Department for Supplying the City with Water.

ANNUAL REPORT

OF THE

CHIEF ENGINEER OF THE WATER WORKS

OF THE

CITY OF PHILADELPHIA.

PRESENTED TO COUNCILS.

PHILADELPHIA:
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1859.

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REPORT.

TO THE SELECT AND COMMON COUNCILS
OF THE CITY OF PHILADELPHIA:—

GENTLEMEN: In obedience to the ordinance regulating this department, the following report is respectfully submitted to your consideration.

The works generally are in a good condition, a large amount of repairs having been made the latter part of the year. There is still much to do before they are all in perfectly satisfactory working order. Experience has taught that it is the most economical in running machinery to keep it in perfect repair. This is particularly the case with heavy pumping machinery like that belonging to the Department. It is hoped that before the warm weather makes its large demands upon the works all the machinery will be in perfect order and capable of being worked to its utmost capacity, as, from the large increase in the demand for water since any additions have been made to the pumping machinery, it will require the most careful management of the works, and care and economy in using the water, to insure a supply sufficient to meet the greater wants the coming season.

In the report submitted to you in October, 1858, by this Department (which will be found appended), the deficiency in machinery, reservoirs, and mains was pointed out.

The following is a description of the works, with remarks upon their present condition, their operation, and what they require.

PUMPING MACHINERY.

FAIRMOUNT WORKS.

These are the works originally erected to supply the City with water, and with the exception of the Turbine wheel and pump

attached to it, they are now completed as designed. All that portion of the city lying south of Vine street is supplied by them. These works were first put into operation July 1st, 1822, and in all their arrangements reflect great credit on the wisdom and forethought of those who designed them, as well as the superior mechanical skill and integrity with which all the work was done. There are eight breast wheels, fifteen and eighteen feet diameter, fifteen feet length of bucket, and one Jonval turbine, seven feet diameter, giving motion to nine double-acting pumps, sixteen inches diameter of cylinder, and five and six feet stroke of piston. Their capacity at a good stage of water is twelve millions of gallons per day; and in seasons of drought ten millions may be set down as their utmost capacity. The compensating or store reservoirs, constructed by the Schuylkill Navigation Company on Tumbling Run, near Pottsville, are a great assistance to the works, for without them in the latter part of the summer the capacity of the works would probably not exceed eight millions of gallons per day; but these reservoirs are drawn off as the natural supply fails, and keep up the deficiency in part caused by the large increased amount of water used by the Navigation Company since their locks have been so much increased. The great amount of water pumped from the mines adds also to the constant volume of the river. For the most part of the year, the volume of water coming down the river is very much greater than can be passed upon the wheels, and, as a consequence, is wasted. When the proposed additional wheels and pumps are constructed, this will be made available, and give these works a capacity of from sixteen to twenty millions of gallons per day, except in the latter part of the summer, when it will be but ten millions. The cost of these works without mains or reservoirs, but including cost of water-power, dam, mill-house, and pumps, was in all about six hundred thousand dollars as they are now. The running expenses was last year $3,847 00; add to this the interest of the cost, $36,000 00. The repairs which are not so frequently necessary as to the steam machinery, but, by taking the repairs for some years, they are found to be about $5000 00 per annum for keeping up the dam, gates, wheels, and pumps in good working order. The cost of raising one million of gallons of water into the reservoir is $14 66, or $15\frac{27}{100}$ cents

per million gallons raised one foot high. The wood work of the head gates has been thoroughly repaired, and the flume gates are now being renewed; great care has been taken in the selection of the wood, and we may look for durability at least equal to the former ones, which were placed there in 1843. The buildings require considerable repairs, which are now being made, and will require painting inside as well as outside.

The power of the wheels is from thirty-five to forty horse power each, or about three hundred and forty horse power in all. The additional three wheels proposed will be about one hundred horse power each, making the whole power of Fairmount works, with the proposed enlargements, equal to six hundred and forty horse power. For details of the operation of these works the past year, see accompanying Table I.

TABLE I.

Account of the Consumption of Water, and Operation of the Fairmount Water Works, during the year 1858.

	Total number of gallons pumped each month during the year.	Average number of gallons pumped per day each month.	Total No. of hours run eight breast wheel each month.	Average number of hours run by each wheel per day.	Total No. of hours run by Turbine wheel each month.	Average number of hours run by Turbine per day.
January . . .	224,267,755	7,234,443	2554	10.29	395	12.74
February . . .	166,994,220	5,964,079	2045	9.13	166	5.92
March	222,547,810	7,178,961	2644	10.66	294	9.48
April	261,441,820	8,714,727	3054	12.73	392	13.06
May	261,558,573	8,437,373	3012	12.17	431	13.90
June	347,559,469	11,585,315	3935	16.39	633	21.10
July	366,997,070	11,838,615	4227	17.04	604	19.48
August . . .	303,795,305	9,799,848	3737	15.06	287	9.25
September . .	276,821,730	9,227,391	3284	13.68	370	12.33
October . . .	249,269,420	8,040,949	3059	12.34	242	7.80
November . .	199,142,750	6,638,091	2423	10.09	212	7.06
December . . .	178,022,745	5,742,669	2361	9.25	15	...
Total	3,058,418,667					
Daily average .	...	8,379,229				

SCHUYLKILL WORKS.

At these works are four low-pressure or condensing engines. Nos. 1 and 2 are alike, and have vertical steam cylinders with a beam overhead; the pumps are double-acting and vertical, and

are placed immediately under the steam cylinders, the pistons of the pump being a continuation of that of the steam cylinder; the fly-wheels are connected at the opposite ends of the beams to that of the steam cylinders. The following are their dimensions:—

Steam cylinder, 36 inches diameter, 6 feet stroke,
Pump cylinder, 18 " " 6 "
Fly-wheels, 18 feet " weight of each 8840 lbs.

These engines are arranged to cut off at half stroke.

No. 3. This has also a vertical steam cylinder, and gives motion to a pump nearly horizontal by means of a bell crank. The following are the dimensions:—

Steam cylinder, 36 inches diameter 6 feet stroke,
Pump cylinder, 21 " " 4 "

Nos. 1, 2, and 3 are supplied with steam from four tubular boilers, constructed upon a very objectionable plan as regards economy of fuel, durability, and repairs.

TABLE II.

Account of the Consumption of Water and Operation of the Schuylkill Works, during the year 1858.

(Engines Nos. 1, 2, and 3.)

	Total number of gallons pumped each month during the year.	Average number of gallons pumped per day each month.	Total number of pounds of coal consumed each month during the year.	Average number of pounds of coal consumed per day each month.	Number of hours each engine worked per month.	Average number of hours each engine worked per day.
January . .	108,020,750	3,484,540	370,465	11,950	276	8.90
February . .	106,159,200	3,791,400	343,955	12,284	276	9.85
March . . .	139,509,520	4,500,307	584,319	18,849	394	12.70
April . . .	154,892,050	5,163,068	534,205	17,806	410	13.66
May	133,088,950	4,293,191	556,584	17,954	375	12.09
June	127,229,310	4,240,977	581,992	19,399	354	11.80
July	214,708,950	6,926,095	757,010	24,419	572	18.45
August . . .	151,786,500	4,896,338	523,327	16,881	396	12.45
September . .	189,401,710	6,313,390	567,927	18,930	424	14.13
October . .	147,014,300	4,742,396	610,369	19,689	434	14.03
November . .	138,476,020	4,615,867	672,376	22,412	461	15.36
December . .	103,334,400	3,333,367	337,911	10,900	259	8.35
	1,713,621,660	4,694,853	6,440,440	17,645	4632	12.69

Average duty in million pounds raised 1 foot high per 100 lbs. of coal, 25.5

TABLE III.

Account of the Consumption and Operation of the Schuylkill Works during the year 1858.

(Cornish Engine.)

	Total number of gallons pumped each month during the year.	Average number of gallons pumped per day each month.	Total number of pounds of coal consumed each month during the year.	Average number of pounds of coal consumed per day each month.	Number of hours run each month.	Average number of hours run per day.
January . .	76,102,560	2,454,921	184,884	5,964	414	13.35
February . .	64,297,080	2,296,324	132,104	4,718	300	10.71
March . . .	37,104,840	1,196,930	96,852	3,124	185	5.96
April . . .	87,635,520	2,921,175	163,290	5,443	412	13.73
May	81,101,520	2,616,178	175,308	5,655	410	13.22
June	112,759,560	3,758,652	207,564	6,918	526	17.53
July	71,786,880	3,315,705	152,880	4,931	355	11.45
August . . .	129,358,080	4,172,840	234,976	7,579	597	19.25
September . .	118,518,100	3,905,603	303,422	10,114	614	20.46
October . .	129,358,600	4,172,858	242,916	7,830	630	20.32
November . .	95,447,060	3,181,568	190,920	6,364	466	15.53
December . .	102,550,532	3,308,081	193,480	6,241	571	18.41
Total . . .	1,106,020,332	3,030,192	2,278,596	6,242	5480	15.00

Average duty in million pounds raised 1 foot high per 100 lbs. of coal, 46.54.

No. 4 is a Cornish engine with a vertical steam cylinder at one end of an overhead beam, and a single acting plunger pump at the other. The following are the dimensions:—

Steam cylinder 60 inches diameter, 10 feet stroke.
Pump " 30 " " 10 " "

The steam is used at about 35 lbs. pressure, and cut off at twenty-eight inches. Steam is generated for this engine in four cylinder boilers, 54 inches diameter, 30 feet long each, having two heaters underneath 26 inches diameter, and 26 feet long. None of the boilers at these works are of the best construction to insure economical results. Those attached to the cornish engine are, however, much superior to the old ones. Notwithstanding the large amount of money expended in repairs during the former part of the year 1858, there were but two of the engines in running order in July, Nos. 2 and 3, and but No. 3 in perfectly satisfactory (working) order. They are now in much better condition. No. 1 is having a broken valve box re-

placed with a new one, and being put in good running order, it was almost useless in the condition it was through the summer. It will be necessary to place all the engines at the works in the best possible condition, as the demands will be very great next summer.

The two boilers first placed in the works are so far gone as to be unsafe, and two additional ones should be at once constructed in their place, for which there is room in the new boiler-house; they would cost about two thousand five hundred dollars each, and one thousand dollars for the brickwork; this will enable the Department to save a large amount of fuel, and to keep the boilers in better condition. All the boilers are connected, so that any or all of them may be used at pleasure. The following was the duty of engines Nos. 1 and 2 when they were new, from April 1 to December 31, 1845, viz.: 3,582,456 lbs. of anthracite coal was consumed, during which time the engines made 11,300,640 strokes. The height to which the water is elevated is 115 feet, add friction of ascending mains 9 feet, equal to 124 feet; this will make a duty of 26,000,000 of pounds raised one foot high by the consumption of 100 lbs. of anthracite coal. The duty of these engines for the past year was an average of 25,500,000 of pounds raised one foot high with 100 lbs. of anthracite coal. The detailed operations of Nos. 1, 2, and 3, will be shown by the accompanying table, No. 2.

No. 4, the Cornish engine, is in principle the best engine belonging to the Department, as will be seen by inspecting the accompanying table, No. 3, but is not constructed sufficiently strong for the work it has to do. It will be evident from comparison of the accompanying tables, Nos. 2 and 3, that had the water pumped by engines Nos. 1, 2, and 3, been pumped by an engine of the same principle of construction as No. 4, there would have been a saving of 1,298 tons of coal, the services of three of the firemen and one assistant engineer could have been dispensed with, making a saving in all of about seven thousand dollars per annum in the running expenses; from this it is evident that it will be to the interest of the city should they (continue to use the present source of supply) at an early day so substitute a cornish pumping-engine in place of Nos. 1, 2, and 3. Pumping-engines are constructed upon this principle much more economical in consumption of fuel than No. 4.

The capacity of these works through their present mains, and with the boilers now in use, is 10,000,000 of gallons. The cost of them as they are, as near as can be ascertained, is about $150,000 00, the running expenses (coal, oil, engineers, firemen, &c.) the past year $29,467 83; the repairs are about $3,000 00 per annum, interest of cost of work included, making the whole running expenses $41,468 00, or $14 70 per million gallons raised into the reservoir, or 12.41 cents per million gallons raised one foot high. The accompanying Table IV. exhibits the amount of water pumped the past year.

TABLE IV.

Schuylkill Works.

	Total number of gallons pumped each month during the year.	Average number of gallons pumped per day each month during the year.
January	184,123,310	5,939,461
February	170,456,280	6,087,724
March	176,614,360	5,697,237
April	242,527,570	8,084,252
May	214,190,470	6,909.370
June	239,988,870	7,999,629
July	286,495,830	9,241,800
August	281,144,580	9,069,180
September	307,919,810	10,263,993
October	276,372,900	8,915,254
November	233,923,080	7,797,436
December	205,884,932	6,641,449
Total	2,819,641,992	
Daily average	.....	7,725,044

DELAWARE WORKS.

There are two engines at these works, one is high pressure, steam cylinder horizontal, working a horizontal double acting pump by means of a vertical beam, the pump being placed 18 feet below the steam cylinder and opposite to it

Steam cylinder 30 inches diameter, 6 feet stroke.
Pump " 18 " " 6 " "

a connecting-rod at the upper end of the beam gives motion to a fly-wheel 22 feet diameter, and weighing 8½ tons.

No. 2 is a condensing engine, vertical cylinder, overhead

beam, the pump placed horizontal and connected to the steam cylinder by means of a bell-crank which is attached to the piston of the steam engine by being continued through the underhead of the cylinder. The fly-wheel is at the opposite end of the beam.

Steam cylinder 42 inches diameter, 6 feet stroke.
Pump " 19½ " " 6 " "

Steam is generated for these engines in a gang of six cylinder boilers 40 inches diameter, 26 feet long, with a heater under each, and by a large wagon tubular boiler which is used but a small part of the time, the cylinder boilers being principally depended upon, as they consume less coal in doing the same amount of work. These works were in a most deplorable condition; a valve-box in each of the pumps was bursted, so that the pump-cellar was overflowed with water; and both of the engines needed attention; in fact nothing but the pressing necessity upon the works would have induced the running of them in the condition they were found. Two of the cylinder boilers were so much strained as to be useless; they have been repaired, and both of the pumps have been fitted with new valve-boxes. One of the columns supporting the beam of No. 2 is broken and must be braced before the engine is used to any extent. The cost of these works is difficult to ascertain, but $150,000 00 will be about the cost of engine-house, engines, &c. &c.; the expenses for wages, coal, oil, &c., for the past year, have been $16,338 26. It costs, therefore, to raise one million of gallons of water into the reservoir $33 47, or one foot high $29\frac{80}{100}$ cents. A stand-pipe is much needed here; the pumps would be relieved, and a larger amount of water could be pumped, as well as a large saving in fuel and repairs effected by it. The ascending main could then be used for a distributing main, thus greatly increasing the capacity of the works. Their operation is shown by Table V.

TABLE V.

Account of the Consumption of Water, and Operation of the Delaware Works, during the year 1858.

	Total number of gallons pumped each month during the year.	Average number of gallons pumped per day each month.	Total number of pounds of coal consumed each month during the year.	Average number of pounds of coal consumed per day each month.	Total number of hours run each month.	Average number of hours run per day.
January . .	50,389,360	1,625,463	275,560	8,889	507	16.35
February . .	32,739,000	1,169,250	250,996	8,946	419	14.96
March . . .	60,161,976	1,940,708	389,280	12,557	596	19.22
April . . .	60,041,422	2,001,380	362,320	12,077	564	18.80
May	62,652,576	2,021,050	410,496	13,241	596	19.22
June	76,998,824	2,566,627	451,452	15,048	704	23.46
July	79,838,980	2,575,451	470,400	15,174	659	21.25
August . . .	81,649,028	2,633,839	490,560	15,824	729	23.51
September . .	66,770,010	2,225,667	318,232	10,607	610	20.33
October . .	66,355,050	2,140,485	352,960	11,389	606	19.54
November . .	60,659,202	2,021,937	307,570	10,252	594	19.80
December . .	58,932,262	1,901,040	321,226	10,362	557	17.96
	757,187,690	2,074,486	4,401,052	12,057	7141	19.56

Average duty in million pounds raised 1 foot high per 100 lbs. of coal, 16.00.

TWENTY-FOURTH WARD WORKS.

There are two direct acting Cornish pumping (bull) engines here. The steam cylinders are inverted, and placed immediately over the pumps, the pistons of the steam cylinders being attached directly to the pump plungers.

Diameter of steam cylinders 50 inches stroke, 8 feet.
" " pumps " 17 " " 8 "

Steam is generated in four boilers, two for each engine, but all connected. They are full Cornish boilers, six feet diameter, thirty-two feet long, with inside flues four feet diameter. The fire is built in the flues; and the heat is made to pass back through them, then front along the sides, and back again under to the chimney. They are the most economical boilers belonging to the Department. The engines are both fitted with "patent equilibrium valves," which makes them entirely controllable, no matter what the height of the water in the stand-pipe may be. These works have suffered much from being placed in charge of

incompetent hands, and from the ignorance of those who attempted to improve them of the principles upon which they are constructed. The following will illustrate some of the alterations made to these engines. They were originally calculated to use steam of thirty-five pounds pressure to the square inch, expansively. The tappets and levers were so altered that the steam was generated at about fifteen pounds pressure, and made to follow the piston the whole of its journey. The water used in condensing the steam was originally raised by means of a lifting-pump. It was necessary to raise it about twelve feet. The pumps were detached, and the water used for condensing the steam taken from the ascending main under a head of two hundred and thirty feet, without taking the friction of the mains into account. This was taken from the ascending main below the pumps and guard-valve; and, by the water being thus drawn from under the plungers, they fell a considerable distance before they met the water. As the plungers weigh twenty-three thousand pounds each, the concussion produced by their fall bursted the guard- and stop-valves, and several times the ascending main, as well as loosened many of the joints. It has cost, in repairs to the ascending main, valve, &c., the past six months, not less than $1500 00; and it will require at least $500 00 more to put it in complete order. Other like alterations were made; and, although much has been done, it will be impossible to restore them to their original effectiveness without entirely rebuilding them. That which was ignorantly taken to be defects, and which they attempted to remedy, was, in reality, among the good points of the engines. The duty of these engines, running irregularly, as they of necessity must, without a reservoir, has been reduced very much from what they originally gave. The boilers and flues had also been neglected for a long time.

Notwithstanding they were so much out of repair, and the irregular manner in which they are of necessity run for want of a reservoir—the engines being worked as the water is used—had the Delaware works been fitted with pumping-engines such as these, instead of those in the works, the saving in pumping the amount of water that was raised the past year would have been 800 tons of coal, which, at the price paid for coal, would

be $3500 00. The services of two of the firemen could be dispensed with, making a total saving of $4440 00.

The rapid increase in the demand for water made upon these works makes the immediate erection of a reservoir necessary. The average daily amount of water the latter part of 1855, when the works were first run, was 103,606 gallons; in 1856, 143,654 gallons; in 1857, 334,106 gallons; in 1858, 559,390 gallons. From this, it will be evident that, in the warm months of the coming summer, there will be a deficiency, as, without a reservoir, the capacity of the works is 1,000,000 gallons per day, being the amount that can be pumped by one engine.

The cost of pumping water at these works the past year, including interest upon engines and engine-house, &c., coal, oil, repairs, &c., wages of engineers and firemen, was $10,482 05, or $46 48 per million gallons raised into the stand-pipe, equal to 22.33 cents per million gallons raised one foot high.

The accompanying Table VI. exhibits the operation of these works the last year:—

TABLE VI.

Account of the Consumption of Water, and Operation of Twenty-Fourth Ward Works, during the year 1858.

	Total number of gallons pumped each month during the year.	Average number of gallons pumped each day during the month.	Total number of pounds of coal consumed each month during the year.	Average number of pounds of coal consumed per day each month.
January	10,033,278	323,654	62,720	2,023
February	9,390,600	335,378	69,320	2,440
March	11,009,186	335,135	71,680	2,312
April	10,473,950	349,131	72,800	2,427
May	11,844,940	382,095	78,400	2,529
June	17,163,366	572,112	134,400	4,480
July	18,749,710	604,829	143,600	4,632
August	14,549,920	469,352	151,138	4,875
September	30,025,292	1,000,843	195,857	6,528
October	30,088,460	970,596	171,850	5,544
November	20,061,104	668,703	148,400	4,947
December	20,787,818	670,574	145,336	4,688
Total	204,177,624	559,390	1,444,501	3,949

Average duty in million pounds raised 1 foot high per 100 lbs. of coal, 27.

In conclusion, it is but justice to the engineers who have charge of the works, as well as to the Department, to show the difference in expenses of running the several works (labor excepted), which is the same between the first six months and the last six months of the year.

Supplies for all works.

	From January to July.	From July to January.
Coal	$18,228 90	$14,260 52
Oil and tallow . .	3,184 03	1,439 26
Wood	291 73	21 00
Packing waste, &c. . .	927 17	690 81
	$22,631 83	$16,411 59
Cr. By 350 tons of coal on hand, at $4 . .		1,400 00
Which is an excess of the amount on hand July 1st		$15,011 59

Being a saving of $7,620 24. The amount of water pumped the last six months above the first six was 589,087,993 gallons. This would make the expense to the city in the above supplies, in raising one million of gallons of water into the reservoirs for the first six months, an average of $7 24½, and for the last six months $4 04¼, or a saving of sixty-four dollars per day in the above supplies alone in raising the average daily amount, or a total saving of $11,885 88 for the last six months.

The following exhibits the cost of raising one million gallons of water in the reservoirs, and also that of raising it one foot high by the different works including all expenses, interest of works, &c. :—

	Into reservoirs.	Height of reservoirs.	One foot high.
Fairmount . . .	$14 66	96 feet.	15⅓ cents.
Schuylkill . . .	14 70	119 "	12⅓ "
Delaware . . .	33 47	112 "	29¾ "
24th Ward . . .	51 38	230 "	22⅓ "

The discrepancy between this comparison and that made in the Report of 1851, pages 8 and 9, is explained by the fact that no charge was then made for the water-power at Fairmount.

The accompanying Table VII. exhibits the amount of water pumped by all the works.

TABLE VII.

Total Quantity of Water pumped by all the Works in the City during the year 1858.

	Total number of gallons pumped each month during the year.	Average number of gallons pumped per day each month during the year.
January	468,813,703	15,123,022
February	379,580,100	13,556,432
March	470,333,332	15,172,043
April	574,484,760	19,149,492
May	550,246,559	17,749,889
June	681,710,529	22,732,684
July	752,081,590	24,260,696
August	681,138,833	21,972,220
September	681,536,824	22,717,844
October	622,085,830	20,067,284
November	513,786,142	17,126,204
December	463,627,757	14,955,734
Total	6,839,425,959	
Daily average	.....	18,738,153

Total quantity consumed first six months		3,125,168,983
" " last "		3,714,256,976
		6,839,425,959
Daily average first six months	17,266,126	
" last "	20,186,179	
Average daily increase of the amount of water pumped over that of 1857		1,428,835

RESERVOIRS.

At Fairmount there are four reservoirs containing, together, 26,896,636 gallons, the surface of the water is 96 feet above tide; another reservoir, located on Corinthian Avenue and Poplar street, is connected with these works; this can, however, only be used as a store reservoir to the old reservoirs as they have no independent connection. When used as recommended (see accompanying report) it will be of great importance to the Department. The surface of the water in this reservoir is 110 feet above tide. This will contain 20,321,392 gallons, and with the four reservoirs at Fairmount a storage capacity of 47,218,028 gallons, this would be equal to the average supply of nearly four days when the demand was greatest. All that portion of the city lying south of Vine street, comprising First, Second, Third,

Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, and Tenth Wards, receives its supply from these reservoirs and Fairmount Works.

Schuylkill Works have but one reservoir; the surface of the water is 119 feet above tide, and it contains 9,800,000 gallons. This reservoir is entirely too small; when any accident occurs to the mains or machinery, it is drawn off in a few hours. The proposed alterations in the height of the new reservoirs and Delaware reservoir, so that the surface of the water will be on the same level in all of them, will remedy this defect, as there will not only be a larger storage capacity, but the works can mutually assist each other. There is not now storage capacity (in the reservoir of Schuylkill Works) equal to one day's average supply for September, when the demands upon the works were greatest. That part of the city lying north of Vine street to Cohocksink Creek, from thence all west of Sixth street, is supplied from these works, comprising Eleventh, Twelfth, Thirteenth, Fourteenth, Fifteenth, Twentieth, and part of the Sixteenth Wards, depends entirely upon this reservoir.

Delaware Works have two reservoirs; the surface of the water in these is 112 feet above the tide. They contain, together, 9,284,000 gallons; this is equal to nearly four days' average supply when the greatest demands were made upon the works. The city lying east of Sixth Street and north of Cohocksink Creek, comprising part of the Sixteenth, Seventeenth, Eighteenth, Nineteenth, and Twenty-third Wards, is supplied by these works. When the contemplated improvements (see accompanying report) are made the storage capacity of the new city reservoir will be increased 13,733,325 gallons, the Delaware reservoir 10,207,256 gallons. There will then be storage capacity in the new reservoir of 34,054,707 gallons, in the Schuylkill reservoir as it is 9,800,000 gallons, and in the Delaware reservoir, as it will be when raised as proposed, 19,491,258 gallons, making a total storage capacity of 63,345,963 gallons. Allowing that it requires an average of 2,500,000 gallons a day to supply First, Second, Third, and Fourth Wards, and an average of 7,725,044 gallons were required to supply Eleventh, Twelfth, Thirteenth, Fourteenth, Fifteenth, Twentieth, and part of the Sixteenth Wards, and an average daily supply of 2,074,486 gallons for the Seventeenth, Eighteenth, Nineteenth, Twenty-third, and part of the Sixteenth Wards, making in all an average daily

supply of 12,299,530 gallons, there will then be a storage capacity equal to five days' supply. With the proposed additions the city will be but poorly supplied with reservoirs, but as the works will be so arranged that they can mutually assist each other, the risk of being out of water is greatly decreased.

Twenty-Fourth Ward Works. The stand-pipe is still depended upon for a reservoir. This, until lately, was almost destroyed, so far as storage capacity was concerned, by a pipe inserted in the inside leading to within thirty feet of the top; this, instead of leading the water into the stand-pipe, was the one by which it passed out, making but thirty feet of the stand-pipe available for storage. This was another of the alterations made to these works. A branch was inserted in the main to connect with the reservoir as well as surveys made, and a proper location selected (see accompanying report), and there should be no further delay in constructing it, as the works have already been in operation over four years, and, although they have succeeded in keeping up a much more uniform and giving a larger supply than was expected, they could be made to do without a reservoir, having nothing but the stand-pipe to depend upon. No better evidence is needed of the reliability of the engines than the constant supply they have kept up even though badly managed and neglected.

DISTRIBUTION.

No pipe over twelve inches diameter has been laid since Consolidation until this summer, while over 200,000 feet of distributing main have been laid down, principally 4 and 6 inch, and, as a consequence, great deficiency is felt in the supply of water in some portions of the city. The proposed mains (see accompanying report) will remedy many of these deficiencies, and give a satisfactory supply to the citizens now so indifferently supplied; but it will be necessary to lay several additional large mains in a few years, as there will be still deficiencies felt, and which, by the extensions of the service mains, are constantly being made greater. There can be no better evidence of the rapid growth of the city than the great amount of pipe laid, when it is remembered that pipe is only laid in public streets and upon the petitions of the owners of property, who pay all the expenses of such extensions. The first six months of this year there was

17,079 feet of pipe laid, which cost, including making and setting of stops, fire-plugs, and every expense, pipe, lead, and castings excepted, $10,453 24, or 61.20 cents per foot; and from the first of August to the present time there has been laid 55,045 feet of pipe, including all expenses for labor, making and setting stops, fire-plugs, &c., material only excepted, at a cost of $15,697 82, or 28½ cents per foot. 2,376 feet of the latter pipe is a sixteen inch main, extending from the thirty inch main on Poplar street along Twentieth to Green street. It has fully answered all expectations, and now gives an abundant supply of water to that portion of the Fifteenth Ward. The saving to the city in the expense of laying pipes the latter part of the year in comparison with the former was therefore $18,100 78. The last of the old wooden pipes in use for water mains have been taken up and iron pipe substituted. These were laid from Arch to Vine on the east side of Broad street, and from Filbert to Vine on the west side of Broad street, and on the south side of Vine from Broad to Fifteenth street. The logs taken up were in a remarkable state of preservation, and would have probably answered for many years had it not been for the steam engines which have lately been attached to them for their supply, since which time they have been a constant source of annoyance and expense. Up to 1832, the city had laid 241,604 feet of wooden pipe, since which time none have been laid, and that which was laid has been gradually substituted by iron pipe. At first, wooden pipe was thought superior to iron, and was used entirely until 1804, when 3,978 feet of the latter were laid; but from that time until 1818 none but wooden pipe was used. In that year 400 feet of iron pipe were laid, and in 1820 the committee on water became satisfied from their experience that they were not only as good as wood, but, in fact, better. Iron pipes were therefore substituted for the wooden ones; they were found not only stronger but more durable, easier laid, and less expensive. A large number of the stops in the mains were out of order, many of them closed, or but partly opened. A number of connections have also been made which will perfect the circulation and add to the supply of water. The eighteen-inch main leading from the Delaware reservoir, at Seventh and Germantown road, was laid so near the surface that the stop at this point had never been opened to within seven inches and a

half of its full capacity; this has been lowered nine inches, and the stop is now opened to its full area. This will assist in making up the deficiency felt in this district.

The deficiency in supply at the vicinity of Broad and Girard avenue demands early attention; if the twenty-inch main is laid to connect the Schuylkill and Delaware reservoirs, it will remedy it.

The accompanying tables, Nos. 8, 9, 10, and 11 exhibit the locality of the pipe laid the past year, and table No. 12 the total amount of pipe laid.

TABLE VIII.

First District.

Iron Pipes laid in the First, Second, Third, and Fourth Wards.

Streets.	Location.	Size.	Feet.
Rye	South of Reed	3 in.	240
Watkins . .	From Fifth to Sixth	4 in.	444
Franklin . .	From Sixth to Seventh	"	445
Francis . .	West of Twelfth	"	352
Lancaster .	South of Reed	"	332
Fourth . . .	From Moore to Mifflin	"	12
Marshall . .	From Fourth to Fifth	"	452
Church . . .	North from Reed	"	238
Taylor . . .	Ninth to Passayunk Road	"	829
Pearce . . .	From Fourth to Fifth	"	452
Barlow . . .	From Wharton to Reed	"	455
Wheat . . .	From Marion to Wharton	"	294
Earp . . .	From Eighth to Ninth	"	475
Anthony . .	South from Dickerson	"	225
Evangelist .	West from Seventh	"	330
Shippen Lane	From Shippen to Fitzwater . . .	"	375
Canal . . .	From Moyamensing Av. to Fifth . .	"	720
Williams . .	From Moyamensing Av. to Crosby . .	"	410
	Attachments to fire-plugs	"	71
Morris . . .	From Fourth to Jefferson Av. . . .	6 in.	310
Seventh . .	From Morris to Moore	"	425
Tenth . . .	From Lewis to Morris	"	140
Morris . . .	East from Tenth	"	225
Fourth . . .	From Moore to Mifflin	"	400
Church . .	South from Reed	"	26
Moore . . .	From Cuba to Jefferson Av. . . .	"	207
Moore . . .	From Fifth to Sixth	"	452
Seventeenth .	From Carpenter to Prime	"	408
Seventeenth .	From Catherine to Christian . . .	"	395
Jefferson Av.	North of Moore (west side) to Gardette .	"	1,214
Jefferson Av.	From Greenwich to Franklin (east side) .	"	310
Jefferson Av.	From Morris to Moore	"	450
Jefferson Av.	From Franklin to Cottage	"	777
Church . .	From Reed to the canal	"	2,051
Moore . . .	From Front to Church	"	255
Sixteenth . .	From South to Shippen	"	300
Shippen . .	From Twentieth to Twenty-Second . .	"	935
Jefferson Av.	From Moore to Mifflin (both sides) . .	"	927
Moore . . .	From Jefferson Av. to Fourth	"	326
Prime . . .	From Gray's Ferry Road to Twenty-Fourth	"	1,220
	Connections, &c.	...	125
			19,029

Of the above, 3,414 feet were laid first six months.
15,615 " last "

TABLE IX.

SECOND DISTRICT.

Iron Pipes laid in the Fifth, Sixth, Seventh, Eighth, Ninth, Tenth, and Twenty-Fourth Wards during the year 1858.

Street.	Location.	Size.	Feet.
Darby Road . .	From Maylandville to Hamilton Terrace	6 in.	1,014
Hamilton Terrace	From Baltimore Pike to Darby Road .	"	666
Baltimore Pike .	From Hamilton to Till St. . . .	8 in.	651
Thirty-fourth . .	From Oak to Chestnut	6 in.	245
Thirty-third . .	From Lancaster Pike to near Bridge .	"	2,450
Bridge	West of Thirty-third (relaid) . . .	"	250
Thirty-third . .	South from Bridge St.	"	26
Eagle	From Lexington to Oneida St. (relaid) .	"	685
Lexington . . .	(Relaid)	"	498
Bridgewater . .	North from Market	"	193
	Connection to Almshouse . . .	"	36
	Attachment to Till St.	10 in.	40
Johnson . . .	. . . . .	4 in.	498
Bridge	(Relaid)	"	17
Walter	. . . . .	"	436
George	From Eighteenth to Nineteenth . .	"	324
Broad	From Arch to Vine (east side) . .	"	1,280
Broad	From Arch to Race (west side) . .	"	647
Broad	From Vine to Race and from Arch to Filbert (west side)	"	1,228
Logan	From Lancaster Av. to Haverford Rd. .	"	936
Vine	From Broad to Fifteenth (south side) .	"	452
Bridgewater . .	North from Market	...	6
	Attachments to plugs	4 in.	144
Eagle Court . .	From Bird's Alley to termination . .	3 in.	340
Barker	From Nineteenth to Twentieth . .	"	253
Chestnut . . .	West of Darby Road	8 in.	620
	Total . . .		13,835

Of the above, 5,830 feet were laid during first six months.
8,005 " " last "

TABLE X.

Third District.

Iron Pipes laid in the Eleventh, Twelfth, Sixteenth, Seventeenth, Eighteenth, and Nineteenth Wards.

Street.	Location.	Size.	Feet.
Susquehanna Av.	From Front to Second	6 in.	1,130
Emerald	From Letterly to York	"	602
Emerald	From Huntingdon to Letterly	"	1,000
Sepviva	From Wood to York	"	585
Coral	From Front to Wood	"	383
Sepviva	From Vienna to Wood	"	838
York	From Commerce to Gunner's Run	"	359
Amber	From Cumberland to Sergeant	"	393
Sergeant	From Amber to Emerald	"	862
Coral	From York to Adams	"	418
Coral	From York to Dauphin	"	397
Coral	From Cumberland to Huntingdon	"	794
Cumberland	From Emerald to Jasper	"	448
York	From Cedar to Brown (west side)	"	1,371
York	From Duke to Brown	"	201
Coral	From Dauphin to Wood	"	403
Jefferson	From Germantown Road to Fourth	"	144
Cumberland	From Coral to Emerald	"	445
Fourth	From Diamond to Susquehanna Av.	"	599
Fourth	From Susquehanna Av. to Dauphin	"	608
Parker	From Wood to Dauphin	4 in.	300
Girard Av.	From Ash towards Norris	"	413
Ash	From Brown to West	"	216
Parker	From York to Adams	"	401
Letterly	From Amber to Emerald	"	840
	Attachments	"	36
	Total		14,195

Of the above, 1,166 feet were laid the first six months.
13,029 " " last "

TABLE XI.

Fourth District.

Iron Pipes laid in the Thirteenth, Fourteenth, Fifteenth, and Twentieth Wards.

Street.	Location.	Size.	Feet.
Oxford	From Eleventh to Mervine	3 in.	6
Oxford	" "	6 "	260
Columbia Av.	From Mervine to Twelfth	6 "	269
"	" "	4 "	18
"	" "	3 "	6
Thompson	From Seventh to Eighth (both sides)	6 "	18
"	" "	4 "	997
"	" "	3 "	4

TABLE XI.—CONTINUED.

Street.	Location.	Size.	Feet.
Green	East from Pennsylvania Av.	6 in.	173
"	" "	4 "	17
"	" "	3 "	6
Linn	From Twenty-second to Twenty-fourth	6 "	36
"	" " "	4 "	1,041
"	" " "	3 "	4
Cambridge	From Sixteenth to Seventeenth	4 "	451
"	" "	3 "	4
Stiles	" "	4 "	467
"	" "	3 "	4
"	From Eighteenth to Ridge Av.	4 "	486
"	" "	3 "	4
Hutchinson	From Thompson to Girard Av.	4 "	657
"	" "	3 "	4
Tyler	From above Poplar to Girard Av.	4 "	607
"	" "	3 "	4
Lewis	From Jefferson to Oxford	4 "	555
	Pipe used on connections at dead ends	10 "	68
	" " "	8 "	104
	" " "	6 "	182
	" " "	4 "	217
Twentieth	From Spring Garden to Hamilton	6 "	454
Hamilton	From Twentieth to Twenty-first	6 "	516
"	From Twenty-fourth to Twenty-fifth	6 "	493
Oxford	From Tenth to Eleventh	6 "	428
Columbia Av.	From Twelfth to Thirteenth	6 "	448
Jefferson	From Seventh to Eighth	6 "	907
Thompson	From Eighth to Ninth (both sides)	4 "	525
Burn's	From Columbia Av. to Oxford	4 "	545
North	From east side of 16th to west side of 18th	4 "	934
Franklin	From Thompson to Master	6 "	477
Master	From Twelfth to Broad	6 "	1,071
Biddle	From Twenty-third to Twenty-fifth	4 "	936
Mulveyney	From Columbia Av. to Jefferson	4 "	1,107
Spring Garden	From Twenty-fourth to Twenty-fifth	4 "	945
Cadwalader	From Jefferson to Oxford	4 "	531
Marshall	From Oxford to Montgomery	6 "	980
Germantown Rd.	From Susquehanna Av. to Eighth	6 "	1,620
Centre	From Eighteenth to Twentieth	4 "	870
Twentieth	From Green to Poplar	16 "	2,376
Germantown Rd.	From Diamond St. to Susquehanna Av.	6 "	374
West	From Coates to Brown	4 "	650
Fennimore	From Sixteenth to Seventeenth	4 "	450
Girard Av.	From Tenth to Eleventh	4 "	453
	Connections	4 "	110
	"	6 "	196
	Total		25,065

Of the above, 6,669 feet were laid first six months.
18,396 " last "

TABLE XII.

Recapitulation.

WARDS.	3 inch pipe.	4 inch pipe.	6 inch pipe.	8 inch pipe.	10 inch pipe.	16 inch pipe.	Total.
First District.							
First, Second, Third, Fourth	240	6,911	11,878	...	...	...	19,029
Second District.							
Fifth, Sixth, Seventh, Eighth, Ninth, Tenth, Twenty-fourth	593	5,868	6,063	1,271	40	...	13,835
Third District.							
Eleventh, Twelfth, Sixteenth, Seventeenth, Eighteenth, Nineteenth	...	2,206	11,989	...	...	...	14,195
Fourth District.							
Thirteenth, Fourteenth, Fifteenth, Twentieth . . .	46	13,569	8,902	104	68	2,376	25,065
	879	38,554	38,832	1,357	108	2,376	72,124

Total number of feet laid first six months . . .	17,079	
" " last " . . .	55,045	
Total number of feet laid during the year . . .		72,124
" " previously		1,429,037
Total number of feet now laid		1,501,161

Being a total of 321 feet more than 284¼ miles.

The pumping mains at all the works are entirely too small. Fairmount is better supplied than any of the other works. The mains are all short (about three hundred feet), and one to each of the pumps, each sixteen inches diameter, being the same as that of the pumps. At the Schuylkill works, there are three mains, two of eighteen inches diameter and one of twenty inches diameter; they are each three thousand two hundred and fifty feet long; they convey the water pumped by two eighteen inch, one twenty-one inch, and one thirty inch pump; it is impossible to work all the pumps at the same time without risking the bursting of some of the mains or connections. At the Delaware works, there is but one main of eighteen inches diameter and thirteen thousand two hundred and sixty feet in length. All the water pumped by two eighteen inch pumps must be forced through this main, and when both the pumps are run together, it results in a fracture of some kind either in the pumps or mains.

Twenty-fourth Ward works has but one main of sixteen inches diameter, twelve hundred feet long, through which all the water pumped by two seventeen inch pumps must be forced. This main should be twenty inches, as originally designed.

QUALITY OF WATER SUPPLIED.

Fairmount.—Except in times of freshet the water supplied by these works is but little objected to, and in fact has probably not deteriorated much in quality since the construction of the works. The pool formed by the dam is a vast subsiding reservoir, and if in its construction there had been a sluice-way made where the river is deepest, little or no fault could be found with the character of the water, but as it is the best of water or that freest from organic or other impurities passes over the dam, while that which contains a larger proportion of impurities is supplied to the wheels and pumps. By constructing a sluice-way leading from the deeper parts of the pool, so that a large part of the water which now passes over the dam in the ordinary stages of the river, could be drawn from near the bottom or deeper parts of the pool. A sunken dam or vier should also be constructed from the end of the mound-dam across the opening of the head gates to the end of the steamboat wharf, this vier should come to within eighteen inches of the surface in ordinary stages of the river. The impurities could then be drawn off by the sluice, and the purer water only pass over this sunken vier to the works. It has been found by careful observation at the Germantown water works, which are supplied by a small stream into which much that is objectionable is drained, that while at the bottom of the collecting reservoir the water may be totally unfit for use, being sometimes even offensive to the smell, at the same time that within a few inches of the top is limpid and perfectly free from taste or odor, and Germantown is supplied with very excellent water from this source at all seasons of the year; by the careful management of this stone reservoir all the surplus water, except in times of heavy freshet, is discharged from the bottom of the reservoir, and the impurities consequently carried with it.

It will also be necessary to prevent the draining of all objectionable matter into the Schuylkill, at least as far up as the

falls, so that all impurities can have an opportunity of sinking before they reach the works, which they will do with great rapidity particularly when the sun shines upon the water.

Schuylkill Works.—The character of the water supplied by these works is about the same as that of Fairmount. It could be improved by deepening the forebay so as to allow subsidence, and by making such arrangements that the water could be taken from near the surface. A fine opportunity was afforded to improve the water when the wharf in front of the works was extended, but it was neglected, and the undertaking would now be attended with great expense.

Delaware Works.—These works take their supply from the River Delaware. At certain seasons of the year the character of the water supplied by these works is much complained of, and has been in fact unfit for drinking and culinary purposes. The remaining part of the year it is highly esteemed, and preferred, by those who use it, to the water supplied by the Schuylkill. After a careful examination of the subject, no entirely satisfactory reason can be given for these difficulties, or a remedy suggested in which there is a positive certainty of success. It is to be regretted that more careful examinations and observations have not been made or records of any kind kept. The Department will carefully observe the condition of the water every day as soon as the warm weather commences, and endeavor, if possible, to guard against the re-occurrence of these difficulties, or at least collect such facts as will enable the difficulties to be remedied in the future.

Some alterations should be made in the inlet where the water is received from the river; the trunk leading from the end of the pier has been examined and found in as good condition as when first put in, but it was partly filled with mud, which has been in part and will entirely be removed as soon as practicable; the mouth of the trunk is placed entirely too low, from the mistaken idea that the purest water could be found at or near the bottom of the river. The pier should be extended, and a new inlet from the river constructed. The alterations suggested in the pier of the Lehigh Coal Company, above the works (see accompanying report), would assist greatly by passing impurities from the creek through the sluice-ways which now pass in front

of the trunk, and are liable to be drawn into it and pumped into the reservoirs.

Twenty-Fourth Ward.—These works are situated on the west bank of the Schuylkill, a short distance above the dam. This location has frequently been objected to; and it is not that originally selected, which was near the foot of the inclined plane. Notwithstanding the apparent objections to the location of these works, the water supplied by them is more uniformly limpid than that supplied by any other of the works which take their water from the Schuylkill. The water is received through a tunnel of very large dimensions into the strainer and stop-house, where that near the surface is made to pass through a number of apartments in which the water is ten feet deep, through a series of strainers. When two millions of gallons a day are supplied by these works, the velocity of the water passing through this tunnel into the reservoir is but about two miles per day, thus allowing the heavier impurities to fall in the tunnel, or be stopped in the chambers before passing into the subsiding reservoir, which is seventeen feet deep, seventy-five feet wide, and one hundred and sixty-five feet long. At the opposite end to that at which the water enters the reservoir, it is drawn from near the surface into the pump-well, under the engine-house; by this means, with attention, the water supplied by these works will always be limpid, no matter in what condition or how turbid the water in the river may be.

It would certainly be better to bring the water for the supply of the city from a distance than to take it from the rivers immediately in the vicinity. It is therefore hoped that Councils will make the necessary appropriation at an early day, so that the preliminary explorations and surveys may be made, which, it is believed, will demonstrate the practicability of securing an abundant supply of unexceptionable water by gravitation, and perhaps at a saving of expense over the present mode of procuring it. Where water is so largely used for mechanical and chemical purposes as in this city, the demand for such purposes rapidly increasing, the water should never be turbid, but uniformly limpid. It is unnecessary to enlarge upon the necessity of the water supplied for domestic purposes being of an unexceptionable character, the health as well as the comfort of the citizens being materially affected by it.

GROUNDS.

These have been much neglected for several years. The embankments at Fairmount have been gullied and washed with the rains. The grass and trees have been very much injured by the goats who have had free range of the grounds. A large amount of repairs have been done to the embankments by filling the gullies, sodding and planting trees in place of the dead ones. The pavements and drains have also been put in good order, as well as the fencing around the park. It will still need a large outlay to place and keep the grounds in the condition they should be kept.

The lot to the north of the reservoirs has been laid out in walks, and, to a large extent, graded and prepared for planting grass in the spring. Three hundred choice shade-trees and evergreens have been set out. When these grounds are in order, the city will have a park of thirty acres, which cannot be excelled in attractiveness and interest, making it the most pleasant and convenient place of resort in the city; and every effort will be made by the Department to keep this, as it always has been, the most favored resort of our citizens. An efficient and gentlemanly police-officer is always on the ground, so that there is no improper conduct; and the citizens may resort to it, or send their families with perfect safety.

The fencing at Schuylkill works will require renewing in the spring; and those generally around the reservoirs require repairing and whitewashing.

SHOP.

The shop in Cherry street has been much neglected. No change has been made in the tools, or additions made to them, for many years. It was originally intended to do the work for Fairmount Water Works; but, since Consolidation, all the stops, plugs, &c., required by the Department should be made here; but this, for want of tools, is impossible; and numbers of stops and plugs, as well as a large amount of other work, has to be done in other shops, much to the disadvantage of the Department. The sum of six thousand dollars spent in enlarging the shop, erecting a small steam-engine, and purchasing a few simple tools, will enable the Department to make and repair all the stops

and plugs which the city requires, as well as make and dress the tools, and, to a considerable extent, do the repairs for the works, thereby saving several thousand dollars annually. The following is an account of the operation of the shop since July, no accounts being kept previous to that time. The credits are as low as the city procures work of the same kind from other shops.

1858, Dec. 31.	Cr.	By stops, plugs, &c., furnished 1st Dist.		$2029 48
	"	" " " " " "	2d "	852 25
	"	" " " " " "	3d "	667 38
	"	" " " " " "	4th "	1605 47
	"	" ferrules for Register's office		459 00
	"	" repairs for Fairmount works		172 92
	"	" " " Schuylkill "		49 68
	"	" " " Delaware "		32 75
	"	" " " 24th Ward "		66 49
	"	" stock on hand		2787 23
				$8722 65
July 1st.	Dr.	To stock on hand	$3790 34	
Dec. 31st.	"	" materials, iron, brass, &c. &c.	2195 01	
" "	"	" Wages	1898 38	
				7883 73
Balance profit of the shop for six months				$838 92

The office accommodations for the department are entirely inadequate; such arrangements should be made that the department could do all its business in one office, which would save a large amount of trouble and time. The public are very much inconvenienced in paying their water rents and transacting other business; the attention of Councils has frequently been called to this subject, and it is hoped they will take some speedy action upon it.

STEAM FIRE-ENGINES.

This most valuable addition to the fire department, so far as any practical adaptation of steam to fire-engines is concerned, was first introduced into this city the past year. It is true the city owned a steam fire-engine for some time previous, but only lately has been put to practical use, after an expenditure of a large sum of money for repairs and alterations. What is known as the Philadelphia steam fire-engine No. 1 is in every respect an efficient and practically useful apparatus, simple and durable in construction of both boiler and machinery. Great difficulty

has been experienced in procuring an adequate supply of water for them; this has in part been remedied by applying the suction of the engine immediately to the plug; while this gives a much better supply of water, the ram or concussion produced by the operation of the pump loosens the joints of the plug or some of the connections, and in one instance the main was burst; to remedy this defect, and also to give a more copious supply of water, the department has constructed a fire-plug of much larger dimensions than that now in use, and which has in addition an air-chamber attached to it, to receive the ram of the water. It is hoped by means of this that the steam fire-engines can be worked without the city being put to the expense of constructing large cisterns to pump from.

Stationary steam fire-engines in large establishments where steam is used, is found a valuable protection against fire. If Councils would pass an ordinance allowing any establishment paying over fifty dollars per annum water rent the use of a fire-plug to be erected, in any convenient place on the premises at the expense of the owners of the establishment, provided they will not use the plug except in case of fire, no doubt many such engines would be erected. They should have pumps at least four inches diameter and five hundred feet of good hose with a branch pipe always ready for use; they would not only be of use to the establishments in which they are located, but of great value in case of fire in the vicinity.

STREET-STOPS AND FIRE-PLUGS.

The following table exhibits the number of fire-plugs and stop-valves in each of the four districts into which the city is divided by the Department; also the number of fire-plugs attached to the mains of the Germantown Water Company.

District.	No. of cocks in mains.	No. of fire-plugs.
First	424	531
Second	1,146	763
Third	868	572
Fourth	661	581
22d Ward (Germantown)	...	54
Total	3,099	2,501

The 2,501 fire-plugs in the city cost about one hundred thousand dollars; the expense of keeping them in repair is about two thousand dollars a year; this, with the interest upon the cost, will make them an annual expense to the city of eight thousand dollars. It is also necessary to erect about two hundred and fifty each year at a cost of one thousand dollars. At the rates in which the mains are now being extended makes the total annual expenses of the fire-plugs say nine thousand dollars. As the Insurance companies are the parties most benefited by these plugs, should not some measures be adopted by which at least a large portion of these expenses should be borne by these companies, and not by the Department, as they yield no income? and it should also be borne in mind that a very large amount of water is annually used in extinguishing fires.

FINANCE.

For the receipts and operations of the register's office, see the accompanying report of the register, W. J. P. White, Esq.

The necessity of the re-assessment of the water rents, which has been apparent for some years back, and which was several times commenced, was, as soon after the organization of the present Department and the proper authority and appropriation could be procured from Councils, commenced, and has been prosecuted with vigor, and now almost completed. It will be found a work of great importance and thoroughly and carefully done, and with ordinary care the books can be kept up. It will also largely increase the revenue of the Department.

The following amounts have been received at the Cherry street office since July and paid to the city treasurer:—

Rent of wharf at Fairmount	$100 00
Rent of lot 20th and Poplar st.	29 75

The expenditures of the Department for the year have been as follows:—

Salaries and office expenses	$31,109 84
Coal, oil, &c., including supplies of all kinds	38,776 98
Repairs to building and machinery	21,089 20
Taxes	393 40
Iron pipe and castings	54,814 35
Labor laying pipe, setting plugs, stops, &c.	26,129 77
Repairs to plugs, stops, pipes, &c.	12,293 49
Re-assessment of water rents	3,189 00
Old bills	182 06
Total,	$187,978 09
Unpaid bills of all kinds against the Department	$6,453 52

The estimated expenses for eighteen hundred and fifty-nine are as follows:—

Salaries	$36,300 00
Supplies	29,450 00
Repairs	16,250 00
State Taxes	500 00
Extending mains, making new attachments, &c.	89,200 00
Total,	$171,700 00

The following table will exhibit the income and expenses of the Department for the past four years, 1855, 1856, 1857, 1858; to this should be added the amount collected by the solicitor for water-pipe; the Department has no means of ascertaining the amount except for the past year, when $29,987 16 were returned to the solicitor for water-pipe, to collect by lien.

	Receipts.	Expenditures.	Balance profit.
1855	$382,036 72	$250,895 37	$131,141 35
1856	351,936 49	138,954 85	212,981 64
1857	425,426 11	200,605 82	224,820 29
1858	457,518 48	187,978 09	269,540 39
Totals	$1,616,917 80	$778,434 13	$838,483 67

The amount of loans on account of water works yet to be redeemed, 672,700 00.

The following bills for water-pipe have been served by the inspectors of the several districts from July to January, with the reductions and allowances for corners.

	Feet of frontage.	Total amount.	Reductions.	Amts. due City for pipe.
First District . . .	22,447¾	$16,835 84	$2,519 70	$14,316 14
Second " . . .	9,737½	7,303 12	823 97	6,479 15
Third " . . .	16,272½	12,204 36	941 26	11,263 10
Fourth " . . .	21,326½	15,994 50	1,020 32	14,974 18
	69,784¼	$52,337 82	$5,305 25	$47,032 57

Yours, respectfully,

HENRY P. M. BIRKINBINE,
Chief Engineer.

DEPARTMENT FOR SUPPLYING THE CITY WITH WATER.
Philadelphia, January 12, 1859.

H. P. M. BIRKINBINE, ESQ.,
Chief Engineer of the Water Works.

SIR: Inclosed herewith you will find a full report of the receipts and deposits of this Department for the year 1858.

The amount of water rents of 1858, remaining unpaid December 31, 1858, was $10,082 71, of which $2450 50 has been paid since, leaving the amount to be collected $7632 21, of which a very large proportion will be found to be errors, which, of course, cannot be collected. These discrepancies are caused by the imperfect and incorrect registers from which the duplicates were made, and mostly arise from the very inaccurate means of identifying the different properties. I fear it will be impossible in many cases to execute the law relative to cutting off the pipes of delinquents to the full extent.

In consequence of the extraordinary amount of labor required to make the new registration of water rents, as directed by ordinance of October 16, 1858, it is impossible to have all the duplicates for 1859, prepared in accordance with the eleventh section of an ordinance organizing the Department for supplying the city with water, approved October 3, 1854.

Great care has been taken in making the new registers; and, when completed, they will no doubt do away with errors and discrepancies proceeding from the present imperfect system. In making the assessment, more attention has been paid to the situation of the building than to the name of the owner, showing rather where the water is used, than by whom the rent is payable, thus making it far easier to correct errors, discover frauds, and collect delinquent water rents and penalties.

Since the adoption of the ordinance for making the re-assessment, a large force has constantly been employed in examining every dwelling-house, store, manufactory, and other building, and making daily reports to this office in detail.

A large number of discoveries of fraudulent use of water have been made; and I have no doubt that the whole increase in the

income of the Department from the re-assessment will exceed $75,000.

Instances have occurred where a permit has been granted for water to supply a single house at the rate of $2 50 per annum, when, upon examination, the same hydrant was used to supply eighteen different houses. Such examples are of very frequent occurrence.

The rates are continued as heretofore; and, in cases where steam-engines, boilers, &c., are used, and where applications are made to supply distilleries, breweries, dye-houses, and other manufacturing establishments, the capacity and dimensions are carefully estimated, and rated accordingly, the size of every steam-engine and boiler being recorded in detail.

The system of inspection established for this purpose works admirably; and I am happy to state that all the officers and clerks connected with this Department have discharged their several duties promptly, faithfully, and cheerfully.

Total Amount of Receipts and Payments made to the City Treasurer from January 1, to December 31, 1858.

	Rents of 1856.	Rents of 1857.	Penalties of 1857.	Rents of 1858.	Penalties of 1858.	Iron pipe.	Fractional rents.	Total.	Paid City Treasurer.
January . .	$36 45	$3,916 50	$562 13	$25,314 25	. .	$3,179 48	$1,318 35	$34,327 16	$34,327 16
February . .	. .	2,124 25	295 24	38,250 00	. .	1,898 04	884 94	43,452 47	43,452 47
March . . .	. .	1,811 50	255 00	223,264 58	. .	1,071 59	1,048 90	227,451 57	227,451 57
April . . .	. .	506 00	69 28	10,163 25	$428 11	1,577 09	2,662 49	15,406 22	15,406 22
May	. .	595 25	77 28	7,931 00	381 70	1,078 66	1,659 33	11,723 22	11,723 22
June	. .	471 75	64 76	38,981 75	1901 49	1,940 32	1,860 44	45,220 51	45,220 51
July	. .	390 00	57 26	2,329 00	334 24	2,012 78	2,132 10	7,255 38	7,255 38
August . . .	. .	269 50	36 23	9,460 48	1403 30	2,708 21	1,912 11	15,799 83	15,799 83
September . .	. .	25 00	3 75	12,031 25	1749 77	4,192 84	1,742 94	19,735 55	19,735 55
October . . .	. .	13 50	2 02	3,624 75	388 65	6,318 46	1,106 23	11,516 61	11,516 61
November . .	. .	44 50	6 67	6,034 75	879 25	6,304 78	1,000 99	14,270 94	14,270 94
December . .	. .	119 00	15 15	4,355 25	619 79	4,784 82	1,465 01	11,359 02	11,359 02
	$36 45	$10,286 75	$1444 77	$381,740 31	$8086 30	$37,130 07	$18,793 83	$457,518 48	$457,518 48

Respectfully,

W. J. P. WHITE, *Register.*

REPORT

OF THE

CHIEF ENGINEER OF THE WATER WORKS,

IN RELATION TO A BETTER SUPPLY OF WATER FOR THE ACCOMMODATION AND CONVENIENCE OF THE CITIZENS OF PHILADELPHIA.

TO THE SELECT AND COMMON COUNCILS
OF THE CITY OF PHILADELPHIA:—

GENTLEMEN: The Chief Engineer of the Water Works, to whom has been referred sundry complaints of the citizens of the city of Philadelphia in relation to the inadequate supply of water, respectfully reports:—

The complaints of the water takers are well founded, and call for immediate action. Your attention has been thus early directed to the subject on account of the necessity of making arrangements to meet the requirements of the coming summer. During the months of July, August, and September, on warm days the demand upon all the works frequently exceeded their ability as much as four million of gallons per day, and had the mains been of sufficient capacity to supply to consumers all they required, the deficiency would have reached six millions.

At first the works appeared to be inadequate to supply the city, but after careful examinations, the machinery generally was found to be out of order, and numerous leaks and other imperfections were discovered, causing a loss amounting to about twenty per cent. of all the water pumped. Thus it became apparent that had the works been in perfect order and managed with care, sufficient water would have been raised to meet the largest demand yet made upon them through the present mains. The reservoirs, as they are at present arranged (no two of them being of the same elevation, and all their systems of pipes requiring to be kept separate), are not of sufficient capacity to

distribute an adequate supply. It is a fact, apparent to all, that some means for a larger supply of water and a better distribution must at once be carried out.

The opinion has frequently been expressed that we must look to some other source than the Delaware and Schuylkill in the immediate vicinity of the city for an abundant supply of pure water. Attention has been directed to the Wissahickon, as well as the waters of the Delaware, above Easton; the Lehigh and the Schuylkill, above Reading, have also been suggested. To all these sources there are objections.

THE WISSAHICKON.—The waters of this stream are not so pure as those of the Schuylkill. They could not be procured without pumping, nor is there a sufficient volume of water without store reservoirs of very great capacity, and a large amount of its drainage is from a thickly populated district, as well as from numerous factories. This source has frequently been examined with a view to a supply of water, and was in fact one of the sources originally surveyed for a supply to the city, and, with works of proper construction, no doubt, would have been adequate for an ample supply for many years, but now would be inadequate. At the early day this idea was suggested, entire control of the stream and all its tributaries, as well as most of the surface drain by it, could have been procured, thus insuring the purity of the water.

THE DELAWARE, ABOVE EASTON.—The water of this river is of an unobjectionable character, and of sufficient volume to meet any demand the city may ever have, but the river at Easton is but 164 feet above tide. This would make pumping necessary at some point, and it would also require an aqueduct of great length and very expensive construction, nor would anything be gained by going so far up the river, as the quality of the water would be no better than that which could be procured immediately above Trenton, and the amount of head that could be gained would be insignificant in comparison to the larger outlay in constructing a conduit of the required length and capacity. This head could be procured with much greater economy by steam pumping machinery.

THE LEHIGH is objectionable for the following reasons, viz: The country through which it flows after leaving the mountains

is highly cultivated and densely populated. A large amount of mine water is drained into it; the numerous shallow pools formed by the dams of the Navigation Company; the smallness of the stream would require its being taken at or near Easton. The aqueduct to the city would be very expensive, and pumping would also be necessary.

THE SCHUYLKILL, ABOVE READING.—The quality of the water is inferior to that we are now pumping from it here. At low stages of the river the drainage from the mines forms so large a portion of it that immediately above Reading it drives out or destroys the fish. The water could not be brought to the city at a sufficient head without pumping—the river at Reading being only 187½ feet above tide; nor could it be taken out any distance above, as so large an amount drawn from the river would materially affect the operation of the navigation, the supply in that locality being scarcely sufficient for their use now. The aqueduct would be at least sixty miles long, and of very expensive and difficult construction.

A more careful and thorough examination of the above indicated sources of supply might show advantages not now apparent, but from the information now had by the department, they hold no inducements sufficiently promising to call for more minute and careful examination. The mode of supply now adopted should not be abandoned unless better or more accessible sources could be found. The whole subject has certainly not been exhausted. There are sources not yet examined, and the subject of a more abundant supply of unobjectionable water is one of sufficient importance to call for a most careful and complete investigation. The department would suggest the propriety of Councils appropriating, say $2,000 for the purpose of making preliminary surveys and examinations. A source of supply has been overlooked, viz: the system of surface drainage and store reservoirs, which is so successfully carried out in some of the cities of the old world, particularly Liverpool and Manchester, in England, where an abundant supply of most excellent water has been procured by the above system. That we have as well fitted and as accessible, and in all points as desirable a source of supply as those of either of the above cities, needs but a careful examination to demonstrate. An average supply of say 30 to 50 millions of gallons per day, brought by its own gravity and

delivered into the city at an elevation of about 150 feet above tide, by an aqueduct of but from 25 to 30 miles in length, is a possibility which the expenditure of a sum not greater than the above indicated will most probably demonstrate to your entire satisfaction. Such a work looks to the future, but the necessities of the city call for an immediate extension and enlargement of the present works. This, as above shown, should be accomplished so as to meet the wants of the coming season. In fact, it is absolutely necessary now that something be done to meet the just demands of the city. The ordinance assessing a water-tax upon every house will probably add many new takers, and there will also be the ordinary yearly increase.

The maximum capacity of the wheels and pumps at Fairmount may be set down at twelve millions of gallons per day, and in times of drought, or when the river is at its lowest stage (generally September and October), at ten millions of gallons per day as its minimum. The whole power of Fairmount is now more than absorbed at low stages of the river. The only increase of supply can be made by introducing more efficient pumping machinery.* In consideration of the above, the following is recommended.

At Fairmount, a turbine wheel and pumps should be erected to take the place of pump No. 4, which is worn out and entirely too light to pump except into the old reservoirs. In fact, it should have been removed several years since. Two additional turbines should be placed below the Mound dam at the north of the present mill-house. With these and the one in place of No. 4 sixteen million gallons of water can be raised for three months in the year, fifteen million for two months, twelve million for five months, and at least ten million for the remaining two months. By raising the stand-pipe at Fairmount ten feet, the new reservoir at Corinthian avenue nine feet, and the Kensington reservoir seven feet, it would bring them all to the same level as that of Spring Garden reservoir. The pumps at Fairmount would then supply the entire city with water for at least four months

* The original estimate of the whole available force of the river, after making the proper deductions for the use of the canal and for leakage, was an average of ten millions ale gallons per day (see report of Water Committee of 1823, page 3), which experience has shown to be about a correct estimate at the lowest stage of the river.

in the year, viz., December, January, February, and March, probably requiring at times the assistance of the Cornish engine at the Schuylkill works. With this assistance, the supply can readily be kept up for two months, viz., April and November, when it will require the assistance of two more of the engines at the Schuylkill works for May, September, and October, and for the remaining three months the assistance of the Kensington works will be required. (See accompanying table, marked A.) This arrangement will save a large amount of expense to the city and simplify the operations of the Department, as well as render them much more efficient. The raising of the new reservoir will increase its storage capacity thirteen millions seven hundred and thirty-three thousand three hundred and twenty-five gallons, and the raising of the Kensington reservoir will increase its storage capacity ten million two hundred and seven thousand two hundred and fifty-eight gallons. It will be necessary to connect the new reservoir with the Kensington reservoir by means of a 30 inch main along Poplar street to Corinthian avenue, and along Corinthian avenue to Girard avenue, and along Girard avenue to Broad street, and a 20 inch main out Broad street to Lehigh avenue, and along Lehigh avenue to Kensington reservoir. This will enable the Department to furnish an ample supply of water to the higher parts of the district through which it passes, and where the supply is now very deficient for want of a main. These reservoirs being all on one level, will mutually assist each other and render the supply of water much more constant and reliable, and it will place all the distribution north of Vine street under the same head.

By the above arrangements, the saving to the city in the annual running expenses of the Schuylkill works will be as follows:—

Coal for six months for engines Nos. 1, 2, and 3, 1,360 tons	$5,440 00
Wages of one engineer, six months . . .	400 00
" of one assistant engineer, six months . .	250 00
" of five firemen, six months . . .	1,125 00
Oil, tallow, packing, &c., about	1,000 00
Repairs about	1,000 00
Total,	$9,215 00

In the estimate, the Cornish engine is considered as being in use all the time, when it will only be needed a portion of the time.

At the Kensington works, the saving will be as follows:—

Coal for nine months for both of the engines, 1275 tons at $4	$5,100 00
Wages of two engineers, nine months	1,200 00
" of five firemen, nine months	1,387 50
Oil, tallow, packing, at about	1,000 00
Repairs about	1,000 00
Total,	$9,687 50

This estimate leaves the works in charge of a machinist and watchman, who can keep them always ready to start at an hour's notice; making a total saving in the annual running expenses of these works of $18,902 50.

The difficulties of a supply of water for the southern part of the city can only be obviated by laying a large main or feeder. This should be laid from the new reservoir along Poplar street to Ridge avenue, along Ridge avenue to Broad street, and down Broad to Prime street; this main to be thirty inches in diameter, and pass from the reservoir to Broad and Prime streets without being tapped. In Prime street, a twenty-inch main to be laid to Tenth street, and a sixteen-inch main to Fifth street. This will enable us to close the stops along South street, and supply all south of South street (consisting of the First, Second, Third, and Fourth wards) from the new reservoir, leaving the old city to be supplied from the Fairmount reservoirs and by the mains now leading from them. This will give an abundant and most satisfactory supply to the old city proper and all south of South street. The superior head of the new reservoir will leave an available pressure at Broad and Prime streets (after the loss of friction) equal to Fairmount reservoirs, if they were placed at that point.

We will thus have the old city supplied entirely from Fairmount reservoirs, for which the present mains are adequate, and the districts from a system of three reservoirs of equal head, and supplied by Fairmount, Schuylkill, and Delaware works, the reservoirs materially enlarged, and sufficient mains to supply the demands at a very large saving in the running expenses.

By erecting a stand-pipe at the Kensington Water Works, the ascending main could be used as a distributing main, and meet the deficiencies felt in that district in mains, as there is now only one distributing main from the reservoir, of eighteen inches diameter, which, in warm weather, is inadequate. A stand-pipe would also relieve the pumps, making a saving of fuel fully equal to the interest of its cost, and also enabling both engines to be worked at the same time to their full capacity, without the risk of constant breaks, as at present.

By raising the Kensington reservoir seven feet, sufficient additional depth would be obtained to add materially to the purity of the water. Much of the difficulty here has been on account of the want of depth of the water in the reservoir. By the extension of the wharf above the works, the water flowing along the shore is forced out, and made to flow in front of the trunk supplying the pumps, and in part drawn into them. No complaints in regard to the purity of the water supplied by these works existed before the extension of this pier. The water from the creek, and that passing up and down along the shore, flowed through sluices prepared in the wharf of the works. This difficulty of the shore water could perhaps be got rid of by merely making a sluiçe through the wharf of the Lehigh Coal Company, if permission could be had, which would place the works in about their original position. The water which flows from the creek at ebb-tide is that from which the impurities are principally furnished. This would involve but a comparatively small expense.

Twenty-Fourth Ward.—A reservoir for these works should be at once constructed. After a careful examination, no change in the location originally intended is recommended. The elevation of this reservoir will be 217 feet above the river, or 100 feet higher than the water in Spring Garden reservoir. This will command the entire city lying west of the river Schuylkill, with but few exceptions. The place originally surveyed is a little south of the top of the old inclined-plane. The superior elevation of this reservoir, when constructed, might make it advisable (when water is needed in the district north of Spring Garden reservoir, and lying higher than it) to convey a main across the river from these works. The large increased water rents which would at once be had from the Twenty-fourth ward will pay the interest on the cost of this reservoir and mains, and make

the works remunerating to the city, and also save in the annual running expenses, as it will be necessary to run the engines only part of each day. The saving will be at least

150 tons of coal, @ $4	$600 00
Wages of one engineer	800 00
" " " fireman	450 00
Oil, packing, and tallow	300 00
Repairs	500 00
Total,	$2,650 00

The stand-pipe was never intended for a constant supply, but only to enable the district to get the use of the water at once. It was then intended to collect the frontages, and apply the money thus procured to building this reservoir and laying the main. A much larger amount of money has already been collected and paid into the city treasury, for the pipe originally laid in front of property, than would pay for the reservoir and main. The stand-pipe has served the purpose of a reservoir much longer than those most sanguine in its favor ever anticipated. The number of water takers and their importance demands the immediate construction of this reservoir. With this, the works will be able to supply an average of two millions of gallons per day. The main to be 16 inches diameter, and laid from the branch originally inserted for that purpose at Haverford street and Lancaster road, along Lancaster road to Belmont avenue, and out Belmont avenue to the reservoir.

Frankford can be supplied with water from the Kensington reservoir, as there will be an abundant head when it is raised as proposed. A main is now laid out to Westmoreland street, Nineteenth Ward. This is but 10 inches in diameter, which, for the present, would no doubt supply. From this point a 12 inch main should be laid out Frankford street to Harrison. As it would all be distributing main, it would cost but little above the amount of frontage that could be charged upon it. There is no doubt that the water rents from Frankford would more than pay the interest upon the cost of the introduction.

MANAYUNK.—This department has not yet found time to make the necessary examinations to enable it to report upon this district, but will endeavor, at the earliest opportunity, to

lay before you such plans as may upon examination be found practicable.

The cost of the above enlargements and extensions of the water works will be as follows:—

Fairmount.

A turbine and two pumps in the place of No. 4 pump	$14,000
Two additional turbines and four pumps, with main, stops, connections, &c., ...	35,000
Extending mill house along the mound dam 60 feet,	15,000
Raising reservoir on Corinthian avenue 9 feet, building retaining walls on Corinthian avenue, Poplar street and Twenty-second street, increasing its capacity 14 million of gallons	32,000

Kensington Reservoir.

Raising the reservoir seven feet, and building retaining walls on Sixth street and Lehigh avenue. .	28,500
Main connecting new reservoir on Corinthian avenue with the Kensington reservoir; from the new reservoir to Broad and Girard avenue, a 30 inch main, and from Broad and Girard avenue to the Kensington reservoir, a 20 inch main	70,000
Stand pipe at Kensington. This to be 140 feet high, 5 feet in diameter, with base of brick work . .	6,000
Costing in all,	$200,500

These enlargements and extensions will save, in the annual running expenses of the works, $18,902 50, or 9.42 per cent. upon the whole cost, besides increasing the stowage capacity of the works twenty-four million of gallons.

Mains for the First District.

A 30 inch main from the new reservoir on Corinthian avenue to Broad and Prime streets, including stops and branches	$122,500 00
A 20 inch main on Prime street, from Broad to Tenth street, including branches, stops, &c.	9,000 00
A 16 inch main in Prime street, from Tenth to Fifth street, including branches, stops, &c.	6,000 00
Total,	$137,500 00

Reservoir and Main for the Twenty-fourth Ward Works.

Embanking, puddling, lining, and sodding reservoir, to contain five millions of gallons . .	$17,500 00
A 16 inch main from Haverford street and Lancaster road to reservoir	25,600 00
Total,	$43,100 00

Of this there will be returned for pipe laid in front of property (9,790 feet) the sum of $14,685, leaving the actual outlay of the city of about $25,515, while the saving in the running expenses, as above shown, will be $2,650 per annum, or 10.37 per cent. on the whole cost of the work.

Frankford, Twenty-third Ward.

A 12-inch main from Richmond line to Harrison street	$23,000 00

Of this there will be returned in frontage upon 10,120 feet of pipe $16,181, leaving an actual outlay of $7,819.

For making surveys for a better supply of water, as above	$2,000 00

RECAPITULATION.

Third and Fourth districts of the Water Department	$200,500 00
First district	137,500 00
Second district	43,100 00
Third district (Frankford)	23,000 00
Making surveys for a better supply . . .	2,000 00
Total,	$406,100 00
Total cost of all the above described, say	$425,000 00

Your attention is respectfully called to early action upon the above, for if the work upon the reservoirs can be commenced at once, and prosecuted through most of the winter, they can be got ready for use. Employment will also be given to a large number of men. It is also probable that contracts for the required mains could be made at much more favorable terms this fall than in the coming spring, and, by having them made through the winter, they could also be laid in time to meet the requirements of the coming summer, and all the above described

works entirely finished within two years. Unless the above improvements are made, the Department cannot give a full and adequate supply in the summer months, when water is most needed. Allow me to remind you, in conclusion, that if the above estimates be correct, the additions proposed to the works and reservoirs will pay a direct annual percentage upon their total cost of 9 per cent. in the saving produced in the running expenses, as well as give a large main to the Twentieth and Twenty-first wards; also an additional main to the Delaware works. The necessity of a main to supply the First, Second, Third, and Fourth wards, and also to relieve the Fifth and Seventh wards from the deficiency felt, is evident. The reservoir and main for the Twenty-fourth ward, after deducting the return that will be made to the city in frontage, will pay a direct annual percentage of 10 per cent. in the saving that will be produced in the running expenses, and the water rents of Frankford (Twenty-third ward) will pay a profit upon the whole cost of introduction, after making the deduction of the frontage that will be collected upon the mains.

Yours, respectfully,

HENRY P. M. BIRKINBINE,

Chief Engineer.

A.

Table showing the Pumping Capacity of Fairmount Works as they are, as they will be with the Additional Wheels and Pumps, and the Supply of Water to the City with the assistance of the Steam Pumping Machinery, and also the probable demand for the next year.

	A.	B.	C.	D.
January . . .	10,000,000	12,000,000	15,000,000	13,500,000
February . . .	10,500,000	12,000,000	15,500,000	13,000,000
March	11,500,000	15,000,000	18,500,000	14,000,000
April	11,500,000	16,000,000	19,500,000	14,000,000
May	11,500,000	16,000,000	24,500,000	17,000,000
June	11,500,000	16,000,000	27,000,000	18,000,000
July	11,500,000	15,000,000	26,000,000	19,500,000
August . . .	10,000,000	12,000,000	23,000,000	20,500,000
September . .	10,000,000	10,000,000	18,500,000	18,000,000
October . . .	10,500,000	11,000,000	19,500,000	17,000,000
November . .	11,000,000	12,000,000	15,500,000	15,500,000
December . . .	11,000,000	12,000,000	15,500,000	13,000,000
Average per day	10,875,000	13,250,000	19,833,333	16,083,333

Or an average daily supply of 3,750,000 gallons above the demand.

The column marked A is the capacity of the works with the present wheels and pumps.

The column marked B is about the capacity the works will have with proposed additional wheels and pumps.

The column marked C is the amount that will be pumped with the assistance of the Cornish engine working all the time, and two additional engines at the Schuylkill works in April, May, June, July, August, and September, and the two engines at the Delaware works in June, July, and August.

The column marked D is the estimated amount of water that will be required the coming summer. In estimating this amount, the amount reported as pumped in 1855 has been taken, and twenty per cent. added for increase as that necessary.

To erect steam pumping machinery to supply a deficiency of three millions of gallons per day, and the expenses of running the engine instead of using the waste power of Fairmount works, as above proposed, would cost as follows (first cost):—

Cornish engine and pump	$35,000 00
Foundations, walling in boilers, and making alterations to the old engine-house . . .	7,500 00
Main, stop, and connections	5,000 00
Total,	$47,500 00

Annual Running Expenses.

Depreciation of machinery	$1,750 00
Repairs	1,000 00
1,200 tons of coal, at $4	4,800 00
Two engineers, at $800	1,600 00
Five firemen, at $450	2,250 00
Oil, packing, tallow, &c.	1,000 00
	$12,400 00
Less interest on $16,500, being the difference in cost of above described addition to Fairmount works	990 00
Or an annual saving of	$11,410 00