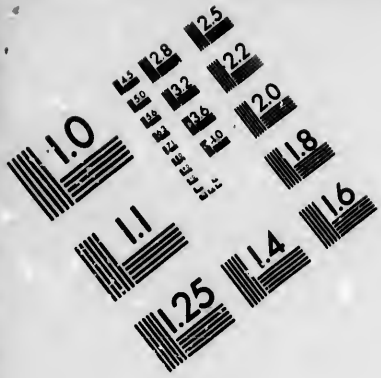

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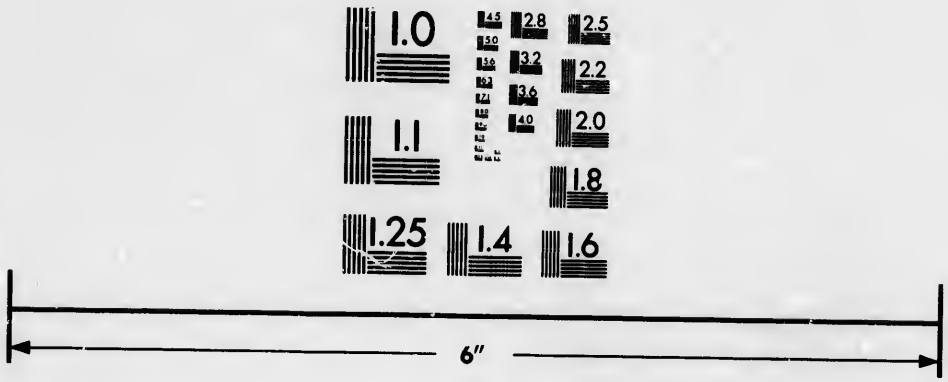

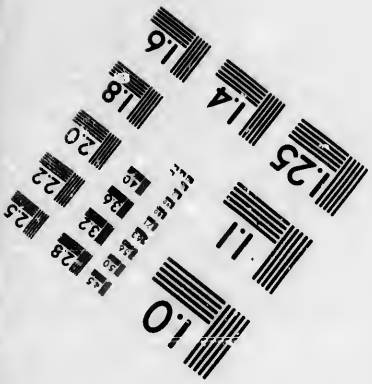

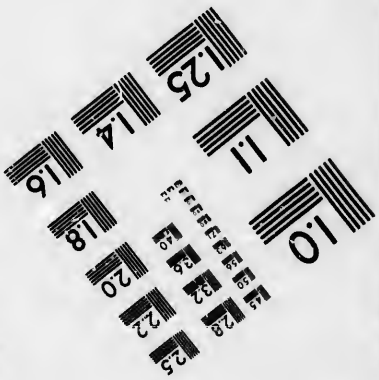

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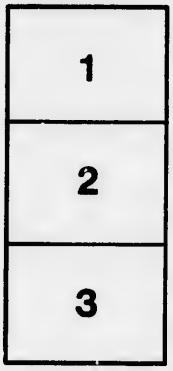

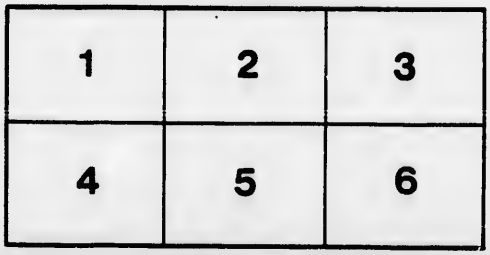

LETTER

OF

CHIEF ENGINEER,

IN

REPLY TO RESOLUTION OF COUNCIL

FOR

INFORMATION RESPECTING WATER WORKS.

MONTREAL:
PRINTED BY J. STARKE & CO.
1856.

CITY HALL,

MONTREAL, 22*nd January*, 1856.

MEETING OF CITY COUNCIL.

"Resolved,—That inasmuch as the Water Works have far exceeded the Engineer's Estimates, and as the present unfinished state of the Works indicates the necessity for a still further large expenditure, it be hereby Resolved, that the Engineer report to this Council at their next meeting, the amounts in detail now required to complete the said works, and when they will be substantially and completely finished."

(*Certified,*)

J. P. SEXTON,

City Clerk.

REPORT.

MONTREAL, 19*th February*, 1856.

J. P. SEXTON, Esq.
City Clerk, Montreal.

Sir,

I have the honor herewith to transmit the amounts in detail required to complete the New Water Works, as called for by the resolution of the Council of the 22nd ultimo. With respect to the time of completion—the amount of work to be done is such, that no more than two months is, in my opinion, required in order to execute it so far as to bring the whole into use; but the character of the work to be done, as well as the state of the whole, make it desirable that this completion should not be forced until the frost is out, the spring rains over, and the ground and the weather fully settled. That portion of the Aqueduct which is still incomplete is filled with water and ice. I do not think it would be prudent to unwater it suddenly, or before the frost is out, as there would not only be some risk of slides, but the cost of its completion would be greatly enhanced. I would name the first of July as the earliest day when the water should be admitted to the wheels, and as these should be worked several weeks before the full load is put on them, I do not count upon the full operation of the works before the first of August. The remainder of the season will be required to complete the embankments, drainage, and works above water level, so as to effect these in the most efficient and economical manner.

Inasmuch as the preamble to the resolution transmitted to me refers to my Estimates, I take this opportunity of making the following explanations with regard to them. With respect to my original estimate of £150,000, made in 1852, I quote from Mr. Jervis' Report, in preference to any statement of the case upon my own part.

"The estimate submitted by Mr. Keefer, is in gross £150,000, "currency, or $600,000. This provides for placing the water "in a Distributing Reservoir, at an elevation of 200 feet above "the water of the harbour. * * * In regard to the first branch "of the estimate, I do not see that any thing is to be added. It "seems to embrace all the works required, and on a plan of per- "manence. The rates of estimate are liberal as compared with "prices paid on the public works in this vicinity, and I do "not see any ground to doubt that the work may be constructed "within the cost estimated by Mr. Keefer. In regard to the se- "cond section, the provision for Distributing Reservoir is for a "surface area of 90,000 superficial feet, or a little over two acres. "This will answer the purpose for equalizing the supply, and "give a fair provision for any sudden demand for the extinguish- "ment of fires. But if the ground were such as to admit an en- "largement, say to double this capacity, at moderate cost, it "would be advisable to have it. This, however, may be considered "hereafter, as the Reservoir may be enlarged at any time. The "only material item that it appears important in any respect to "enlarge, from the estimate, is the Rising Main. This Main "will be under the action of the pumps, and for that reason, "more exposed to injury that will require a suspension of the "works to repair it, and on this account, I advise that two Mains "be laid, namely, one for each set of pumps, but so connected, "that the water may be forced into it, by either or both sets of "pumps when the other is out of repair. Mr. Keefer has pro- "posed a 30 inch Rising Main. Two 24 inch Mains will deliver "under the same head, or the same pressure, 25 per cent. more "water than one 30 inch Main, and will cost about 40 per cent. "more. If two 24 inch Mains are substituted they will be able "to carry a larger supply when full power is required, and one "of them would be sufficient for ordinary supply when the other "may be out of repair. It appears to me, it will be advisable to "make this change in the plan for the Rising Mains. This "item if adopted will add about £10,000 to the estimate. This

" is the only change that I think it necessary to propose, and this " is rather a matter of precaution than of absolute necessity. " Mr. Keefer will no doubt approve of this, as he has intimated " that such precautions might be advisable. In regard to the " estimate in general, it appears to be liberal; at the same time, " it is extremely difficult in such works fully to anticipate all the " items of expense, and I have usually been in the habit of pro- " viding a contingent allowance to meet unforeseen items that " are likely to be developed in the course of construction. This, " Mr. Keefer informs me, has been done in preparing his estimate, " and may be sufficient. But, though the estimate may prove " entirely adequate to the cost of the work, I would still recom- " mend that an allowance of ten per cent. be added to the general " estimate. If the two 24 inch Rising Mains be adopted, the ag- " gregate general estimate will be £160,000 currency; and if " my suggestion of ten per cent. for contingencies be adopted, " the total estimate will be £176,000 currency.

" The population of the City, as I am informed, is about " 60,000. To distribute the water, taking it from the Distri- " buting Reservoir, would cost not far from £1 5s. or $5 for " each inhabitant.

" The cost of introducing the water to the Reservoir, as above, would be, - - - - - - - - - - - - £176,000 0 0
Distribution, - - - - - - - - - - - 75,000 0 0

Total cost of water, £251,000 0 0

" Annual cost of water, namely:

				An. Cost.		
Interest at 6 per cent. on £251,000..	£15,060	0	0			
Annual cost for maintenance and managing works to deliver the water into Distributing Reservoir.....	1,250	0	0	£16,310	0	0
The cost for capital in construction of the works, per inhabitant.....				4	3	8
The cost for annual charges, including interest on capital of all works, except repairs of distributing pipes, (which latter will be small,) $1.08 or.....				0	5	

"So far as regards the cost of delivering the water into the "Distributing Reservoir, the works will require a mere trifle to "add the third wheel and its set of pumps to provide a supply "for double the number of inhabitants. The expense of distri- "bution will be increased as the City increases geographically; "and though the increase in expense will not equal the increase "in population, it may be assumed at the same ratio, and the "charge for water, when such increase takes place in the popu- "lation, will be for 120,000 people.

"Original cost of works, namely:—

To and including Distributing Reservoir, as above,	£176,000	0	0
Add for third Wheel and Pumps, and for enlargement of Distributing Reservoir, probably,.....	14,000	0	0
	£190,000	0	0
Distribution Pipes, at £1 5s. for 120,000.....	150,000	0	0
	£340,000	0	0
Annual cost, £340,000, at 6 per cent.	£20,400	0	0
Annual cost for maintenance and managing the works to deliver the water into Distributing Reservoir,..	1,750	0	0
Total Annual cost, for 120,000 people,	£22,150	0	0

"The cost per inhabitant, when the supply is provided for "120,000, will be:

For construction, the outlay will be	£2	16	8
On annual expense, including interest on capital expended in construction	0	3	8

"How far the City may be disposed to look in anticipating "provision for its growth, I cannot determine. If, however, we "regard the improvements likely to take place, and their influence "on this City, as an important commercial centre, it appears "reasonable to conclude, that its population will reach the num- "ber assumed in the preceding calculation at no very distant "period, and quite within the limits that in a prudent forecast,

"should lead to the anticipation of such preliminary provisions "for a supply of water as are involved in the proposed plan. "The saving that could be effected by erecting works to meet "only the supply of the present inhabitants would be very small, "and would involve a plan of works subject to continual change "in its main features.

"I have taken up the subject of Distributing Pipes, though "that does not enter into the plan of Mr. Keefer, because they "will be indispensable to the enjoyment of the work. The "City has now a considerable quantity of pipe laid down, which "no doubt will enter into any plan for general distribution, and "so far reduce the expense of this portion of the work."

Mr Jervis recommended the duplication of the Rising Main, the enlargement of the Reservoirs, and ample provision for Distributing the water.

The Corporation obtained power to raise £150,000 sterling, which, at the then rate of City Debentures, might reasonably be estimated at £180,000 currency, in addition to the balance remaining of the £50,000 which had previously been appropriated for distribution, &c.

I have felt it necessary to allude to these appropriations, because the impression has been conveyed abroad, that my estimate of 1852 was to have been the limit of the expenditure undertaken in 1853.

The expenditure upon the laying of the Rising Main, and the Distribution, has not been under my control, as is that of the contract work,—the former having been retained in the hands of the Corporation,—and I have been unable to procure the actual expenditure upon the Rising Main, separate from the rest; nor under the circumstances under which this portion of the work has been done, do I believe the Corporation would hold me responsible for the execution of the work at my estimate, even supposing no enlargement of this portion of it had taken place.

The formation of two Distributing Reservoirs, instead of one, was adopted after the works of the Aqueduct had been let to

competent and responsible contractors at about £12,500 below my estimate, under the belief that the appropriations would be sufficient, and that there would be a slight surplus from the Aqueduct, and more especially from the conviction that the prospects of the City then warranted this step,—that it would never be regretted, and that it could be more efficiently and economically done now than at a future day. It will be remembered, that when my preliminary estimate was made the Grand Trunk Company had not been chartered, nor had the commencement of the Bridge been anticipated.

The greatly increased expenditure for land purchases form one of the principal items which have added materially to the original estimate. I have alluded to this in the report which has been printed; and altho' I do not suppose that I will be held responsible for an expenditure not in my department, and over which I have had no control, I will adduce one instance to shew the impossibility of providing for every case which may occur. When the survey was made in 1852, the line crossed a farm which changed hands in March 1853, at something less than £30 per arpent; about the first of June following the Corporation took possession of $1\frac{3}{4}$ acres, and on submission to arbitrators, an award of £3,300 was made, being about £500 more for $1\frac{3}{4}$ acres than had been paid for the whole farm of over sixty acres only three months before.

About two hundred acres are occupied by the Aqueduct, for which I had estimated an average of about £35 per acre. In the case above mentioned, the award was nearly £2000 per acre, but had the Corporation been fortunate enough to have purchased from the party who owned the property when my estimate was made, it is not probable that the demand would have been the one twentieth part of the sum since claimed for it.

The cost of the work embraced in my original estimate, has undoubtedly exceeded that estimate, from various causes which have more or less affected all contracts upon public works entered into in the early part of 1853 and executed in 1854 and 1855.

The war raised the price of provisions, of iron and freights, and the cholera brought a scarcity and high value of labor, and by retarding the work materially increased its cost. But the principal cause has been the quality of the excavation on the line of the Aqueduct. In the five miles of Aqueduct, the depth of excavation varies from five to upwards of twenty feet. The quality of this work and the proportion of it which might prove to be rock, could only be inferred from test pits. These were as numerous as usual,—but it has proved in almost every case, that between the points where they were sunk, the rock rises nearer to the surface, and the other excavation is harder than these test pits indicated. There was not only about double the quantity of rock which the original test pits shewed, but there was almost as great a quantity of cemented material overlying the rock, which was blasted with it, and was equally as expensive to remove. But these were not the only difficulties. The quality of the rock as shewn by every test pit, was that of a soft shale; but upon working it was found to be traversed in every direction, though at considerable intervals, with veins of trap or *banc rouge*—one of the hardest rocks we have,—and the removal of which was the more expensive from its admixture with the other. Nearly 25 per cent. of the whole rock excavation was of this character. As the only intelligible explanation of the Aqueduct excavation, I beg to transmit herewith a profile of the Rock Section, shewing the relative proportions and position of the different material.

With respect to the estimated cost of the completion of the Aqueduct as sent in, in April last, the only basis upon which an Engineer can calculate under such circumstances, is the prices at which the work has been contracted for. Whatever his own views might be with reference to the sufficiency of those prices, It would neither be just to the Corporation or to the contractors, to assume their inability to complete their contract until it had been proved. In the one case the credit of the contractors might have been seriously affected, and in the other case a direct premium would have been held out to them to make new demands.

At that time, in addition to their contract prices, there was more than half of the Bonus applicable to the completion of the work. The contractors claimed rock price for all material on the Rock Section, which was necessarily blasted. I could not deny that they were entitled to this construction under the spirit, if not according to the letter, of the specification; but when a bonus had been granted to meet unforeseen difficulties, I did not feel at liberty to make this classification until it became evident that the bonus was insufficient to cover the increased expenditure. The increasing hardness of the excavation as developed every month, convinced me that I could no longer withhold the classification to which I believed the contractors were by the contract entitled, and this course, together with the slides which subsequently took place, account for the insufficiency of the estimate of last April.

I have the honor to be,

Sir,

Your most obedient servant,

THOS. C. KEEFER.

STATEMENT A.

ESTIMATE OF WORK REMAINING TO BE DONE ON THE AQUEDUCT.

Montreal, 19th February, 1856.

Description of Work.	Quantities.		Rate.	Amount.		
				£	*s.*	*d.*
Cammon Excavation	30,000	cubic yds.	19 cts	1,425	0	0
Puddle	5,000	"	9d	187	10	0
Solid Rock	1,000	"	3s 6d	175	0	0
Ashlar Masonry	150	"	30s	225	0	0
Rubble Masonry in Cement, . .	611¼	"	20s	611	5	0
Do. Do. Dry, . .	70	"	17s 6d	61	5	0
Paving on Sections 1, 2, 3 and 4. .	4,179	"	4s	835	16	0
Do. do. 5 and 6 . .	3,110	"	5s	777	10	0
Rip Rap, ...	5,500	"	2s 6d	687	10	0
Macadamizing	10,643	"	3s 9d	1,995	11	3
Soiling Slopes	10,000	"	1s 6d	750	0	0
Pine Timber	5,956	cubic feet.	1s 3d	372	5	0
Pine Timber, Plank and Scantling. in Bridges, &c.	78,336	Feet B M	175s	685	8	9
Cedar Timber, ...	3,375	"	150s	25	6	3
Oak Timber, ...	68	cubic feet.	1s 6d	5	2	0
Iron Bolts, Straps, &c. . .	1,840	lbs.	1s	92	0	0
Fencing, (at Gregory's and Entrance)	6,382	Lineal Ft.	2s 6d	797	15	0
Do. (at Farm Crossings) . .	5,337	"	1s 3d	333	11	3
Completion of Wheel House, &c. .				148	15	0
Coffer Dam and Pumping on Section No. 1.				375	0	0
			Total, £	10,567	10	6

STATEMENT B.

ESTIMATE TO COMPLETE WORKS AT THE DISTRIBUTING RESERVOIRS.

Montreal, 19th February, 1856.

Description of Work.	Quantities.		Rate	Amount. £	s	d			
Dry Stone Wall	1,472	cubic yds.	10s	736	0	0			
Pitching on Slopes	1,000	"	3s 9d	187	10	0			
Earth Excavation	2,200	"	16 cts	88	0	0			
Macadamizing	2,377	"	3s 9d	445	13	9			
Doors & Windows for Valve House				21	0	0			
Covering Wells, Stone Cutting, Iron Work, &c.				20	0	0			
Valves and fixing Sluices				104	0	0			
Cleaning out bottom of Reservoir				50	0	0			
Iron Railing round Wall	1,500	Lineal ft.	15s	1125	0	0			
				2777	3	9	2777	3	9
Road, West Side.—									
Earth Excavation	2,000	cubic yds	16 cts	80	0	0			
Rock Excavation	560	"	3s 9d	105	0	0			
Dry Stone Wall	547	"	10s	273	10	0			
Macadamizing	948	"	3s 9d	177	15	0			
				636	5	0	636	5	0
Road, South Side.—									
Earth Excavation	2,856	cubic yds.	16 cts	114	4	10			
Macadamizing	1,275	"	3s 9d	239	1	3			
				353	6	1	353	6	1
				Total, £			3767	14	10

ABSTRACT OF ESTIMATES

TO COMPLETE

THE MONTREAL WATER WORKS,

EXCLUSIVE OF

LAND DAMAGES AND DISTRIBUTION.

Montreal, 19*th February*, 1856.

	£ s. d.	£ s. d.
Aqueduct, Wheel House, & Waste Weir—		
Amount per Statement A, . . .	10,567 10 6	
Balance of Bonus to Contractors, . .	1,450 0 0	
Valves, Hoisting Gear, Crabs and Platforms for ditto.	500 0 0	
	12,517 10 6	
Balance due upon Estimates, . . .		12,517 10 6
		2,500 0 0
Pipe, Track and Pumping Main—		
Laying Pumping Main, 3,250 feet, . .	1,625 0 0	
Laying Valves and making Wells for ditto.	250 0 0	
Stop Cocks, Valves and special castings. .	600 0 0	
Pipe Culvert under Lachine Canal. . .	2,000 0 0	
	4,475 0 0	
		4,475 0 0
Distributing Reservoirs—		
Amount per Statement B, ...		3,767 14 10
Contingencies, Superintendance, &c., . .		2,500 0 0
	TOTAL,	£25,760 5 4

THOS C. KEEFER,

Engineer, Montreal Water Works.