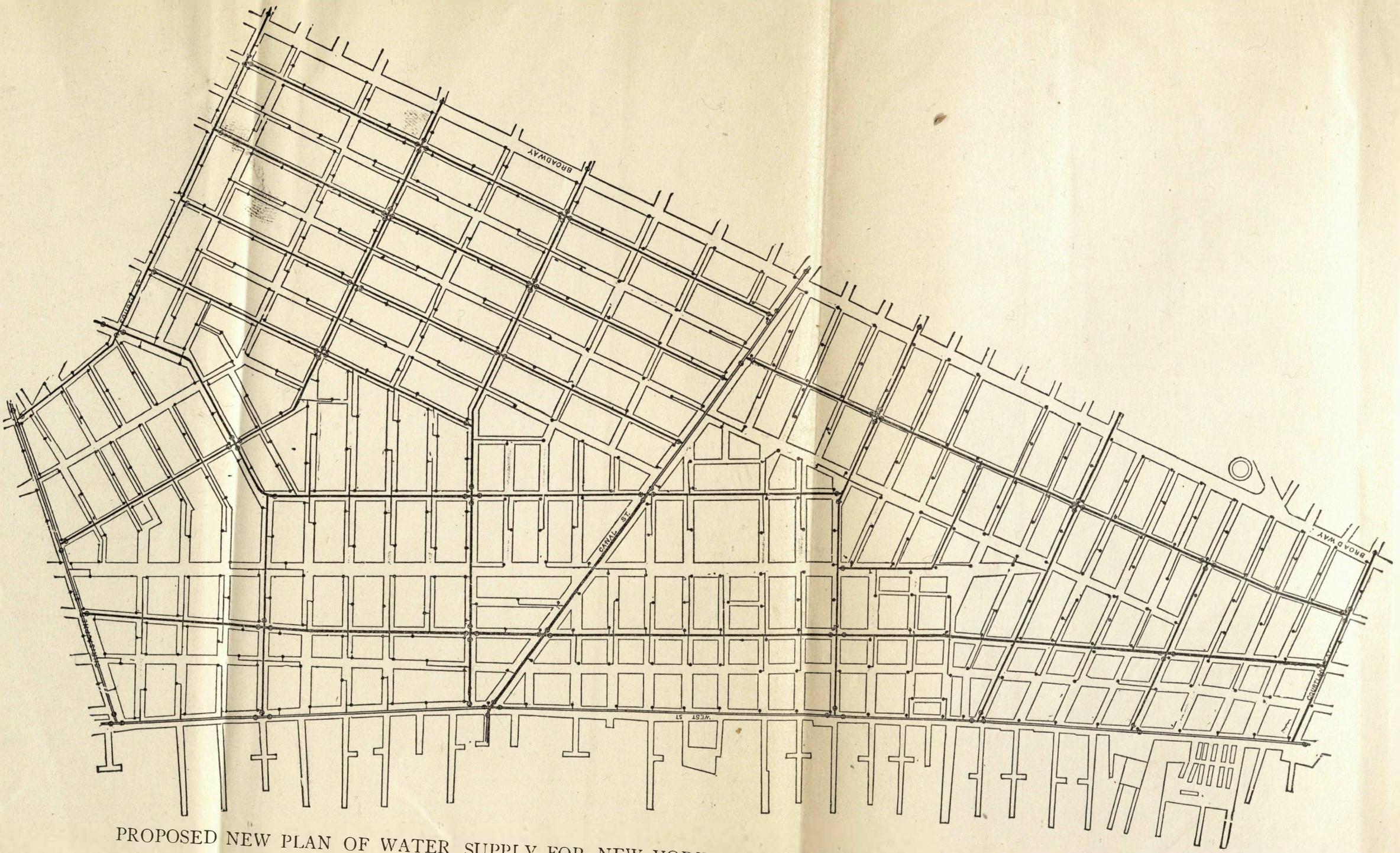
THE INADEQUATE WATER SUPPLY IN NEW YORK, AND ITS REMEDIES.



PROPOSED NEW PLAN OF WATER SUPPLY FOR NEW YORK CITY, BY THE HOLLY SYSTEM OF DIRECT PRESSURE.

[The heavy lines represent Mains of different sizes, and the dots show the location of Hydrants.]

Presented by J. L. DOUGLASS.

THE
INADEQUATE WATER SUPPLY
IN NEW YORK,
AND ITS REMEDIES.

THE HOLLY SYSTEM OF DIRECT PRESSURE ON ALL MAINS AND PIPES.

WATER TO BE SUPPLIED AT ALL TIMES AT THE TOP OF EACH BUILDING ON MANHATTAN ISLAND, BY THE HOLLY SYSTEM.

THE TRIPLE METHOD AS A WHOLE OR SEPARATELY.

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1. Keep pressure upon all Croton Mains within the water district by the Holly System.
2. Get a water supply from excavated or driven wells with an independent set of water pipes and hydrants.
3. Use Ocean water in connection with the Well System if required for Manufacturing, Sanitary and Fire purposes.

Read the Holly Manufacturing Co.'s proposition on page 27.

Read the within official reports.

By J. L. DOUGLASS,
149 Broadway, New York.

NEW YORK:
EVENING POST STEAM PRESSES, 208 BROADWAY, COR. FULTON STREET.

1879.

SCARCITY OF CROTON WATER.—THE HOLLY SYSTEM.

NEW YORK, May 15, 1879.

Your attention is respectfully called to the enclosed extracts from Official Reports of the Commissioners of Public Works, the Health Department, and the Fire Department for the past few years in regard to the insufficient water supply, as furnished from the Croton River, by the present Aqueduct, which was opened in 1842, and from that time has been a source of great public benefit to the people of New York. The rapid growth of New York, as a commercial and manufacturing City, coupled with its advantages as a City of residence, have made such extraordinary demands for water, that the present Aqueduct is no longer ablé to supply the quantity required for all purposes. This fact is proven beyond controversy, by the Official Reports of Chief Engineer Tracy, of Hon. Wm. M. Tweed's Department, and Commissioners Hon. Geo. M. Van Nort, Maj. Gen. Fitz John Porter, and last, not least, Hon. Allan Campbell, G. W. Birdsall, C. E., John C. Campbell, C. E., and others. The public have been annually notified officially of the great scarcity of water, the insufficiency of Aqueduct capacity, the lowness of head of water in the Reservoirs, and the pressing necessity to stop the waste and curtail the use of water.

The Health Department have to bear censure when more water would purify the tenement houses, sewers, water closets, streets, gutters, &c., and thus cleanse and purify, where filth and disease now claim the mastery. They have officially called for more water—but it is not there. The New York

Board of Underwriters have officially called attention to the great scarcity of water supply, to cope with our present buildings, and ask that increased means of supply be given.

The Fire Department have also officially complained of the great scarcity of water, too small mains for supplying the same, and the aid of the Police Department has been called into active service to prevent waste and stop an unnecessary use of water, in time of great drouth.

The faulty construction of buildings, their extraordinary height and combustibility, have placed portions of them above the reach of our present steam fire engines (as used by the Fire Department), in case of fire, and until the fire burns down to their reach they cannot control the fire in its incipiency, if started in the upper part thereof. But for the efficiency of our Fire Department, *which excels the world*, New York would long since have led Boston, Chicago, Portland, Troy and St. John, in a great and destructive fire.

The great storage reservoirs in Westchester and Putnam counties, have proved the wisdom of their projectors and builders, controlling as they do a supply of water for the dry season of the year.

The wooden piers of this City are a source of great danger in case of fire, as many of them are over 600 feet long, and practically uncontrolable with the steamers of our present department for want of power to reach the required distance.

The average height to which our best steamers throw water on ordinary duty is 60 feet, and extreme height when on trial is 150 feet, as reported by the Fire Department.

The Holly Manufacturing Company's proposition to supply new mains, hydrants, engines, engine-houses, and everything complete for a new and independent water supply (or a triple supply), is herewith inclosed, and your attention is respectfully called to it on page 27.

By it they guarantee to throw at one and the same time (*and at any time*), 50 streams of water $1\frac{1}{4}$ inch nozzle 135 feet high, from the hydrant without the use of department engines. With five water districts in use it would give 250 streams of water 135 feet high, at the same time in different parts of the City, or about 8,000 hose connections. This will supply water

to the top of each and every building in the district supplied by the Holly works—the cost of district No. 1, (or more commonly known as the dry goods district), is $1,486,960 complete. This proposition is now before the Mayor, Common Council and Commissioner of Public Works, and requires legislative authority to authorize the work to be done.

The whole City from the Battery to Ninetieth street could be completed in three years, or one district in each year below Twenty-third street. Engines could be placed in 1879, at the outlet of the Reservoirs at Central Park and at High Bridge, and force croton water to the top of each and every building below them, thus doing away with the tower or stand pipe system now in partial use.

With the Holly system in use, the Forty-second Street Reservoir, about which so much discussion has been had, could be removed with safety, as the power would be so great it would not be required as a part of the water supply.

The six sets of engines in each of the three main water districts would be of capacity to supply daily 36,000,000 gallons, or a total of 108,000,000 gallons, an amount greater than the capacity of the present aqueduct.

No plan yet devised can equal the Holly system, combining as it does great power, economy, efficiency and general adaptability for a powerful water supply.

By their use the steam fire engines of the Fire Department would be of no further use, and this expenditure would be saved to the City.

The cost of the entire Holly plan to cover the whole of Manhattan Island (Harlem included) would not equal the interest alone, for six years, upon the new aqueduct, as proposed from the Croton river by the present Commissioner.

With plenty of water, clean streets and sewers, and a reform in the tenement-house system, New York should (with its ocean flow of water to remove the deposit of such a large city) be one of the healthiest cities in the world.

Stand pipes have fallen, reservoirs have leaked badly, and finally broken away, leaving a whole City at the mercy of the flames.

The extraordinary fires of the past few years require extra-

ordinary means to put them out and save insurance capital from wanton waste and destruction. It is estimated from the best sources and statistics that over fifty (50) per cent. of the losses by fire are illegitimate and should be avoided.

By the Holly system, when complete, a stand pipe with take-offs inside the building on each floor and hose couplings, with hose always attached, would complete a Fire Department supply of itself and always at hand, ready for work at a moment's requirement.

If a better system can be devised we advise its use, but until that time comes, we insist that individual ideas and preferences shall give way, that the greatest good to the greatest number shall predominate, and this must result in the introduction and use of the Holly system, as far surpassing all others. It is automatic in action, always ready, and stands unrivalled.

The performances and great duty given at Rochester P. 8 by the Holly Company, challenge the world. Its results have never been equalled, and a challenge is given to all other methods to compete with it.

Too much praise cannot be bestowed upon Hon. Allan Campbell, Commissioner of Public Works, for his persistent and efficient attempt to reform the water system and get a greater supply. He and his predecessors have warned the people of the deficiency and pointed out the remedies. If disaster comes their record is clear. The onus will be upon the legislature and people. It is not too late to pass the necessary measures, at this session of the Legislature, contained in Hon. J. P. McDonough's bill, No. 1,091 Assembly. The necessities of the case demand it.

I have the honor to be,

Very respectfully yours,

J. L. DOUGLASS,

149 Broadway, N. Y. City.

GREAT SCARCITY OF CROTON WATER SUPPLY.

To the Public:

The prevailing scarcity of Croton water supply should attract the attention of the Legislature, at its present session, and of every property owner and tenant in this City. It is a complaint of long standing, covering a period of many years, and has been uniformly the subject of grave consideration by each member of the old Croton Aqueduct Department, and also of each Commissioner of Public Works, from Wm. M. Tweed down to and including our present efficient Commissioner, Hon. Allan Campbell, in official communications, showing the deficiency of water supply as to conduit capacity to convey it to the City. The distribution, when it arrives in the City, is ample in a large majority of streets and avenues. The streets most deficient, owing to small pipes and insufficient hydrants, are West street (where the piers are over 600 feet long), Washington, South, Broad, New, Bond and Great Jones streets, Lafayette place, Elm, Reade, Vandewater and Beekman streets, Fourth avenue, south of Thirty-third street; Second avenue, south of Sixty-sixth street; Eighth, Ninth and Tenth streets, from Broadway (where Stewart's store is) to Second avenue; Worth street (the centre of the great dry goods district), Howard, Grand street, from Broadway to Sullivan street, Broome, Spring and Prince streets, from the Bowery to Sullivan street; Twenty-third street, from North to East river; Broadway, from Fourteenth street to Thirty-fourth street, and Sixth and Eighth avenues, in the vicinity of Twenty-third street. As this is reported from official sources by the Fire Department, it is all the more alarming, and shows the necessity of adding to our water supply, without further delay. Read the following official reports:

Grand Official Exhibition of the Holly System.—Rochester Challenges the World.

The Rochester *Union and Advertiser* of February 19, 1874, gives the following as the official test, capacity and power of

the Holly Manufacturing Company's machinery, piping, &c., upon completion of the works for that City, and upon which it was delivered to the City :

30 one-inch streams from hydrants, vertical, 135 feet high.
1 two-inch stream from hydrant, vertical, 220 feet high.
1 three-inch " " horizontal, 465 " "
1 four-inch " " vertical, 297½ " "
1 five-inch " " " 250½ " "

Beat it who can. This is the only suitable method of power, machinery and water pressure for the City of New York. With it, water would be in the top of each and every building at any and all times, and do away with stand pipes and engines necessary to force water into them. It is in successful use in over one hundred cities in the United States.

Stand Pipes.

In 1871, the tower or stand pipe of the Jersey City Water Works fell to the ground, and for several days the Cities of Jersey City and Hoboken were without water supply, except the temporary amount in the reservoirs.

The cost of new tower or stand pipe was $100,778.71.

(*Report of Levi W. Post, Chief Engineer, Jersey City, N. J., May* 8, 1879.)

New York Board of Fire Underwriters—New York's Water Supply.

At a regular meeting of the New York Board of Fire Underwriters, the following resolutions were unanimously adopted, April 26, 1879 :

Whereas, It has been apparent, by the reports of the Croton Water Department, that the supply of water for general purposes in the City of New York is not large enough to meet the necessary requirements of the City ; therefore :

Resolved, That the New York Board of Fire Underwriters deem it of vital importance that prompt and sufficient measures should be taken to provide the means for the in-

crease of the water supply of the City, and they earnestly urge the proper authorities to take such measures as will secure, at the earliest possible day, this end.

The Fire Department.

The average height to which water is thrown by the fire engines on ordinary duty is sixty (60) feet.

The extreme height to which they can throw, on trial, is one hundred and fifty (150) feet.

The annual cost of six engines (in District No. 1), is $105,-895.00, or $17,649.00 each.

The average amount of water used per hour at each fire is 18,000 gallons.

The average pumping time of engine companies per fire during 1878 was one hour and fifty-three minutes (1.53); for all companies, including trucks, etc., one hour and twelve minutes (1 h. 12 m.) average working time.

The best steamers can throw horizontally a distance of 250 feet, under favorable circumstances. (*Official Statement of the New York Fire Department, May* 9, 1879).

Alfred W. Craven's Reply to General Shaler.

March 20, 1872.—What is the remedy? First as to the supply and its source. The full quantity of water often required in a given time cannot be afforded, whether your supply comes from the Croton river or from the rivers which surround us, so long as the pipes for its distribution remain as they now are. It would be necessary, therefore, either to make extensive alterations in the present distribution, or to lay down a new system of pipes entirely independent of the present one. In view of the fact that for all reasonable and fair demands, exclusive of that for the extinguishing of fires, the present pipes are sufficient, or can be made so at a comparatively moderate expense; and in view of other reasons which would naturally come up on the full examination of the subject, your questions pointing to the utilization of the ocean waters surrounding us, are entitled to the most thorough consideration and thought.

We can assume, at once, that there will be no engineering difficulties in the way. Pumping engines could be erected at different points, capable of delivering a practically unlimited supply from the unexhaustible source referred to, and the distribution could be arranged for different districts, all or any of which could be connected or disconnected with or from each other, as emergencies might require. * * * * * Without discussing here the expediency of using the salt water for flushing sewers and cleaning streets (in regard to which there would be conflicting opinions), its copious distribution could undoubtedly be made available for other sanitary purposes.—*Alfred W. Craven's reply to the Fire Department, March* 20, 1872.

Reply of Hon. George M. Van Nort.

September 30, 1873.—It is evident, however, that before many years, if the increase in the quantity of water consumed continues at the present rate, an additional aqueduct will be required to carry a sufficient supply of water to this City. * * * * * The utmost capacity of the present acqueduct is 115,000,000 gallons per day, and the daily consumption has already reached 104,000,000 gallons. * * * The advantages of securing an unlimited supply of pure water, which can be used not only for the extinguishment of fires, but for sanitary, domestic, manufacturing, and all other purposes, are incalculable, and with two aqueducts, independent of each other, we would be doubly insured against an interruption of the supply from any accident or injury to either of them.

Report of Major-General Fitz John Porter.

January 19, 1876.—The necessity of larger mains is most severely felt in the lower part of the City. Water here should rise to the second story of buildings, but the friction of small pipes and unequal distribution prevent. * * * * * Should the influences continue to prevail which have prevented an increase of the water supply, the great wrong under which the City now suffers may become a crime of incalculable injury to property and health.

The Chief Engineer very justly says, that it is evident that in spite of all the restrictions that can be brought to bear against the waste of water, it will be necessary to build an additional aqueduct from Croton river to Harlem river. An abundance of water for the City's wants for many years can be had in the Croton Valley by establishing storage reservoirs, for which the Croton and its branches offer many admirable sites. But to increase the supply of water to any considerable extent involves the construction of a new aqueduct, and I think no time should be lost in obtaining the requisite data to locate it. I herewith present a resolution embodying the action proposed to be exercised under the Act of 1871, and earnestly ask early concurrence by the Common Council and the approval of the Mayor.

Report of Hon. Allan Campbell.

June 30, 1876.—Since the date of my last quarterly report, I have made a personal examination of the lakes and reservoirs in Putnam County, on which the City must depend for a considerable portion of its water supply during seasons of drought, and when the Croton itself must depend for a considerable portion of its water supply to meet the daily and inexorable demand of more than a million of people.

* * * * * * * *

The secondary, though important question of conducting this supply, or so much of it as may be needed to the City, is a matter of dollars and cents and of skillful engineering. The present aqueduct, the pride of the City, and a monument to the foresight of its projectors, was completed more than a century ago by distinguished engineers, experienced and responsible contractors, and under a wise and honest financial administration. It was not then supposed that within so brief a period the maximum capacity would be reached, and that the City Government would be called upon to meet the necessity of the case, either by restricting the use of the water, or by devising plans for new and additional conduits. Yet such is now the fact, and it cannot be ignored or disregarded by those in authority, upon whom the responsibility must rest. In my

late quarterly report, I briefly alluded to this subject as one of vital importance, and which should receive timely consideration and careful study. * * * * * *

A new aqueduct from the Croton river with the necessary reservoirs and distributing pipes would probably cost not less than fifteen or twenty millions dollars, and would entail upon the City a perpetual charge for interest, repairs and superintendence of more than one million dollars annually. That an additional supply of water for this great and growing City must be provided before the lapse of many years, is an indisputable proposition. * * * * * Very great waste occurs in dwelling houses, and the best mode of correcting it, is a problem of difficult solution.

SEPTEMBER 30, 1876.—The unprecedented and continued drought, and the consequent falling off in the water supply, are matters of such great and immediate importance to every member of this community, that I deemed it proper recently to publish a statement as to the present condition of the water supply, the resources yet available, and the measures adopted to meet present necessities, as well as those in contemplation, to secure an abundant supply of water for the future, even in a contingency like the present. * * * * * The City reservoirs became much reduced (by an unprecedented drought), and the surface of the water in Croton Lake fell to a level of thirty-nine (39) inches below the crest of the dam, so that for some time past only about seventy millions (70,000,000) gallons per day were passed througt the *aqueduct*, the ordinary supply being about one hundred millions. All the water stored in the reservoir at Boyd's Corners (nearly 3,000,000,000 gallons) has been drawn off, and large drafts have been made upon the natural lakes at the sources of the Croton. * * * * * * *

The minimum quantity of water delivered daily has been about seventy million gallons, or sixty-five gallons per inhabitant. * * * * It is, doubtless, true that in some of the more elevated parts of the City much inconvenience has been experienced. The long-continued drought caused a serious reduction of the water level in the City reser-

voirs, and though the aggregate supply was still large, the diminished head of water could not easily be recovered.

One method by which this evil may in good part be avoided in future is, to extend what is known as the high service system, and which has given so much satisfaction wherever it has been applied. * * * * * *

With regard to water, it is often necessary to sink wells, erect machinery, construct reservoirs and aqueducts, lay down pipes and numerous other works in a procurement of a sufficient supply. * * * * * *

Although, as previously stated, the subject of an additional aqueduct or other conduit will be treated of in a special report, I deem it proper now, and while the attention of all is directed to the water supply, to say that it is the opinion of many citizens, who have given the subject study and reflection, that, independent of the fact that the present aqueduct is approaching its maximum capacity, considerations of prudence and safety call for the provision of another conduit. In this opinion I concur. The interests at stake are so large that nothing should be left undone, so far as human foresight can extend, to guard against the hazard of an interruption to the supply of the City with water.

Hon. Allan Campbell's Special Report to the Public.

October 18, 1876.—I am induced by the numerous complaints of citizens and the comments of the public press, in regard to the limited supply of Croton water in this City, to make an official statement on the condition of the water supply and the causes of its present limitation. * * * *

I also stated that the steady and rapid growth of New York would soon call either for the early construction of a new aqueduct, the maximum capacity of the existing one having been reached, taking the rate of present consumption as a guide, or a resort to meters to restrict the use, &c. * * *

Although the public generally are aware of an extraordinary drought during the summer, it is, probably, not known that from June until the present time (October 18, 1876), a period of over four (4) months, the drought in the Croton Valley and

its tributaries has been unexampled within the past fifty years. Since the 22d of June no water has run over the Croton dam, except for the short space of four days. The Croton river itself has dwindled to the dimensions of a mere brook; and resort has necessarily been had to the artificial reservoirs at Boyd's Corners, and to the natural lakes of Westchester and Putnam Counties.

During this period of unprecedented drought, 4,470,000,000 gallons of water have been drawn from the water stored up in these basins. Although we had every reason to anticipate relief from summer showers and autumnal rains, the attention of the Department has been unremitting in procuring such additional supplies as could, by any possibility, be commanded. * * * * * * *

The September rains may be said to have been entirely absorbed by the parched earth, as only one-fourth of an inch was drained into the receiving basins. * * * *

Elaborate and careful surveys of the Croton water shed were made a few years since by the Croton Aqueduct Department, under the direction of Mr. Craven. The maps and records are on file in this Department, from which new dams and reservoirs can be projected and put under contract from time to time, as required. * * * * *

In my (last Quarterly) Report I discussed briefly the question of a new aqueduct, and gave my opinion in favor of such a work in preference to a resort to a system of meters to be placed in every house in order to restrict the use of water, but expressed the hope, that in view of the present burdensome taxation, the great expense of an additional aqueduct might be postponed for a few years.

I am satisfied that early steps should be taken to prepare for the construction of such a work, and the next season can properly be devoted to the necessary surveys and preparation of plans, both scientific and financial, for its consummation. *I estimate the cost of a new aqueduct, including the necessary works of reservoirs and distributing pipes, at twenty million* ($20,000,000) *dollars, and the time for its completion at four years.* * * * * * * *

From what has now been stated, the cause of the present

short supply of water will be apparent. The ordinary daily consumption at this season would be one hundred million (100,000,000) gallons, whereas the present supply is but seventy million (70,000,000) gallons, more than one-half of which is drawn from the reservoirs in Putnam County and Westchester County. This supply is under the control of this Department, and it is deemed prudent, in view of the limited quantity still in store, and a possibility of a continuance of the drought, to restrict the supply to the amount stated, although it is to be hoped, and there is reason to believe, that relief will come from rains at any day. It is better, by economy, to suffer at present partial evil, than by extravagance to run the hazard of a still greater infliction. * * * * * *

That the water does not rise as high as usual in many houses is due to the lower level of the City reservoirs, consequent upon the reduced supply from the Croton river and valley, and can only be remedied by copious rainfalls. The high service supply, which is intended to accommodate certain elevated parts of the City, is very beneficial and useful.

I have caused an examination to be made of the whole City, and I propose to extend the high service system to other elevated portions not now thus accommodated. The expense will be insignificant in comparison with the advantages to be obtained.

It is proper to add that the question of a new aqueduct has no connection with the present limited supply, as the Aqueduct is now only used to about two-thirds of its existing capacity.

The deficiency arises from the extraordinary drought, and not from deficiency of conduits. The views I have presented on the subject of a new aqueduct have reference to the necessities of a growing population, and an increase in commerce and manufactures.

MARCH 19, 1877.—The Aqueduct has been kept in good repair, but, in consequence of the scarcity of water during the past season, the annual inspection of its interior had to be omitted, as the shutting off of the water for that purpose would have completely stopped the supply in the City for the time.

DECEMBER 31, 1878.—The Croton Aqueduct has been subjected to severe tests by the heavy storms which occurred during the quarter, and rendered necessary an extra amount of repairs to ditches, drains, culverts, fences and roads. * * *

The Department had no means to prosecute the necessary work of strengthening the Aqueduct in accordance with the plans heretofore adopted and pursued. * * *

With this new reservoir, the one at Boyd's Corners and the natural lakes, our storage capacity in the Croton Valley is 9,500,000,000 gallons, sufficient to insure a full supply at all times for the present Aqueduct.

As already stated in previous reports, the unusual strain to which the Aqueduct has for some time been subjected, in order to convey the increased volume of water required for daily consumption, has rendered it necessary to strengthen the masonry of the Aqueduct, and protection walls and embankments, where the structure is built upon stone walls, laid dry, across intersecting ravines. These walls have settled in several places, causing cracks and leaks in the Aqueduct. * * *

Since the fall of 1876, when this work was commenced, 3,090 lineal feet of the Aqueduct has thus been improved, and many cracks and leaks stopped.

There are still about 19,000 lineal feet requiring strengthening, 9,000 feet of which are in such condition as to need immediate attention. * * * * * *

Every available dollar of the sum appropriated will be devoted during the coming season to these extraordinary repairs, and perhaps no breach may occur, but the matter is too serious to allow the consideration of a few thousand dollars to stand in the way of such repairs as shall insure the safety of the structure. The responsibility of the Department is very serious in maintaining the water supply, and it seems to me that the moderate and reasonable sums deemed necessary by the engineers should be granted. I may be compelled to ask for additional means from some other fund or appropriation.

The total number of fire hydrants now in use is 5,024.

* * * Aside from the effect of waste, the growth of the City in population, and the increase in size and extent of water pipes, without a corresponding increase in the capacity of the

only supply conduit, the Aqueduct, have necessarily greatly diminished the pressure.

The area of the interior of the Aqueduct is $53\frac{34}{100}$ square feet. (Area of distributing mains, *in all*, $73\frac{94}{100}$ *square feet*, using only 44 square feet.)—*C. E. Birdsall's Report.*

In 1860 the population was 805,658, and in 1863 the daily consumption of water was 54,400,000 gallons, and the Croton Aqueduct Board reported it unsafe to increase the flow of water in the Aqueduct.—*Report of Hon. Allan Campbell, December* 31, 1878, *City Record, p.* 352.

Supply and Population.

The question whether a recurrence of the present scarcity is possible has been mainly answered by the preceding statement, but I answer it more directly by the assurance that, if sufficient additional storage reservoirs are provided in ample time, as the City grows in population, there will be an abundance of water in the Croton Valley for a City of *more than double the present population.—Report of E. H. Tracy, C. E., April* 17, 1872. *See City Record, p.* 1707, *Nov.* 22, 1876.

And when we reflect that we can command, within our present system, by proper and timely works and appliances, two hundred and fifty million gallons (250,000,000) daily, or double the quantity now consumed in London, there does not seem to be any cause for great anxiety on this vital question of a water supply.—*Report of Hon. Allan Campbell, November* 22, 1876, *City Record, p.* 1708.

The average amount per day running through the Aqueduct for 1878, 93,400,000 gallons. Average amount per day running from Croton Dam, 462,854,308 gallons in 1868.

The Croton river (as will be seen by the above table) has the capacity to furnish over three times the quantity now used by the City, and the necessary preliminary surveys and estimates for a new aqueduct, from the Croton river to this City, were made in 1875–6, and this year these surveys have been

extended to the Housatonic river, the nearest available river from which a large supply of water can be obtained, thus connecting the Croton and Housatonic rivers if necessary.—*Report of G. W. Birdsall, Chief Engineer Croton Aqueduct, January* 2, 1879. *See City Record, p.* .

The length of this (Housatonic) line, by the direct route to Bull's Bridge, and thence to the proposed dam at West Cornwall is 26.8 miles, and the elevation above tide at that point is 468 feet * * * * * *

To do this, I propose a dam at the head of Bull's Falls, 8 feet high, thence the water to be led by a canal to pumping works at the foot of the hill, whence it can be driven through a force main to a small basin on the heights, 109 feet above the level of the water in the dam then connecting with the canal.—*Report of Horace Loomis, Assistant Engineer, Jan.* 18, 1879, *City Record, p.* 362.

Estimates and plans have been completed for the project of obtaining a larger supply of water from the Housatonic river, and of increasing it by additional reservoirs in the Croton basin. By a resort both to the Housatonic river, and these storage reservoirs, a large aqueduct can be supplied, which in conjunction with the present aqueduct, will meet the demands of three millions of people. The Commissioner also urges the early execution of the Bronx River project, as a quick and economical mode of increasing the supply.—*Report of Hon. Allan Campbell, March* 31, 1879.

The Cost.

The cost of the Croton Water Works, to the City of New York is now over..... $31,000,000 00

The cost of engines, pipes, mains, valves, hydrants, all complete in District No. 1, as per the Holly Manufacturing Company's proposal to Mayor Cooper, amounts to.....$1,486,960 00

District No. 2 would be about.... 1,500,000 00

District	No.	3	would	be	about....	1,600,000 00
"	"	4	"	"	....	100,000 00
"	"	5	"	"	....	100,000 00
						4,786,960 00

Districts Nos. 4 and 5 would use engines at the outlet of the reservoirs at Central Park only on Croton mains.

Since the estimate No. 1 was made, the well system has been considered and would make a part of the general plan, furnishing a liberal supply of pure spring water.

The Croton river will furnish treble the quantity of water which passes through the present aqueduct, and in due time it will be proper for the City to take steps to secure an additional supply from this source. The money thus laid out, while it will give an abundance of pure water for the increasing population, will also furnish an ample supply for the extinguishment of fires.— *Report of Hon. Allan Campbell, March* 18, 1876.

The available quantity of water—preventing unnecessary waste over the Croton dam—may therefore be set down at a maximum of 125,000,000,000 gallons per annum, or a daily supply of 330,000,000 gallons, provided the Aqueduct is put in a condition to draw all the water which need not be reckoned as loss from natural and unavoidable causes. In other words, the Croton aqueduct can furnish three times the quantity of water now daily consumed; the Croton basin, with its present resources, can feed a city of 3,000,000 people.—*Report of Alderman Wm. H. McCarthy, Chairman, April* 6, 1876.

Don't Waste the Water.

The New York *World*, March 24, 1879, had the following:

Commissioner of Public Works Allan Campbell issued, Saturday, the following notice:

Department of Public Works,
New York, March 22, 1879.

To the Public:

The long winter has caused a fall of several feet in the level of the water in the Central Park reservoir, by waste in houses

to prevent freezing in service pipes, thus causing reduced pressure and much discomfort to many dwellings. I earnestly call upon citizens to suppress all waste, so that the level of the reservoir may be regained as speedily as possible.

ALLAN CAMPBELL,
Commissioner of Public Works.

My project to bring water from the Bronx and Rye ponds will give us ten million gallons daily, at an outlay of one and a half million of dollars. This could be completed in a short time, and would be of great importance, while the question of a greater work was being maturely considered. The Bronx conduit would always remain a valuable part of our water system. * * * *—*Report of Hon. Allan Campbell, April* 18, 1879, *in answer to Hon. James M. Varnum's letter.*

DEPARTMENT OF PUBLIC WORKS,
COMMISSIONER'S OFFICE,
Room 19, City Hall.

NEW YORK, April 11, 1879.

CHAS. F. CHANDLER, M. D.,
President Health Department:

Sir,—With a letter from your secretary, dated 4th instant, was transmitted a report of a Sanitary Inspector, that offensive sewer odors at No. 105 West Forty-second street are caused by the insufficiency of the water supply, which is stated to be very general in that section of the City.

In answer thereto, I beg to state that there is no deficiency in the quantity of water furnished, but we have at present no means of forcing the water to the high level of the upper floors of the houses situated like the one reported upon. In consequence of the waste during the long continued cold weather, the level of the City reservoirs and the pressure in the pipes have been greatly diminish. The growth in population and the rapid extension of the water supply to new buildings and districts also diminished the pressure, and

against these causes *we have no remedy, except to bring more water into the City by new conduits*, and by forcing it to the higher levels by high service pumping works. In the course of the year the new high service works at Ninety-seventh street and Ninth avenue will be brought into use, enabling us to deliver the water at a greater elevation in districts like the one referred to where the deficiency in pressure is most severely felt. At the same, the use of pumps and tanks in houses where the pressure is not sufficient to force the water to the upper floors will insure an ample supply for domestic and sanitary purposes, thus showing that there is no deficiency in the quantity of water required for such purposes.

Very respectfully,

ALLAN CAMPBELL,
Commissioner of Public Works.

Fire Department on Water Supply.

An increased supply of this indispensable element, for fire purposes, is a necessity which this Department can do nothing to provide for, except by way of recommending action on the part of other branches of the Municipal Government. With but very few exceptions hydrants are, in all localities, connected with the smallest pipes running through the streets upon which they are located, and it thus frequently happens that at large fires where a number of the powerful steamers of this Department draw upon the same pipe, or upon pipes of the same diameter contiguous to, connected with and dependent for their supply upon the other, the *quantity of water proves inadequate* for all, and sometimes, at a critical juncture, in effect deprives the Department of the services of apparatus indispensable to an efficient performance of the duties devolving upon it. Some progress has been made in the direction of providing for the need during the past year, the Board of Aldermen having authorized the Department of Public Works to place 150 large hydrants. * * *—*Report of the Fire Department, January* 3, 1877.

As the question of conduits will be discussed in a special report, I will merely state here that the present aqueduct is capable of conveying one hundred and ten million gallons daily, or at the rate of about one hundred gallons per inhabitant, according to the present population. * * * * My principal object, &c.—*Report of Hon. Allan Campbell, Sept.* 30, 1876.

The extreme heat of the past summer has caused great drought in the Croton Basin. The residents of that district say there has been nothing equal to it in the past fifty years. The springs and wells to a great extent dried up, and the natural flow of the Croton river has not furnished half the water consumed during the last three months, the water during this three months having ran over the Croton dam but four days. * *

In addition to drawing from the reservoir at Boyd's Corners, the long continued drought has compelled us to draw water from all the natural lakes in Westchester and Putnam Counties, that were available, they having furnished the whole supply of stored water since the storage reservoir was emptied. * * *

The annual extension of the street mains has brought the daily consumption of all the capacity of the aqueduct, and more than three times as much as the minimum flow of the river can furnish. It is necessary that systematic efforts be made to circumscribe the waste of water, and every citizen should understand that all waste must be stopped.—*Report of John C. Campbell, Chief Engineer, Sept.* 30, 1876, *City Record, p.* 1712.

At Yonkers it was necessary to build 700 cubic yards of protection wall, and 100 cubic yards of retaining wall to protect the aqueduct from injury by excavations on adjoining private property. * * * * * * * * *

The drought of last year in the Croton district will be remembered as one of unusual severity, causing much inconvenience by a scarcity of water in the City. That of the present year, however, has been far more severe, exceeding anything known for half a century ; and these two dry seasons (1876, 1877), following directly one after the other, will be ever memorable in the records of the City's water supply.

NEW YORK, September 28, 1877.

To the Public :

The drought of 1876 in the Croton region and adjacent country—the severest known for half a century—has been followed this season by one of still greater severity, which is seriously affecting the water supply of this City. * * * It is now ninety days since any water ran over the Croton dam into the Hudson river. For some time past large drafts have been made upon the artificial and natural reservoirs of the Croton district, every available lake having been put under contribution ; but the long continued and unprecedented drought warns me to give notice to citizens, and all who use Croton water, to avoid waste, and to call upon them for aid in this great emergency, by observing the strictest economy in the use of water. The officers and employees of this Department have been instructed to exercise the utmost vigilance in suppressing waste, and I have asked the aid of the Police Department in enforcing this order. * * * * * * *

In the belief that citizens generally will appreciate the circumstances as above explained, and contribute their aid in averting a serious calamity,

I am, respectfully,

ALLAN CAMPBELL,

Commissioner of Public Works.

It is therefore unjust to condemn the plan on which our water system is founded, when the evils are attributable not to the system itself and to the sources which nature has supplied, but to the failure of man to carry out in proper time and ways the works necessary to perfect the system. If we were drawing water even from a great river like the Hudson, instead of from the Croton Valley, *and neglected to increase the pumping power and area*, or number of conduits, with the increasing demands of the City, as well might it be said that the Hudson was inadequate, when in fact the fault would rest with man and not with nature. * * * * * * * *

In tunnels or excavations, where it (the aqueduct) rests upon natural foundations, it continues almost unimpaired; but in crossing valleys, upon artificial foundations, very slight settlements sometimes occur, causing cracks and leaks, which can only be temporarily remedied, until the water is drawn off, as is done once a year for as thorough repair as is practicable in the short period of three days, beyond which time the supply cannot be intermitted.

High Service.—When the Croton was introduced into New York, and some years subsequently, the City, as then built, was below the level of the receiving reservoir, and water was delivered to the upper stories of the houses by hydraulic pressure. Since that time the elevated portions of the island have been built upon, where the land is as high as the surface of the Park Reservoirs. Of course at all those points the water must be raised to the upper stories by pumping, and this was doubtless the original design of the Croton Aqueduct Commission.—*Report of Hon. Allan Campbell, C. P. W., October* 31, 1877.

The plentiful supply furnished by the Croton river since the 5th of October has enabled the Department to refill the depleted reservoirs in the Central Park, and thus to increase the pressure in the delivery of water to its normal force, so that complaints of low pressure in buildings have become comparatively few, and are generally caused by defective plumbing. * * * When the great drought terminated on the 5th of October, the depth of water in the Central Park Reservoir was reduced to $10\frac{1}{2}$ feet, and of course the pressure in the delivery of water was correspondingly diminished, giving rise to many complaints, and causing great inconvenience in many cases. We cannot, and should not, shut our eyes to the evil consequences that would have ensued if relief by copious rains had been further delayed. * * * The total length of Croton pipes now laid in this City is $440\frac{36}{100}$ miles, with 4,153 hydrants. The total amount expended for works, structures, aqueduct, pipes, etc., connected with the water supply of the City, in-

cluding maintenance and repairs, from its inception to January 1, 1878, is $34,945,007 94

The total amount of revenue derived from Croton water, from its introduction to the 1st day January, 1878, is 30,396,438 91

Cost over income $4,548,569 03

—*Report of Hon. Allan Campbell, C. P. W., February* 6, 1878.

OFFICE OF THE MERCHANTS' INSURANCE COMPANY,
149 Broadway, N. W. corner Liberty street.

NEW YORK, March 12th, 1879.

Hon. EDWARD COOPER,
Mayor of N. Y.:

Dear Sir,—I have the pleasure to present you with the inclosed propositions for the introduction of the Holly system of water supply in this City, and ask that they may be sent officially by you (accompanied by a letter) to the Common Council of this City for action. Among the advantages to be gained over any other plan proposed are the following:

1. Greater efficiency in supply for the uses of the Fire Department.

2. Affording sanitary supply of water in abundance.

3. High service giving 50 streams of water 130 ft. high from $1\frac{1}{4}$-inch nozzles at one and the same time direct from hydrants.

4. Water supply for propelling machinery in place of steam power in hundreds of buildings where steam is now used.

5. High service of the Croton water supply in the tops of each and every dwelling house and building in the district supplied by the Holly system at any and all times.

6. The use of salt water for all uses of the City in putting out fires, washing streets, sewers, drains, &c., thereby saving the Croton water supply for domestic use and for drinking, which practically enlarges and extends the Croton supply of water for many years to come.

7. By delivery of water under the high or Holly pressure

fires will be speedily extinguished, and a comparatively small amount of water used, which will save a very large amount of unnecessary water damage to merchandize and other property.

8. It gives an inexhaustible supply of water, and is always ready for use without the use of the steam fire engines of the present Fire Department, the steamers of which can be used in other parts of the City until the Holly system shall give its independent water supply all over Manhattan Island, it being subdivided into separate districts of water supply.

9. Each district will be laid out, and have new mains, connections, valves, engines and hydrants independent of the Croton water supply system.

10. The economy to our citizens in health, clean streets, saving in the expenses of the Fire Department and Street Cleaning Department, a plentiful water supply, and bountiful protection against fire will more than compensate for the expenditures of the Holly system as proposed, which are certainly very moderate. Some of the officials of the Holly Manufacturing Company will be in this City during the present week, and will be pleased to explain the plan more fully to you and such city officials as you may invite at your earliest leisure.

Inclosed please find map, papers, &c., relating to the matter.

If the general plan should be adopted, the present is a very favorable time to have the work done, and it would give employment to a very large number of people, as labor and materials are very low.

Anticipating your cordial co-operation, I remain,

Very respectfully yours,

J. L. DOUGLASS.

CONTRACT PROPOSALS

To improve and extend the water supply in New York City on the Holly system of direct pressure.

Propositions of the Holly Manufacturing Company of Lockport, N. Y., to furnish New York City with a triple supply of water, pumping power, delivery pipes, mains, &c., complete for use.

To the Mayor and Common Council and Commissioner of Public Works of the City of New York:

In view of the acknowledged need of increased protection to property from destruction by fire,

The Holly Manufacturing Company of Lockport, N. Y.,

makes the following proposition for securing that object, and at the same time incidentally increasing the Croton water supply for the City of New York.

The method will be on what is known as the *Holly* plan of pumping water directly into street mains under any degree of pressure required, and with contrivances for equalizing and controlling that pressure without reservoir or stand pipes.

In the construction of water works on this plan, the Holly Manufacturing Company have been engaged for many years, and it is in successful operation in more than one hundred cities (100) and villages at this time.

In applying the system for purposes of fire protection in the City of New York, we suggest to arrange for four fire districts, as follows, viz:

Districts.

District No. 1.—Bounded by the Hudson river, Cortlandt street, Broadway, Fourth and Christopher streets.

District No. 2.—Bounded by the Battery, Hudson and East rivers, Cortlandt street, Broadway and Grand street.

District No. 3.—Bounded by Fourth and Christopher streets, Hudson and East rivers and Twenty-third street.

District No. 4.—Bounded by Twenty-third street, Hudson and East rivers and Seventy-ninth streets.

District No. 1.—Is known as the dry goods district, and contains within its bounds an aggregate of values amounting to hundreds of millions of dollars. For the better protection of this property, it is proposed to locate pumping works at or near the foot of Canal street, erect all nccessary buildings, set up suitable pumping engines, make the proper connections for drawing water from the Hudson river, lay pipes in and through the streets within said district as indicated in accompanying ground plan of piping, set hydrants as indicated in said plan and make and construct all other things necessary for the delivery of water, and the throwing of fire streams as hereinafter provided.

The Holly Manufacturing Company proposes that the pumping machinery which will be furnished shall have power to deliver under conditions hereafter named (36,000,000) thirty-six million gallons of water daily. Upon the street mains it is proposed to supply and set, as shown in accompanying plan, (2200) *twenty-two hundred fire hose connections, and guarantee to supply therefrom fifty* (50) *fire streams direct from hydrants in any locality where a fire may occur, each stream to be* $1\frac{1}{4}$ *inches in diameter and one hundred and thirty-five* (135) *feet high.*

For constructing works within said District No. 1, as above specified, fully guaranteed as above, the Holly Manufacturing Company will receive in payment the sum of one million four hundred and eighty-six thousand nine hundred and sixty dollars ($1,486,960), sixty per cent. of which to be paid on estimate as the work progresses, and the balance of forty (40) per cent. on completion of work and fulfillment guarantee.

The Holly Manufacturing Company will give satisfactory bonds that in case of failure to perform as guaranteed, it will remove pumping machinery, and pay all damages which result to the City on account of failure.

The works for District No. 1 can be completed during the present year, and the construction of similar works for any of the other districts can be made for about the same proportionate sum of money.

The completion of the works throughout the City would give an aggreagate of (8,800) *eight thousand eight hundred fire connections from which at the same time two hundred* (200) *fire streams, each* $1\frac{1}{4}$ *inches in diameter and one hundred and thirty-five* (135) *feet high could be thrown upon fires.*

The plan contemplates keeping sufficient pressure in the pipes so that the hydrants will at all times be in readiness for the instantaneous connection of hose and the throwing of fire streams.

In many places where works on Holly's plan are in operation, and have been for several years, the area of territory protected and length of water mains exceeds those in either of the proposed districts.

The plan is entirely distinct and separate from the Croton water supply, and largely increases that supply by otherwise providing water for fires and sanitary purposes, such as street sprinkling, washing gutters, flushing sewers, mechanical purposes, &c.

It is to be understood that the City of New York will furnish sites for engine houses and other buildings, and give right to lay mains, set hydrants, and all other work necessary in the steets, avenues and alleys in said City.

With this plan in operation, owners of property will be able to protect that property by pipes brought into the buildings and carried to the highest stories, with take-offs and hose connections on each floor, from any one or all of which streams may be thrown and fires suppressed without aid from the Fire Department.

The plan contemplates protection of machinery and pipes from effects of river water.

HOLLY MANUFACTURING COMPANY,

T. T. FLAGLER,

President.

Dated February 19, 1879.

Presented by

J. L. DOUGLASS,

149 Broadway, New York City.

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