their capacity in July, 1869.

The vital importance of such increase of power and storage, must be apparent to any one who will remember the difficulties encountered during the drought of the past summer.

The Germantown Works was originally erected by a private company, with limited means; most of the pipe laid is now too small, a sum is included in the estimate for laying a main of increased size, from the Mt. Airy Reservoir down the Main street as far as Wistar street.

A sum is also included for erecting small engines and stand-pipe at the Roxborough Reservoir, to pump the water into Mt. Airy Reservoir.

The two engines purchased for use during the drought, may be used for the purpose.

On account of the inadequate height of the Roxborough Reservoir, these engines will sooner or later, undoubtedly, be necessary. A main of thirty inches diameter has been put through the embankment of the reservoir, for the purpose of supplying these engines when they are required.

Our estimates would be incomplete, unless they included a sum for the purpose of rebuilding the Fairmount Dam from low water upward. The present dam was rebuilt from low tide up, twenty-seven years since, a close examination made on several occasions when it was dry, during the drought,

did not result in the detection of any serious defects. But as no risk should be incurred, I do not think it would be safe to allow it to stand more than one season, the next summer may be employed in collecting the material necessary for its reconstruction.

The estimate is made for the erection of a new dam in front of the present one, upon the cribs sunk there in 1864; and (as the cribs are somewhat defective) for sinking new cribs in front of the new dam, it is proposed to raise the new dam two feet higher than the present dam was when it was rebuilt. The amount for damages, which may be claimed by the riparian owners above the dam is not included, as it cannot now be ascertained.

Much of the land on both sides of the river will have been purchased by the Park Commission, a large amount of the damages may therefore be considered as settled.

A sum is included for putting in the third turbine wheel and pumps, and completing the mill house at Fairmount.

As some of the estimates are necessarily made without the benefit of fully detailed plans and surveys, they are approximate only, but are believed to be ample for the accomplishment of the work.

When Belmont Reservoir was commenced, its area had to be confined within the limits of the public streets of the City, as it is now situate entirely within the limits of the Park, this necessity no longer exists, and it can be enlarged to great advantage and cheaper than at any future time, an amount is included to effect this object.

In making the estimate, my object has been to include all matters required for properly increasing the works on a scale commensurate with the future requirements of our growing City. The works proposed will require not less than three years for their accomplishment.

APPROXIMATE ESTIMATE

For all the Work described in the foregoing Report.

Reservoir for part of Fifteenth, Twentieth and Twenty-eighth Wards, on Strawberry Mansion property, to contain about 89,120,000 gallons.	\$ 425,000		
“ on East Park, for storage for all the City except wards above named, and the Twenty-first and Twenty-second Wards, now provided for, contents about 635,704,200 gallons.....	1,164,407		
“ adjoining the present Reservoir of the Delaware Works, contents about 13,398,475 gallons	160,000		
To enlarge size of the Reservoir now building at Belmont.....	30,000		
		Total for all the Reservoirs,	\$1,779,407
For 36-inch Ascending Main, from Schuylkill Works to Reservoir at Strawberry Mansion, 7,800 feet, at \$18 00.....	\$140,400		
“ 36-inch Ascending Main, from Delaware Works to Reservoir, 13,350 feet, at \$18 00.....	240,300		
“ 36-inch Ascending Main, from Schuylkill Works to large Reservoir, 3,200 feet, at \$18 00...	57,600		
		For all the Ascending Mains,	\$438 300
“ 36-inch Descending Main, from large Reservoir to connect with the Schuylkill and Corinthian avenue Mains, 5,300 feet, at \$18 00.....	\$95,400		
Amounts carried forward,	\$95,400	\$438,300	\$1,779,407

Amounts brought forward,	\$95,400	\$438,300	\$1,779 407
For 30-inch Descending Main, from Reservoir, Strawberry Mansion, to Ridge avenue and Jefferson street, 10,000 feet, at \$12 50	125,000		
For all Descending Mains,		220,400	
“ 30-inch and 24-inch Mains, for the re-arrangement of Twentieth and Twenty-eighth Wards.....	\$50,000		
“ New Mains from Mt. Airy Reservoir, Germantown, to Main and Wistar streets.....	60,000		
		<u>110,000</u>	
			768,700
For Iron Mains of all kinds,			
New Cornish Engine, Schuylkill Works, in place of No. 2, with Foundation, &c., &c.	\$72,000		
“ Cornish Engine, Schuylkill Works, to replace No. 3 with Foundation, &c.....	75,000		
“ Engine Boilers, Foundation and Suction Main, Delaware Works.....	64,850		
“ Engine and House, with Stand-pipe at Roxborough Reservoir.....	10,000		
		<u>221,850</u>	
For Engines of all kinds,			221,850
New Turbine Wheel at Fairmount, and finish of the Mill House.....			145,000
Rebuilding the Dam from low tide.....			215,000
			<u>\$3,129,957</u>

As the Strawberry Mansion Reservoir will not be high enough to supply the higher parts of the Twenty-eighth Ward, it may be thought better to supply these grounds from the Belmont Water Works, instead of by the Strawberry Mansion Reservoir. This will make the following modification of the above estimate.

Deduct the cost of the Reservoir and Ascending Mains of the Strawberry Mansion Reservoir.....	690,400		
Amount carried forward,.....			<u>\$2,439,557</u>

Amount brought forward,..... \$2,439,557

Add—		
For 36-inch Ascending Main to Belmont Reser- voir.....	\$ 91,800	
“ 30-inch Descending Main to Ridge Avenue....	216,000	
“ Enlarging the Reservoir	30,000	
“ an additional Engine and Fixtures.....	50,000	
“ Suspended 36-inch Main across the river, founded upon the pier of the Reading Rail- road Bridge.....	80,000	
	<hr/>	467,800
		<hr/> <hr/>
		\$2,907,357

Making a saving of \$222,600.

The estimated receipts of the Water Department for the next year are, \$872,000; by a small increase in the water rents now charged, this may readily be increased \$200,000 without hardship to any one. The water rents of this City are considerably lower than those of any large City in the United States.

Very respectfully,

FREDERIC GRAFF,

Chief Engineer of the Water Department.

The large reservoir proposed for supplying all the City, except the Twentieth, Twenty-first, Twenty-second and Twenty-eighth Wards, is shown on accompanying map, marked A.

The Belmont Reservoir, now building, is marked B.

That proposed to be built by placing a dam across a valley, is marked C.

Belmont Engine House is marked D.

