

UNIVERSITY OF TORONTO
JAN 24 1894

REPORT BY E. H. KEATING, Esq., CITY ENGINEER,
TORONTO, ON PROPOSED TRUNK SEWER,
OTTAWA.

TORONTO, Dec. 26th, 1893.

To His Worship, O. Durocher, Esq., Mayor of Ottawa.

DEAR SIR,

Your letter of the 7th instant, conveys the request that I should examine and report upon the scheme for a proposed system of Trunk Sewers, for which a by-law authorizing a grant of \$365,000 to defray the cost is to be submitted to the ratepayers on the 1st January, 1894, and you ask for my report before that date.

In compliance with this request I visited Ottawa, and spent three days in going over the round, examining the plans and obtaining information necessary for my guidance.

I need scarcely say that the limited time allowed me is not sufficient for a thorough investigation of all the questions which are involved in considering a project of this nature. I have, however, given the matter as much study as the time given me would permit, and I am indebted to Mr. Surtees, your engineer, and Mr. Perreault, his assistant, for their kindness and patience in explaining the scheme and in giving me information and data bearing upon it.

I am informed that about half the total area within the present city limits, is now provided with drainage facilities, and that the proposed scheme was prepared with the view to affording means by which the other half of the city area could be drained.

Much of this outlying district is suburban, and apparently waste land, so situated that it cannot be properly drained without involving the construction of long, deep and expensive main sewers.

At the time of my visit the water courses were frozen over, the whole country covered with snow and the temperature several degrees below zero, so that the opportunity for inspecting the ground was not as favorable as could be desired.

Under the proposed plan the City is divided into four main drainage areas represented to be of the following dimensions:—

Area No. 1.....	515 acres.
2.....	73 ⁸
3.....	320
4.....	161
Total	
	1742

Area No. 1 is designed to have an independent outlet into the existing sewer on First Avenue, which, however, is too small to carry off the combined sewage and rainfall of the district, hence Mr. Surtees has proposed the double sewer mentioned in his report, as a means of overcoming the difficulty.

The other areas, Nos. 2, 3, and 4, have been designed to have a common outlet through New Edinburgh into the Ottawa River below the Rideau Falls.

The gradients of the proposed sewers are marked on the profile, 1 in 500 throughout, except for a distance of 700 feet at the crossing of the Rideau canal, where the inclination is increased to 1 in 50.

The proposed plan, as explained by Mr. Surtees, provides for the construction of the following works:—

EASTERN DIVISION.

Size of Sewer.	Description.	Thick- ness.	From	To	Average	Leng'h
					depth of cutting.	
6' 0" steel pipe	Outlet.	Inches	200
6' 0" x 4' 0" "	Brick Sewer.	14	River.	St. Patrick St.	24	5000
6' 0" x 4' 0" "	"	9	St. Patrick.	Neville's Cr'k.	17	8900
4' 6" x 3' 0"	"	9	Neville's Cr'k.	Cor. Bank and Archibald Sts.	20½	6300
3' 3" x 2' 2"	"	9	Cor. Bank and Archibald Sts.	Concession St.	15½	2900

WESTERN DIVISION.

3' 6" x 2' 4"	Double Sewer	Cor. Elm St. and 1st Ave.	Willow Street.	12	2250
3' 0" x 2' 0"	Brick Sewer.	On Willow, Bell & Emily	12	2280
Total length..				27830

Or over 5¼ miles of new main trunk sewers,

From the information furnished, the above works will involve the excavation of the following quantities of earth and rock according to the gradients laid down on the profile :—

	Rock—cubic yards.	Earth—cubic yards.
EASTERN DIVISION	58,800	79,000
WESTERN DIVISION	5,500	7,200
Totals—	<u>64,300</u>	<u>86,200</u>

Assuming that the works should be carried out in accordance with the above data, and as at present designed, the following is my estimate of their probable cost, exclusive of land damages :—

ESTIMATE.

EASTERN DIVISION—

Rock, 58.800 cub. yds., at \$2.00	\$ 117,600
Earth, 79,000 cub. yds., at .70	55,300
Bricks, 4,610 M at \$22	101,420
Junctions, allow	2,500
Man-holes	8,000
Canal and River crossings, allow extra . .	15,000
Outlet	8,000
Engineering and contingencies, allow 10%	30,780

\$ 338,600

WESTERN DIVISION—

Rock, 5500 cub. yds. at \$2.00	\$11,000 00
Earth, 7200 cub. yds- at 50 cts...	3,600 00
Bricks in lower or egg shaped sewer only 525 M. at \$22.00	11,550 00
Junctions and man-holes, allow	1,500 00
Engineering and contingencies, allow 10 %	2,750 00

30,000 00

Total probable cost, exclusive of
upper or storm sewer in area
No. 1

\$369,000 00

In this estimate I have omitted the double or storm water sewer proposed to be built immediately over the projected sanitary sewer on

Preston and Cedar streets and on First avenue, because I have no details showing the precise method proposed for its construction, and also for other reasons which I will explain further on.

In going over the ground a few alterations in the alignment suggested themselves, which would, I think, be beneficial and likely to reduce the cost of the works considerably.

In Area No. 1 a saving could be effected by following the course of the creek from the intersection of First avenue and Spruce street to Cedar street, if the right of way could be acquired free or at trifling expense, which I am told is the case; or otherwise the line might advantageously be diverted from Cedar to Spruce street.

In Areas No. 2 and 3 I should prefer changing the crossing of the Rideau Canal from Neville's Creek to Ann street, and conveying the sewage across the canal by means of a submerged street pipe. If the line is then carried diagonally across the ordnance property to Nelson street, there would be a saving in distance of about 400 feet and a corresponding saving in expense.

From an engineering point of view, however, the best location for this portion of the sewer appears to be across the Canal at Baxter's Creek, following down the east side of the Rideau Canal and diagonally across the Ordnance property to Nelson street. The adoption of this route would shorten the sewer by about 1,200 feet and would avoid a good deal of heavy and expensive work. The only objection to this route apparently is that a portion of the sewer would be outside the present city limits.

In suggesting these alterations to Mr. Surtees I was informed that it is the intention to make such changes in the location as may appear advisable after the passage of the By-law, when further and more complete plans and surveys will be made before the actual work of construction is commenced. There can be no doubt that such surveys and plans are needed, and the information which they will afford may result in other alterations and improvements being made which will still further reduce the expenditure. I need scarcely say that it is true economy to spend a liberal sum of money in preliminary surveys and investigations before commencing a project of this nature, and that I

hope you will not make the fatal mistake, which is sometimes committed by municipalities, of curtailing the allowances for engineering expenses

Regarding the sizes of the proposed sewers, I am informed that they have been proportioned, when running two-thirds full, to carry off the sewage from a prospective population of 400 to the acre (which is assumed at 40 gallons per head per day) in addition to a rainfall of three inches in 24 hours. Mr. Surtees estimates that on this basis an allowance of 8 cubic feet per minute per acre is sufficient to carry off the combined sewage and rainfall. He has referred me to the existing trunk sewer (the size and capacity of which were proportioned on this basis) as evidence that no greater allowance need be made, it being asserted that this sewer has never been over-taxed. Assuming that this information is correct, the sewers should be capable of discharging the following quantities of combined sewage and rain water, and to do so would require to be of the dimensions given below, providing that gradients of not less than 1 in 500 are adhered to as proposed:—

Table giving the required dimensions of Egg-shaped and Circular Sewers to discharge 8 cubic feet per acre per minute.

Area.	Estimated No. of Acres required to be drained.	Reqd. discharge cub. ft. per min.	Required size of egg-shaped sewer $\frac{2}{3}$ full.	Required size of egg-shaped sewer full.	Equivalent size circular sewer full.
No. 1	515	4120	4' 4" x 6' 6"	3' 8" x 5' 6"	4' 4"
No. 2	738	5904	5' 0" x 7' 6"	4' 3" x 6' 4 $\frac{1}{2}$ "	5' 0"
No. 3	1066	8538	5' 8" x 8' 6"	4' 11" x 7' 4 $\frac{1}{2}$ "	5' 9"
No. 4	1227	9816	6' 0" x 9' 0"	5' 2" x 7' 9"	6' 2"

It will be noticed that the sizes of the sewers required to meet the above conditions are greatly in excess of those provided under the proposed scheme.

Mr. Surtees, however, explains that it is unnecessary to provide for the trunk sewers carrying off all the storm water from the different areas. He states that in area No. 1, Dalhousie ward, the rainfall from at least 200 acres will have its natural discharge into the Rideau Canal and need not enter the sewer, and he estimates that in the other areas one-half the rainfall can be diverted from the sewers. The effect of these modifications will, of course, be to reduce the required capacity of the sewers very considerably. I am not however, sufficiently acquainted with the ground to express an opinion as to the correctness of these latter conclusions. I think it is a matter of regret that there are no available records or data regarding the maximum rates of rainfall during short periods of time, so as to make it possible to calculate with some degree of certainty what the actual delivery from the different areas is likely to be; and I would suggest the advisability of your establishing rain gauges in at least two separate localities within or near the City, with the view to obtaining this information, which will be found serviceable in the future.

In the City of Toronto provision is made for a rainfall of one inch per hour, and it has been found that this allowance on some occasions has been insufficient. I understand you have equally heavy rainfalls in Ottawa occasionally.

After giving the whole question as full consideration as the limited time allowed me would permit, the conclusions I have reached are as follows.—

EASTERN DIVISION—AREAS 2, 3, 4,

1. That the outlet and general route for the sewer have been well selected, subject, however, to the alterations I have suggested, and to such further alterations and modifications as may appear advisable after more complete surveys and plans have been made.

2. That if a combined system of sewers is adopted it would appear advisable that provision should be made for the disposal of at least one inch of rainfall per hour in addition to the sewage from a prospective population of 60 or 80 to the acre. Deductions, however, may be made for storm water which will naturally flow off into adjoining streams and

water courses, but the amount of these deductions can only be determined definitely after the surveys and plans referred to have been prepared.

3. That the cost of constructing efficient Trunk Sewers on the combined system (viz. :—to carry off the combined sewage and storm water) even after deducting the storm water which will naturally flow off into the adjacent water courses, would be too great to warrant the adoption of the combined system throughout.

4. That the cheapest and best way to provide for the drainage of areas 2 and 3 is by the adoption of the separate system, *i. e.*, to construct the sewers of sufficient capacity to carry off house drainage only together with the rain water from back yards and the roofs of buildings, which cannot conveniently be carried off elsewhere, and that separate storm water sewers may be constructed hereafter discharging into the nearest available outlets, when the necessity for them arises.

5. That New Edinburgh and area 4 should be drained on the combined system into one common outlet as proposed and that all the sewers be made of sufficient capacity to drain any adjoining districts that are likely to be annexed to the City within say 20 years.

6. That the proposed gradient of 1 in 50 at the Rideau Canal crossing is objectionable on account of the excessive velocity it will induce, and that it should be modified.

7. That if the proposed scheme is carried out it would appear advisable to increase the thickness of the brick-work in some of the larger sewers where the cuttings exceed 16 feet in depth, and that circular sewers would appear to be better and cheaper than those of egg-shape, above 24 inches by 36 inches.

WESTERN DIVISION—DALHOUSIE WARD.

8. That a trunk sewer carried up Willow street as proposed will necessarily have to be very deep to afford lateral drainage to some of the intersecting streets, and that the route can be improved after a plan showing the relative levels of the district has been prepared.

9. That I cannot endorse the plan to construct the proposed double trunk sewer in this district, as I think it objectionable.

10. That it would appear preferable to construct a single sewer of increased capacity of an ample overflow at or near the intersection of Elm street and First avenue.

11. That under the proposed scheme no drainage is provided along Preston street from Willow street to the Canada Atlantic Railway, where it seems to be urgently needed, and where a main or trunk sewer will probably have to be provided at some time.

12. GENERAL.—That the amount of money to be voted under the By-law, viz.: \$365,000, is probably ample to construct the main or trunk sewers covering the ground indicated, providing the modifications I have suggested are adopted.

13. That in the event of the By-law passing, the first thing required is a complete and accurate contoured plan of the whole district to be drained, showing the precise boundaries of the different drainage areas and the levels at all street intersections and changes of grade in the street levels,

14. That before construction is commenced, not only the Trunk Sewers but all the lateral or branch sewers should be accurately plotted on a plan drawn to a similar scale and that the levels of the inverts of the sewers and the gradients should be marked on the plan for easy reference, so as to avoid the possibility of serious errors which are otherwise liable to occur.

I have the honor to be,

Sir,

Your obedient servant,

E. H. KEATING