Upon Different Proposed Methods of Increasing the City Water Supply, and Extensions and Improvements to the Waterworks System

BY WILLIS CHIPMAN, CIVIL AND SANITARY ENGINEER.

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This quantity of water should be suf-

The hydraulic machinery installed in

two million gallons per day, each, oper-

by a 35-inch turbine to pump water

capacity of the hydraulic plant, will

therefore be five million imperial gal-

In 1881 the Board decided to install a

RESERVOIR.

station, the elevation of the water in

reservoir when full being 240 feet above

the pump house floor, and about 195 feet above Dundas street at Richmond,

of through the main supply pipe.

stored supply to be drawn upon in

The suggestion has been made to add

SUPPLY MAIN.

pumps to the reservoir, with a gate

valve near pump house and a check

valve near road, about one-third of

To supply the city, an 18-inch main

As a part of the original system, an

age not as yet determined.

the fire supply required.

distance to reservoir.

case of fire.

in the business parts of the city.

REPORT UPON WATER SUPPLY. gallons per 24 hours, or 2.777 gallons 220 imperial gallons per minute, or a total of 3,520 gallons per minute for Nov. 14, 1903. To the Board of Water Commissioners ficient for a population of 50,000 peo-

for the City of London, Ont.: Gentlemen,-On May 19, 1903, I received your instructions to examine the (appendix), the daily consumption of existing waterworks system. and to re- water per capita in a number of places port upon the available means of in- in Canada and the United States, secreasing the supply. The problem is an intricate one, admitting of several solutions.

INSPECTIONS. During August I examined the springs and streams between London and Delaware on the main River Thames, also the north branch to lot con. 4, and the south branch to lot year. It is now being replaced by two 5. con. A. Township of London.

I have from time to time inspected ated by a 50-inch Wm. Hamilton turthe pumping station, visited the reservoir and studied the reports and records on file in the offices of the board. My assistant was also engaged by the board to determine the elevations from the lowest springs. The combined of the several springs and streams in the vicinity of Londo

PRELIMINARY INVESTIGATIONS. From the first report published by steam pumping plant of two million the board (1879) it appears that three gallops capacity, and let contract for proposed sources of supply were insame. This machinery is now in efvestigated before submitting the money bylaw to the people. for coning engine was added, at a cost of structing the works:

1. North branch of Thames River. 2. Pond Mills.

3. Coombs' Springs.

gallons per day. As the first scheme did not include a storage reservoir, and as the quality tubular type, with a combined power of the water was very inferior, the of four of the water was very inferior, the of four hundred commercial horse City Engineer, Mr. Wm. Robinson, and power, sufficient to produce steam Consulting Engineer. Mr. T. C. Keefer, reported against it. and a boiler in reserve.

Upon syphoning the water from the pond at Pond Mills, southeast of the city, the supply was found to be inadequate, the pond not recovering its normal level for months after the test. By measurements made by the engineers in 1878, the daily flow from the springs was found to be as follows: Coombs Springs, 1, 2 and 32,065,207 Dufton's Springs 304,148 Colville's Springs 85,214 Griffiths Springs 567,174

Total, U. S. gallons......3,001,743 The flow from the Coombs Springs sides being paved and concreted. was at this time utilized to operate a small mill, the water being stored in vegetable organisms in the reservoir. to be taken from the hydrants. two ponds, from which it was conveyed by a flume to an overshot water The old mill, which stood a little to the northwest of the present pumping station, has been removed, but the ponds have been utilized as collecting basins

The flow from the Griffiths Springs The flow from the Griffiths Springs in the vicinity of the pump house that double the strain on pipes, on services, was also utilized to run a small mill hold about three million gallons. The by a large overshot wheel. This mill was in operation until a few years before the supply of water was taken by

It was decided to adopt the Coombs Springs as the source of supply, to a large reservoir to contain five days' pump by steam to a reservoir on the supply, or twenty million gallons. Such Il south of springs, and distribute to a reservoir could be constructed a the city by a 15-inch supply pipe. The short distance southwest of the exestimated cost as given in the bylaw isting one, but the cost would, in my mbmitted to the people was \$325,000.

The bylaw was carried, and in Janupumping machinery, which would give 18 ary, 1878, Messrs, Robinson, Tracy and Fairbairn were appointed engineers.

CONSTRUCTION. The tenders received were so much lower than anticipated, that it was long was laid from the water power decided to substitute water power for

ply pipe to 18 inches. Two Risdon turbines, 72 inches in diameter, were installed, each of 110 horse power, under a head of 101/2 feet, was laid from a connection with the the capacity of pumps being 3,000,000 first described main near the road, U. S. gallons per day, against a head thence along what is now known as

The distribution system as laid was the East Cove, thence across private s follows: 37,166 feet of 4-inch. 61,583 feet of 6-inch. 18,603 feet of 8-inch. 17,722 feet of 10-inch. 3.164 feet of 12-inch. 22,521 feet of 18-inch. Total 160,759 feet, 3,750 tons.

Fire hydrants set, 180. The dam was a stone-filled timber pletion of the dam was delayed until January, 1879, by a flood in the preced-I infer that only part of the Coombs

ed 1,000,000 gallons. In this year, three miles of mains were also laid. Mr. William Robinson retired in 1878.

and Mr. T. H. Tracy was appointed Engineer, a position held until his resignation in July. 1891, when the pres- might ent Engineer and Superintendent was appointed.

INCREASING SUPPLY.

From 1880 to 1886 the supply from the Coombs Springs was sufficient. In July and August of the latter year there as follows was a scarcity of water. In the sum-mer of the following year the lawn services were cut off, and the supply to the Grand Trunk Railway. In 1888 the Dufton Springs, yielding 200,000 gallons, were added, but in 1889 another shortage occurred.

A test well was commenced in 1889, and completed in 1890. Three additional test wells were sunk in 1890 and 1891, without success in finding good water. and the Griffiths Springs, and increased the supply by 1,500,000 gal- cent of those above given.

The total supply in 1891 amounted to mond the static head from the r 3,576,000 U. S. gallons, or 2,930,000 im- voir is about 85 pounds, and the perial gallons.

the supply was less than the demand, be assumed for the district. necessitating the restriction of sprinking of lawns and streets, and the cut-

ting off of the G. T. R.

In 1895 the lower Colville Spring, yielding 400,000 gallons per day, was pumped temporarily. In 1897 this supply was piped to the pump well, and in 1898 the Griffiths Springs and springs on the north side of river were added. In 1901 the demand overtook the supply, and an additional 275,000 gallons vere temporarily pumped from springs discovered near the pump house. In the years 1902 and 1903 the summers

FIRE SUPPLY. In addition to the domestic supply provision must be made for the water equired for fire protection. required for fire protection.

The quantity used during a year for fires is probably less than one-sixth of one per cent of the total pumped, but

it is necessary to provide a compara-tively large amount for a short time at a high pressure.

To fulfill the standard requirements now demanded by the Canadian Fire Underwriters' Association. water must be provided for sixteen fire streams each through a 1 1-8-inch plain nozzle

at the end of a single line of 21/2-incl

fire hose, 250 feet in length, the run-

ning pressure at the hydrants being 90 pounds.

The flow from each nozzle will be

sixteen streams.

This would be at the rate of about 5,000,000 gallons per 24 hours, or a supply one-fourth greater than the maximum domestic consumption.

As the 18-inch conduit can only convey the present domestic consumption lecting principally those with a popumain must be laid for the fire supply. This duplicate pipe would 100 gallons per capita within a few double the supply to the city, but with years, and 120 gallons per capita in the two conduits in operation during thirty years. lation between 20,000 and 60,000, and supply. eliminating places where the conditions are materially different from those in a large fire, with sixteen standard fire

streams, the pressure at the fire hy-1879 continued to be operated until this power pumps, each of a capacity of loss of about 30 pounds, and a 24-inch same quantity with a loss of 13 pounds. The larger the supply main the for the future needs of the city are conbine. There is also being added a one million gallon power pump, operated friction loss, but no pipe, however large, could possibly give the fire pressure

To give the required fire pressure, another pumping station might be con-structed on the line at or near the domestic supply and the fire supply combined, or about 7,500 gallons per

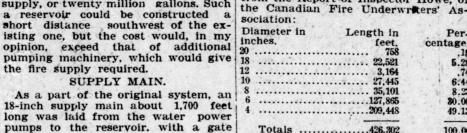
ficient condition. It cost about \$15,000. These pumps would draw water from In 1894 the Blake-Yates steam pumpthe two conduits leading from the reservoir and force it into the distribuabout \$32,000. This new steam pumping tion system. This pumping plant engine has a capacity of four million would require to have a capacity of bout nine million gallons per day, There are five boilers of the return but as it would only be operated during fires, fuel economy need not be considered in designing the machinery The maximum fire supply demandfor both pumping engines at one time, ed by the Underwriters may never be needed, as the number of fires during year at which more than four or The reservoir is located on a hill five streams are used will be very few, about 1,700 feet south of the pumping but if a conflagration were threatened.

the full supply and pressure would be Taking into consideration the exten of the city, the water pressure availgiving a static head of about 85 pounds able from the reservoir, the character and height of the buildings, the location of the manufactories, etc., and at the top, 200 feet square at bottom, the infrequency of the high fire pres-17 feet deep when full, and contains sure service required, I am of the opinion that the attempt to give the poor sary fire pressure at the hydrants should be abandoned, and that steam The embankments are of earth, the There is practically no growth of low fire engines be relied upon. the supply There is no proper overflow from the The pressure on the system reservoir nor means of draining it, ex- gives a good domestic service in all

though there is probably a slight seep- dential districts. there are three large collecting basins entire city at every fire alarm, would increase the leakage, and capacity of these ponds might be in- greatly

parts of the city, and it is also suffici-

creased at a moderate expense, the should not, in my opinion, be adopted. DISTRIBUTION SYSTEM The following schedule giving the lengths of each size of main. is taken from the Report of Inspector Howe, of the Canadian Fire Underwriters' As-



This statement includes 758 feet 16,000 feet of 18-inch pipe from Springbank to Wharncliffe road in the western part of the city.

In the business streets there are

Laid along

.Pipe Line road and York street.

Clarence and Richmond streets.

Forest Hill and across the river.

Mount Pleasant avenue. Mount Pleasant avenue. Wharncliffe Highway.

about 18,000 feet of mains, the proporthe Pipe Line road to the east side of follows: 6 inches diameter, 38 per cent. cliffe and Stanley, thence along Stan-8 inches diameter, 35 per cent. ley and York to Waterloo street. The 10 inches diameter, 17 per cent. length of this supply main is approx-18 inches diameter, 10 per cent. imately 20,500 feet. When the Killey steam plant was to therein, constituting 79.13 per cent

20 Springbank.

.. Springbank.

York street. York street.

.Dundas street. .Piccadilly.

Waterloo street.

.Maitland street

.Oxford street Ridout street.
Richmond street.
Richmond street.

Waterloo street.

Rectory street. Egerton street. Dundas street.

added in 1882, a 20-inch discharge pipe was laid from the new pump house diagonally across the 18-inch force of the whole, consist of a total length of nearly 64 miles, of which 38 per cent main leading to the reservoir, to the are 6 inches diameter and 62 per cent city supply main on Pipe Line road. 4 inches: The discharge from the Blake-Yates steam pump was also connected with Diameter in

this 20-inch pipe in 1895. The pumping plant can be shut off Springs supply was at first taken, as from the reservoir and the city by 1580 springs were added that yield- gate valves and check valves, thus preventing water flowing back towards the pumps, if the machinery be stopthe reservoir, and pumping directly to the city, but the arrangement of valves | be improved upon, so that in case of fire alarm, the engineer might

pump directly into the mains under higher pressure. The friction loss in this supply main between Springbank and

as follows:				
Imperial Per	Gallons. Per	Friction	Loss.	
minute.	24 hours.	Pounds.	Fee	
1,000	1,440,000	5.2		
1,500	2.160,000	11.6		
2.000	2.880,000	21.2		
2,500	3,600,000	31.0		
3,000	4.320.000	44.0	10	
3,500	5,040,000	63.0	1	
4,000	5,760,000	80.0	17	
100000000000000000000000000000000000000	BOA A STANLEY TO SEE STANLEY		Control of the	

In 1890 a gallery was constructed inches in diameter, the friction losses, westerly, which partially drained the when delivering from 3,000 to 5,000 gallons per minute, would be about 80 per

At the corner of Dundas and Rich- inch hose neggles only. mond the static head from the reserness portion of the city has practically the same elevation. This pressure may

To obtain the actual pressure on the

Per	Per	Effectiv	e
minute.	24 hours.	pressure in	city.
.000	2,880,000	85-21 64 p	ounds
2,500	3,600,000	85-31 54	
3.000	4,320,000	85-44 41	"
3,500	5,040,000	85-63 22	44
1,000	5,760,000	85-80 5	
The d	existing supp	oly main is,	here-
fore, o	f sufficient	capacity to c	onvey
		ill supply of	
	and to el	ve an efficien	t-do-
springs	, and to zi		

term, and as the average life of pump-ng machinery, filtration systems, etc., may also be taken as thirty years, it would appear reasonable that all ex-tensions and improvements now to be undertaken, should be such as would be sufficient for the next thirty years

at least.

Taking all the foregoing points into consideration, I am of the opinion that your Waterworks System should be, when completed, sufficient for a population of 60,000 people, but it may not be necessary to construct at once all the works demanded for this population.

CONSUMPTION. The present average consumption of water in the city is about 3,600,000 galons per day, or 90 gallons rer capita. Under your present Rules and Reguations, the per capita consumption will probably slowly increase. year by year; at least this has been the rule in other places. It may safely be assumed that you will require at least

With a population of 60,000, consuming 120 gallons per capita, the average drants would be reduced to less than daily consumption would be 7,200,000 gallons. The daily maximum would A 20-inch main will deliver 3,500 gal-probably exceed this by one-third, lons at the City Hall with a friction making a total of 9,600,000 gallons per day, or 6.666 gallons per minute. This estimate of the supply requisite

greater the discharge, and the less the servative, as will be seen upon comparing it with the average daily consumption in other places, where the flat rate system of collecting revenue is in force. The average daily consumption per

capita in several cities, is approximatewesterly limit of the city, to pump the ly as given in the appendix. Schedule By allowing five persons for each service, the population supplied may be approximately obtained; and the

per capita per consumer.

WASTE OF WATER. That a large part of the water now supplied to your city represents waste can be easily proven. Some of this waste is preventable, while some is not. Of the latter class, the leakage from mains is the most important. Defective plumbing, leaky faucets, and the unrestricted use of hose, are however, responsible for the greater

system, I would estimate to be about Gallons. Evaporation and seepage from 30,000 reservoir Mains, 30 miles, at 3.000 gallons per mile 270,000

and parks 50,000, making a total of ufacturing, street sprinkling etc. gallons for municipal purposes. The railways are the largest public consumers, but unfortunately there is

the city mains, possibly 500,000 gal-

Adding together the amount allowed for leakage, for the municipal purposes the total maximum pumped, gives 2,-750.000 gallons as the domestic consumption, during the hottest weather. The Superintendent writes me as folor about 70 gallons per capita, or about lows, respecting their experience; 49.13 two barrels per day for each man, wo-

it can be easily shown that half of it of the meters; the interest on the in-20-inch pipe at Springbank, and about represents useless leakage, that is, the city is now pumping about 1,400,000 the saying of the water, and thereby gallons of water to a height of 240 feet for which it receives no return and We adopted the meter system fifteen which serves no useful purpose.

The water used for manufacturing tions of the different sizes being as and for building purposes is included in the domestic consumption. Except- and petter to both the consumer and ing the railways, there are not many large coasumers of water in London, and I believe that relatively, more water is used for manufacturing pur The following is a statement of all poses at Brockton, Mass., at Lawrence, the principal mains. Those not referred Mass., and many other places mentioned in appendix "A." formerly referred to, than in your city.

COST OF PUMPING. In discussing the cost of pumping water, the first cost of the works

18-inch supply, main

asant avenue.

ET SY STATE OF	and reservoir.
W. P. pumps.	18-inch supply, main
Reservoir & pumps.	Waterloo street.
Waterloo.	Adelaide street.
Adelaide.	Rectory street.
Rectory.	Egerton street.
Richmond.	Maitland street.
York.	Piccadilly,
York.	Piccadilly.
York.	Piecadilly.
18-inch main on	And a service to the service to
Pipe Line road.	Francis street.
Francis street.	Mt. Pleasant avenue
Forward avenue.	Douglass avenue.
Douglass avenue.	Wharncliffe H'way.
South side river.	Oxford street.
Wharncliffe H way.	
Bathurst	Albert street.
York.	Central avenue.
Piccadilly.	Grosvenor street.
South.	York street.
Piccadilly.	Grosvenor street.
Hamilton road.	Central avenue.
Hamilton road.	Dundas street.
Frances.	Dundas street.

avenue. Adelaide.

There are 429 city fire hvrants and | should, in my opinion, be taken into 29 hydrants on private properties, all consideration. of same pattern, provided with two 21/2ads sais POPULATION.

fr 1881 the population of the city was given as 19,725, in 1901, 39,059, but during the interval three suburbs were annexed as follows: London East, in 1885, population .4.557 London South, in 1890, population.3,469 London West, in 1898, population.2,009 lion gallons.

Assuming the same rate of growth to the dates they were annexed, I estisale that the total population within the city mits to have been approximately as charges, which amount to about \$35 per million gallons puncted, not in-cluding interest and sinking fund vices, seventy five per cent to be me-tered within five years. mate that the total population within 1898 38,000

The London works have cost about \$500,000, the interest and sinking fund charges on which amount to about \$120

ance about \$3 per million gations. When pumping by water power, the cost may be reduced to \$2 per mil-

The total cost to the city is, there- in Canada, you will find that the first fore, \$55 to \$60, or say \$57 per million. cost of the works has been low, the It is often argued by prospective concost of extending mains and laying the years 1902 and 1903 the summers have been wet, and the supply has been sufficient.

The present supply is estimated by Mr. Moore to be as follows:

Coombs Springs 1,721,000 Cloville (lower) Springs 1,250,000 Colville (lower) Springs 225,000 North Side Springs 255,000 Pump House Springs 275,000 Pump House Springs .39.50)

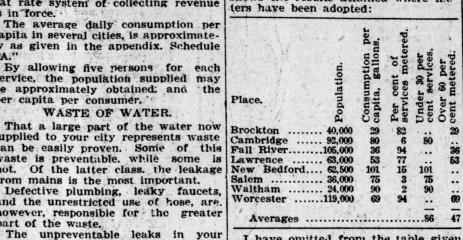
It my reasoning be correct, the city should receive more than five cents per 1,600 gallons for water supplied to As Waterworks Debentures may, by statute, be issued for a term of thirty years with a sinking fund sufficient to meet the principal at the end of the deavored to show the revenue now redeved from different sources.

ceived from different sources:		
Service. Revenue.	Water used daily, gallons.	Rate received per 1,000 gals,
Municipal— Leakage	300,000	}
Street sprinkling, parks and sewers 3,900 City and public	350,000) 6½e
Bailways 700	100,000	or Sand in
C. P. R 1,000) G. T. R 3,500) Demestic consumers—	500,000	2½c
*Lawns 16,000	2,000,000 750,000	8) 9c 12) 9c
Totals	3,500,000	71/20

It is evident from the foregoing that the railway companies are now being supplied with water at less than cost, and at a much lower rate than the

citizens. METERS. It has been proven by experience in many places that by the general in-stallation of meters on the services the consumption of water has been greatly reduced, without restricting its The following table compiled from

the Annual Report of the Massachu setts State Board of Health for 1900 shows the results attained where meters have been adopted:



I have omitted from the table give in this report those places with a pop-ulation of less than 20.000, also those in which over 30 per cent, but less than 60 per cent, of the services are meter-In places where over 60 per cent of

the services are metered, the per capita consumption is about 55 per cent of he consumption in places where less The municipal and public buildings than 30 per cent of services are metermay require 100,000 gallons, the street ed. This consumption includes water sprinkling about 300,000, sewer flushing used for all purposes, municipal, man-

hough there is probably a slight seepge not as yet determined.

To increase the present pressure by In addition to this elevated reservoir, there are three large collecting basins in the vicinity of the pump house that and only pump house the solution.

The two railway companies are now paying the city \$6,000 per annum, which at five cents per thousand gallons would save the consumption at Brockville, Wind-the consum of the number of iccomotives washed I am of the opinion that by the adopout, the number of tenders filled, and tion of meters on 75 per cent of the the taps, fixtures, yard hydrants, etc., services in London, the consumption on the properties of the railway com, would be decreased by over 25 per cent. panies, I am of the opinion that they or more than 1,600,000 gallons per day. The exterience of Madison, Wiscon-

sin, a city with a population of 20,000. may be of interest: The water supply, which is obtained from drilled wells, became taxed to the and railway uses, gives a total of 1.- limit, and as no additional supply was 250,000 galtons, which deducted from available, meters were adopted after be decreased. several years of agitation and discus-

> "The pumpage of water is certainly cheaper under the meter system and easily makes up more than the cost vestment, the repairs of the same the saving of the pumping machinery. years ago, with all objections in-aginable. Today our consumers would not part with the meters. It is cheare the city. The meter system is the true The waterworks system is owned by the city and the average duly consumption is now 1,000,000 gatlons. Additional evidence might be presented in favor of the meter system from city officials, waterworks superinterdents and others. The objection: are the first cost, the annual expense

and the restrictions of water to the householder Meters have been so in proved and cheapened in price during recent years that a reliable article with a life of twenty years at least, can now be purchased at a reasonable cost. The annual charges for repairs and cleaning are generally over estimated. At Madison it costs \$100 per year to clean 500 meters or one-sixth of the total nuriber.

At Lexington, Ky., the expenses of all kinds for labor and materials on meters, are less than thirty five cents per meter per annum, and the superintendent writes: "And if they five times that amount, we would think it money well invested."

That meters restrict the use of wa ter has been proven over and over again by practical experience to be untrue. It only serves to detect leaks and stop waste. The success of the meter system de-

pends to some extent upon the tariff of rates adopted, but in any case the meter should be owned, set, and main-The size of the meter should be des-

ignated by the Superintendent, and a different size of meter, this rate to be sufficient to meet all expenses of installing and maintaining the meters, including interest, depreciation, re pairs, cleaning reading, book-keeping When pumping by steam the coal addition to this fixed charge, the concosts about \$8 per million gallons sumer should pay for the water used. pumped, and the charges for attend- at a reasonable rate, not more than ten cents per 1,000 gallons, nor less than five cents.

Whatever decision you may come to in regard to improving the waterworks The annual operating expenses for system, I believe you should at once the last ten years, have ranged from adopt the meter system, commencing adopt the meter system, commencing with the larger consumers, and year increasing the restored seemed. Comparing London with other places

Total first cost\$87.509 Annual Charges-Interest, 4 per cent..... eading meters 2,000 Total annual expenditure....\$10,000

The direct saving will be the cost of pumping and distributing 1,000,006 callons per day, which at five cents per thousand gallons, will amount to 18,350 per year.

To state that the cost of pumping only should be charged against the

extra million of gallons pumped, would be unfair, as the additional volume pumped demands larger mains more machinery; it increases the wear and tear, also the expense of ewage purification. By the adoption of meters in London, the present supply would be ample until the population exceeded

TARIFF. The Schedule of Rates adopted in 1896 are those in force today, the discount for prompt payment on flat

rates being 20 per cent. The flat rates are very similar to those in other places. For a private dwelling not exceeding three rooms. the rate is \$5, each additional room 75 cents, bath \$4, closet \$3 50, lawns \$4 for 2,000 square feet, etc. The meter rates per 100 cubic fee

are as follows, without discount: Up to 15,000 cubic feet, per quarter Further amount over 15,000 and up to 100,000 cubic feet....... Further amount over 100,000 cubic feet per quarter..... 5 Church organs

There is also a charge for meter rentals as follows: 1/2-inch, \$1 per quarter. 4-inch, \$1 50 per quarter. 1-inch, \$2 per quarter. 2-inch, \$2 50 per quarter.

4-inch, \$5 per quarter. 6-inch. \$7 per quarter. The revenue received from ordinary onsumers is now about \$74,000 for an average consumption of about 2,500,000 gallons per day This would be at the rate of a little

more than eight cents per 1,000 gal-lons, or five cents per 100 cubic feet. The flat rate is, therefore, materially lower than the meter rate, which is sufficient of itself to discourage the At Milwaukee a fixed uniform charge

of \$1 per year is made on each service,

to cover the cost of reading meters. etc., and all water used is paid for at springs above the city on the north meter rates. At Cleveland the rate for metered is a uniform one of 51-3 cents per 1,000 gallons provided that for water taken through a 5-8-inch meter, the payments shall not be less than \$2 50 indifferent success. per year, where the flat rate was \$4. or where the flat rate was over \$4 and in all

In this Province compare Berlin with and two cents per 1.000 for all over no way of accurately determining the Brockville. If the number of services that the minimum being \$5 per annum There is no apparent leakage, al- ent to cope with small fires in the resi- quantity of water taken from the city at Berlin were increased to 2,000, the on a 5-8-inch meter, 312 50 on an inch ly sulphurous water, quite unfit for keeping complicated, and occasionally Middlesex, rise to the northward and

tity than for a larger. I believe that you should repeal your present schedule, simplify and raise he flat rate, adopt a uniform meter rate, and abandon the term meter rental. In my opinion a uniform rate of four cents per 100 cubic feet in addition to a fixed quarterly charge based on the size of the meter, would soon become popular, the revenue would increase, and the water pumped would

INCREASING THE SUPPLY. present supply, which during a dry mestic demands.

Many additional sources have been uggested for invetigation: (b) Springs below the city. (c) Springs above the city. (d) Artesian wells: (e) Surface streams.

(f) Galleries in London West. (g) Lake Eric. (h) River Thames. (i) Redmond Pond. (A) SPRINGBANK Although levels have been taken over a large area of country west of Lon-don, the gathering ground that supplies the springs at Springbank has In some portions of London West, not been determined, and the source beds of sand and gravel are found that remains an unsolved problem. The wa- provide an angle supply for domestic ter may come from the high ground to wells.

flow of Dignam Creek at several points flows southerly through subterranean might throw some light on the prob- beds of grave! underlying London West to the main river, the water be-In my opinion there is no possibility ing filtered in its passage through the of obtaining any large increase of wa- gravel. ter from Springbank or vicinity. Some further experiments at Spring-bank and south of Eyron might result in the discovery of veins of water-bear-such underground flow.

matter of chance. that water might be found at the bot-form of this vein. It would cost but owing to its comparatively shallow little to sink a test shaft, to determine depth. this point, but the supply, if found, Experiments and tests may, however, would probably be small.

That you may compare Loudon wa- have faith in this scheme of its imter with that supplied in some other practicability. places in Ontario, I give the following table of analyses. The first six of these analyses were made by Dr. W. H. In the year 15% the Town of Petrolea Ellis and the last two by A. McGill. with a population of about 6,000, con-

ship of Lobo, distance from Byron about 6 miles, estimated flow 125,000 gailons per day. All of the foregoing are on the north side of the Thames River, and the following are on the south side: Batman's Springs at Kilworth, Lot C. Township of Delaware, distance from

Byron about 3 miles: measured flow 150,000 gallons per day at road above cemeteries, and 225,000 gallons at the river. strong's Springs on Lot 1. Con. IV. of Delaware Township, flow souther'v to Dignam Creek, the distance from

ured flow 80,000 gallons per day, below the ponds and dams. After an inspection of all of the fore-going springs, I am of the opinion that not more than one million of gallons per day, nor less than half a million of gallons per day, may be obtained from the springs on both sides of the river between Byron and Kilworth, and that the water may be conveyed to

Springbank, but not without pump-In discussing the supply obtainable from springs, it is often assumed that the visiable flow is only a fraction of the total, but this assumption is not

warranted. Upon reference to the reports of you Board, it will be found that the flow from the Coombs Springs. Dufton's Springs and Colville Springs as measured before the waterworks were constructed, was practically the same as

the flow today,
In my opinion it is not probable that a greater supply can be obtained from these springs than the measured flow given, or a total of about 406,600 galons per day from the springs between Byron and Kilworth, and less than one million gallons per day for all the

springs above Kon oka. Along the north branch of the river on Lot 6, Con. IV., Township of London, there are several large springs on both sides of the river, and I am informed that there are other springs

between them and the city.

The Cronyn Springs on the south bank on Lot 6, have a combined flow of about 350,000 gallons per day, and White's Springs on the opposite bank have a flow of about 425,000 gallons, To utilize the water from these springs a pumping station would be required to pump against the full res-

ervoir head carried on the city sys-As the springs below Byron would only require to be pumped to Spring-bank, the annual cost would be slightly less, and as the supply of water would be about the same, they should therefore be acquired before the

Many wells have from time to time been sunk by private parties at many different points within the city, with

small, and in the majority of cases Further proof of the efficiency of The Buffalo rates are six cents per the water has been slightly sulphurmeters may be found in Schedule "A." 1,000 gallons for the first 22,500 gallons, ous. At Springbank the wells sunk by the Board, produced a fair flow of strong-

The supply of water obtained has

The strata of the comiferous limestone which underlie the County of

to the eastward of London, and fall slightly to the westward and south-From my own experience with drilled wells at St. Marys, Goderich, Strathroy and Petrolea, and from the results in London, I am of the opinion that there supply from this limestone or below it in the vicinity of London.

Your present supply is found in beds of gravel, over-lying clay, at an elevation slightly above the river. (E) SURFACE STREAMS.

The surface streams in the vicinity If meters be not adopted, it becomes of the city that might be secured for mperative to immediately increase the increasing the water supply are Dignam Creek, Pond Mills stream south of season is barely sufficient for the do- the city, Ox-Bow Creek, which enters the river from the northeast near Komoka, and Crow Creek west of Ko nuggested for investigation: moka. There is another stream that

(a) Additional supply at Spring- enters the north branch of the river. a short distance above the city, known as the Medway, but I am informed that it becomes practically dry in the summer season. All of these streams, except the Medway, are of small volume and drain,

cleared agricultural lands. It is probable that the quality of the water in either branch of the Thaines above the city would be found superior to the creek waters at certain seasons of the year.

(F) GALLERIES the southeast or by subterranean It has been suggested that the water channels from Dignam Creek to the from the north branch in the vicinity southwest. Careful gaugings of the of Wharnciffe and above the mills,

From my own observations and from

ing gravel that might yield a supply The strata of gravel and impervious worth collecting, but this is entirely a clay are very irregular, and I could find no continuous gravel bed connect-I am informed that a vein of dry ing the upper reach of the river with coarse gravel was struck on the con- the main stream. If such a flow were duit line from Byron. It is possible discovered, it would probably be sub-

> be necessary to convince those who (G) LAKE ERIE.

In parts per million. Date. ZZ Traces 126 132 .Feb., 1891 .May, 1891 .Nov., 1889 7.00 1.50 1.50Traces

markably pure. but hard, and is well miles distant in a straight line. suited for all domestic purposes.

(E) AND (C) SPRINGS. Along the banks of the river between distance only into consideration, it Byron and Delaware, there are numer. ous springs, the flow from the most important of which have been measured and found to be as follows: Springs, Lot 31. Con. III trolea.

Township of London, distance from

As shown by the above analyses, the structed a System of Waterworks, tak-London water from the springs is re- ing its supply from Lake Huron, 12 Lake Erie is distant 24 miles from London, and taking population and

> supply of water to London from Lake Erie would cost less per capita, than to carry Lake Huron water to Pe-Taking into consideration, however,

Byron about 31/2 miles, measured the quantities of water necessary for flow 125,000 gallons per day.

Blizzards' Springs, Lot 32, Con. III...

Township of London. distance from about seven times the caracity of the sent about \$6,500 per vear, or \$7 per lestimate that 6,500 meters will cost as fellows:

This reduces the cost per million fallons pumped.

This reduces the cost per million fallons pumped.

This reduces the cost per million fallons pumped.

Setting 6,000 meters lustice \$5.... 18,000 which would cost between four and which would cost between four and

would at first appear that to convey a