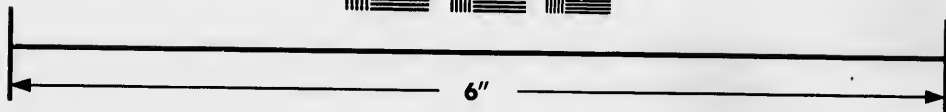
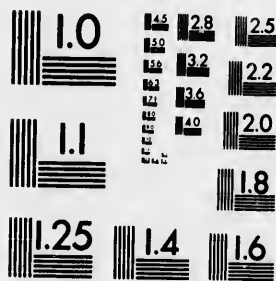


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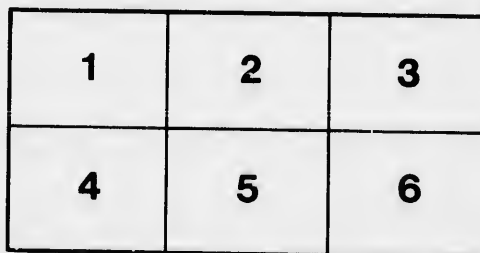
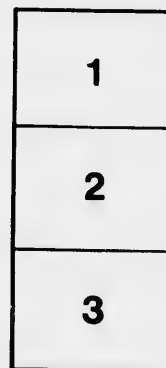
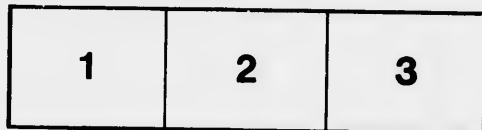
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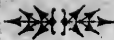
... on the

Sewerage System

... of the

City of Kingston.

... By **T. O. Bolger,**
City Engineer.



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KINGSTON, Oct. 26th, 1892.

To the Mayor and Council :

GENTLEMEN—As authorised by your instructions, I employed Captain Cochrane during the summer months to take the necessary levels to enable him to make a contour plan of the city. Having taken the levels he compiled a plan of the City from the Ordnance Surveys and traced the contour lines thereon, thus making a most complete and valuable plan, which will prove of inestimable value to the City in the future.

Having carefully studied this plan with reference to the sewerage of the City, I beg leave to report as follows :

The area of the portion of the City which is now thickly inhabited enough to require attention in the matter of sewerage is under 1000 acres ; bounded on the north by the Concession road and Stephen street, and on the west by Victoria and Collingwood streets. The tract lying north of Stephen street is so sparsely inhabited that the question of sewerage has not come up there yet. Outlets will have to be found into the river, as this section cannot be connected with the system of the southerly portion of the City.

The area lying west of Victoria and Collingwood streets as far south as Union street can all be intercepted and brought to the common outfall by gravitation, as mains on Johnson and Union will carry all that section eastward. South of Union and west of the production of Alfred street the sewerage, if ever it is conducted to the common outfall, will have to be conveyed along King to lower Gordon, and then pumped into the intercepting sewer on Stuart street, but the necessity for this will not occur for years to come.

The area above alluded to, viz : south of the Concession road and east of Victoria and Collingwood streets, is naturally divided into four drainage areas ; the first being the water shed of the old water course now occupied by what is known as the Young street sewer ; the second is the area roughly bounded by Barrie street on the west, and North street on the north—in fact, the old town limits. In this area all the streets that run to the water have a direct independent fall, and the cross streets can be all drained into these by short lines of sewers, as shown on the plan which

accompanies this report. The third area is what may be called the North street drain area, taking in all the territory north of North and Mack streets except a small section lying north of the line of Pine street, which forms the fourth area. Part of this area flows naturally north towards Russell street, and part easterly towards the Cataraqi, but it can be all taken down to Cataraqi street by a sewer on the line colored green on the plan.

Approximately these areas contain :

No. 1.....	200
2.....	350
3.....	350
4.....	100

Total..... 1000 acres.

With regard to the disposal of the City sewerage, I have come to the conclusion, after a careful consideration of all the known means of disposing of sewerage, that the most feasible way this City can dispose of its sewerage is to deliver it into the water of the lake either at several different outlets as at present, or to intercept as much of it as possible and carry it to one common outlet, and then run it through a submerged pipe far enough out into the river that it may be carried away by the downward current.

The other methods of getting rid of sewerage would all be too expensive to be considered : first for irrigation or intermittent downward filtration, there is no suitable land in the vicinity, as a sandy, porous soil is best adapted for that purpose, and in this neighborhood the soil is all a heavy, impervious clay ; besides, the expense of pumping such a volume of sewerage to the height and for the distance necessary to reach any kind of available land in this vicinity would be so great that the subject cannot be entertained.

Again, chemical treatment of any thorough kind would require large tanks and buildings in connection, and there is no available place within reasonable distance of the City, where the sewerage could be conveyed by gravitation for treatment, and where a suitable site for such premises could be procured, except, perhaps, in the marsh near the old lead smelting works ; anyway, the cost of these works would be very large at the outset, and there would be a constant yearly expense to keep them going.

At Mimico I saw a sewer disposal work in operation on what is known as the International System, This was to

treat the sewerage of 700 people and the plant cost \$8000, and then was not anything like complete. I am of the opinion that a plant to treat the sewerage of Kingston thoroughly by any of the chemical systems would cost well on to \$50,000, with a yearly cost of \$2000 to keep it going.

The Conder System, of introducing sulphate of iron into the sewers by means of small apparatus called ferrometers, is said to have worked well and might be taken into consideration, but the plan I have considered so far is discharging into the lake 4000 feet from the wharf front.

There are two systems of sewerage which have each their advocates among distinguished engineers and sanitarians, viz: the Combined and the Separate. The Combined is when there is but one sewer in the street into which is conveyed the sewerage proper, that is the household wastes, the cellar drainage, and also the roof water and the storm water from the street surface. The Separate system admits nothing into the sewer but the sewerage proper, and generally provides in addition small porous pipes alongside the sewer to convey the subsoil and cellar drainage, and has other drains again for the storm water. Now I am of the opinion that under favorable circumstances the Separate system is the best in a sanitary point of view, and if I had the planning of the sewers of a town where no sewers previously existed, I would follow the Separate system as near as possible, if it were at all practicable to get rid of the storm water without too great a cost; but in Kingston I do not see how that system can be adopted, for the reason that all the drainage so far has been on the combined plan. But some of the features of the Separate system may be introduced in the future with advantage, namely, the small drains for subsoil water, and then with the fine fall that all the principal sewers will have, the introduction of storm water will have no injurious effect.

The chief object in the disposal of sewerage is to get rid of it quickly before any decomposition takes place, and with this end in view all sewers should be straight and laid to such a grade that their least velocity will be two feet per second and as much more as possible within the limit of a speed that will not wear the sewers out with the friction. Now two feet per second equals nearly a mile and a half an hour, and at this speed the sewerage from any part of Kingston in properly constructed sewers would be clear of the proposed outfall pipe within two hours of leaving the house, that is,

where there would be a considerable flow in the sewers, but towards the upper end of all sewers the flow gets so small that periodic flushing has to be resorted to, and for this purpose I recommend flush tanks working automatically, flushing arrangements connected with the water mains and flushing flues at the dead ends of small lines, through which the flush can be made with a hose. The flush tanks are of course the best, and their number can be increased when funds are available.

On the accompanying plan the proposed intercepting sewer is shown colored green. This will be an egg-shaped brick sewer 2' 4" x 3' 6", from the junction at Gore street, decreasing in size to about 1' 6" x 2' at the ends. This to connect with a 30" steel pipe at the foot of Gore street. The steel pipe to be about 4000 feet long to deliver the sewerage at a point beyond Point Frederick. If this point of discharge prove a source of danger to the water supply of the Military College, they must be either induced to take the City water or the sewerage must be carried further out.

I may say here that I believe that if some suitable salt of iron, solution copperas or chloride of iron, were introduced into the intercepting sewer a certain distance back from Gore street, that the sewerage would be so deodorized and purified that it could be discharged 500 feet from the end of the wharves without being the slightest nuisance. This would save \$25,000. It will be observed on inspecting the plan that a small area is left below the intercepting sewer near the Barracks to the north, and near the water works pumping station to the south, where the ground is too low for the drainage to be intercepted without pumping, but the amount of sewerage from these areas is so small that it can be emptied into the lake with impunity.

In laying down the intercepting sewer I carry it along Ontario street for economy sake, although by doing so a very small head is obtained at Gore street for the discharge through the submerged pipe. A better way would be to carry it along King street, with a low level interception on Ontario street, the sewerage in which would have to be raised by pumping or by a Shone pneumatic ejector. On the Ontario street route, as shown, the average depth of the sewer would be about 8 feet, while on the King street route the depth at William street would be over 20 feet, increasing the cost perhaps \$20,000; but the King street route with a low level sewer on Ontario street would be the most complete.

In making the following suggestions I only contemplate for the present constructing the intercepting sewer as far north as the North street drain, and as far west as the Hospital, as for some years to come the volume of sewerage outside this limit will be too small to cause a nuisance. I do not contemplate an intercepting sewer large enough to carry the whole volume of storm water, but that overflows be provided at intervals to discharge the excess of the storm water into the lake. This plan is according to the best practice.

There are four old stone drains in the city, viz., the Princess street sewer, the Clarence street sewer, the Young street drain, and the north street drain, in all about 15,300 feet. These sewers, more properly speaking drains, cost the city between \$40,000 and \$50,000, and are still in a good state of preservation. Now, these drains are by no means what they ought to be for the carriage of sewerage, but to take them out and replace them with good brick sewers would cost from \$75,000 to \$90,000. Now I believe they can be made serve for years to come by making their bottoms smooth and oval with concrete, thus giving the sewerage flow a good velocity, and also by providing them with proper ventilation through frequent man-holes.

The ten miles of tile sewers already constructed can be made connect with the system proposed, and can be all made to work all right by making the improvements enumerated below.

I also give a list of sewers which ought to be constructed in the older part of the City to replace the old stone drains. Some of these are very urgent, while others may be deferred for the present. I give the estimated cost of each. This estimate is more than 20 p.c. greater than the actual cost of the sewers already constructed. I put the cost thus high to cover extra depth required in the interior of the city.

I also name and estimate for some sewers outside the old ones that will have to be constructed in the near future. Any sewer not enumerated in the Schedule or shown on the plan can be easily brought into the system.

I also strongly recommend the construction of a large storm water drain down Victoria and Collingwood streets to the lake, to cut off the floods from the western area which, in times of heavy freshets, overload the down town sewers, and this overloading will be increased the more improvements are made in the western area. I consider this drain absolutely necessary.

If all these suggestions are carried out the quantity of sewer gas in the sewers would be reduced to a minimum, and if the proper precaution is taken in the house drainage and plumbing no sewer gas need ever enter a house; in fact there would be very little dangerous gases in the sewers to hurt anything.

The following is a Schedule of the suggested improvements and an approximate estimate of their cost :—

INTERCEPTING SEWER.

Brick sewer from Hospital to Gore street, 3200 feet, at \$6	\$19200 00	
Brick sewer from North street drain to Gore street, 5200 feet at \$6,	31200 00	
25 manholes at \$50	1250 00	
Brick chamber on Gore street	1000 00	
14 overflows	1400 00	
4000 feet steel 30 in. pipe at \$7	28000 00	
		<u>\$82050 00</u>

PRESENT TILE SEWERS.

46 new manholes at 50.....	\$2300 00	
44 flushing connections at \$40.....	1760 00	
Extra manhole covers	600 00	
		<u>\$4660 00</u>

OLD STONE SEWERS.

Concreting Princess St. Drain bottom, 3200 feet at 60c.	\$1920 00	
9 manholes at \$50	450 00	
		<u>2370 00</u>
Concreting North St. Drain, 6000 feet at 60c.....	\$3600 00	
12 manholes at \$50.....	600 00	
		<u>4200 00</u>
Concreting Young St. Drain, 5000 feet at 60c.....	\$3000 00	
12 manholes at \$50.....	600 00	
		<u>3600 00</u>
Concreting Clarence St. Drain, 1100 feet at 60c.	\$660 00	
3 manholes at \$50	150 00	
		<u>810 00</u>
		<u>\$10980 00</u>

TILE SEWERS PROPOSED TO REPLACE OLD STONE DRAINS.

Barrie street, Colborne to King, 3800 feet, 12, 15, and 18 in. tile, with 11 manholes and 1 flush tank	\$5430 00	
Division street, from Brock to Earl, 1200 feet, 2 ft. 6 in. brick sewer	6000 00	
Union street, from West to King, 750 feet, 12 in. tile, with 2 manholes and 1 flush tank ..	1355 00	
West street, from Union street to Lake, 850 feet 12 in. tile, with 2 manholes and 1 flush tank....	1280 00	
Gore street, from Bagot to King, 1100 feet 12 in. tile, with 3 manholes and 1 flush tank	1930 00	
William street, from Barrie to Ontario, 2400 feet 12, 15, and 18 in. tile, with 7 manholes and 1 flush tank.....	4080 00	
Johnson street, from near Barrie to Ontario, 2900 feet 12, 15, and 18 in. tile, with 7 manholes and 1 flush tank.....	6280 00	

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Brock street, from Bagot to Ontario, 1400 feet 12, 15, and 18 in. tile, with 4 manholes and 1 flush tank.....	3130 00
Queen street, from Chapman street to Lake, 3000 feet 12, 15, and 18 in. tile, with 7 manholes and 1 flush tank.....	6480 00
Colborne street, from Division to Sydenham, 1500 feet 12 in. tile, with 5 manholes and 2 flush tanks.....	2760 00
Bay street, from above Montreal to Rideau, 800 feet 12 in. tile, with 2 manholes and 1 lamp hole.....	1350 00
North street and Rideau, Montreal to Bay, 1000 feet 12 in. tile, with 2 manholes and 1 lamp hole.....	1500 00
Clergy street, Ordnance to Earl, 1600 feet 9 in. tile, with 7 lamp holes.....	2100 00
Sydenham street, Bay to West, 2100 feet 9 in. tile, with 10 lamp holes.....	2700 00
Montreal street, 2100 feet 9 in. tile, with 9 lamp holes.....	2700 00
Bagot street, Earl to Raglan Road, 3000 feet 9 in. tile, with 12 lamp holes.....	3700 00
King street, Gore to Place d'Arms, 2300 feet 9 in. tile, with 8 lamp holes.....	3100 00
Wellington Street, West to Place d'Arms, 2300 feet 9 in. tile, with 9 lamp holes.....	2400 00
Barrack Street, between Bagot Street and water, 600 feet 12 in. tile, with 1 manhole and lamp hole.....	900 00
Place d'Arms, 600 feet 12 in. tile, with 1 manhole and 1 lamp hole.....	700 00
Simcoe, Maitland and Emily Streets, 1200 feet 9 in. tile, with 3 manholes and 3 lamp holes.....	1400 00
O'Kill and George Street, 1100 feet 9 in. tile, with 2 manholes and 2 lamp holes.....	1500 00
University Avenue, Johnson to Brock, 250 feet 12 in. tile, with 1 manhole and 1 lamp hole.....	1000 00
Princess Street, West of Division, 550 feet 9 in. tile, with 1 manhole and 1 lamp hole.....	1000 00

\$64,305 00

NEW TILE SEWERS RECOMMENDED.

James Street, Patrick to Montreal, 900 feet 9 in. tile, with 2 manholes and 1 lamp hole.....	\$1000 00
James Street, continuation to Rideau, 950 feet 12 in. tile, with 1 manhole and 1 lamp hole.....	1500 00
Stephen and Montreal Street to James, 2400 feet 12 in. tile, with 3 manholes and 1 lamp hole.....	4000 00
Barrie, John and Massie's field, 1800 feet.....	3000 00
Raglan Road, 1200 feet.....	1800 00

\$11,300 00

SUMMARY.

Intercepting Sewers.....	\$82,050 00
Improvements to present tile sewers.....	4,660 00
Improvements to old stone drains.....	10,980 00
Replacing old stone sewers.....	64,305 00
New tile sewers recommended.....	11,300 00

Storm water drain, Victoria and Cellingwood..... \$173,295 00

\$181,395,00

The length of the present tile sewers is about	52,000 feet
The length of the old stone sewers to remain	15,300 "
The length of the intercepting sewer including submerged pipe.	12,400 "
The length of sewers recommended to replace old sewers.	37,000 "
The length of new sewers recommended	8,100 "

124,800 feet

or 23 $\frac{3}{4}$ miles.

In conclusion I would recommend that in such an important matter as this, the opinion of an expert sewerage engineer be obtained.

I would suggest the following names of American Engineers who stand high in such matters, viz, Rudolph Hering, Chester Davis, Mr. McAlpin, and Col. Waring; either of these would be first class but very expensive.

We have good men in Canada who, I think, would do equally as well and cost not perhaps half the money. I may mention Allan McDougall; William Kennedy or Thos. Keefer. The latter is the most eminent but is, perhaps, too old to care about such work.

I may add that if the cost of the intercepting Sewer is too great to attempt in the present state of the City's finances, all the other works could be carried out either in the whole or in part and the intercepting Sewer left till the City could afford it.

Respectfully submitted.

T. O. BOLGER,
City Engineer.

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