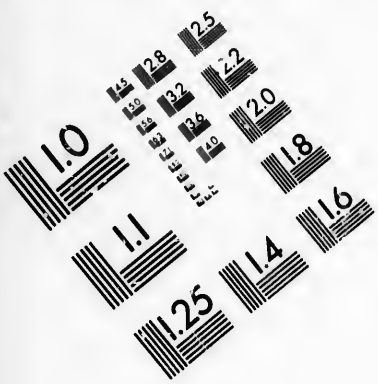

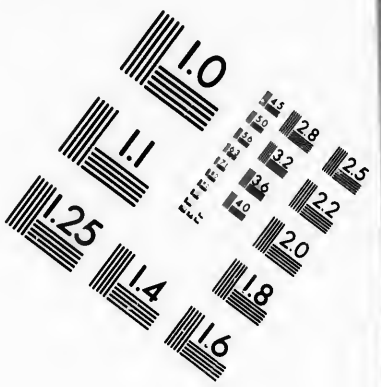

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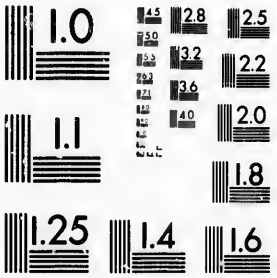

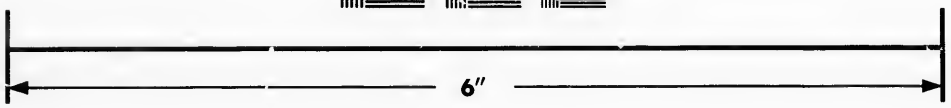

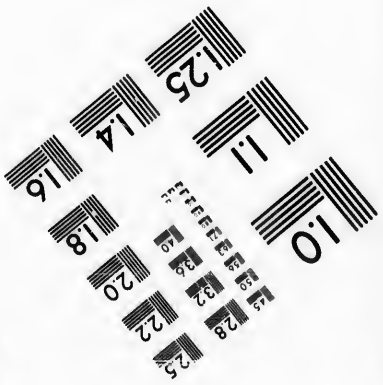

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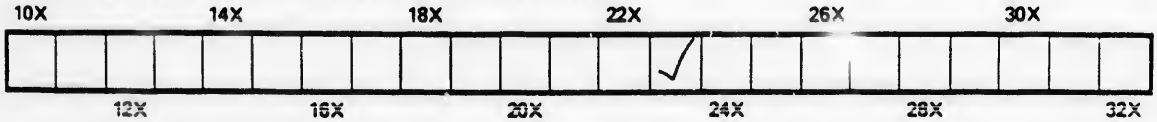

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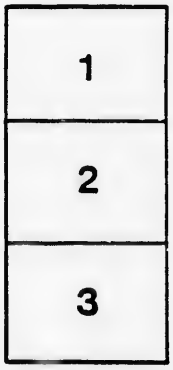

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The Montreal, Ottawa and Georgian Bay Navigation.

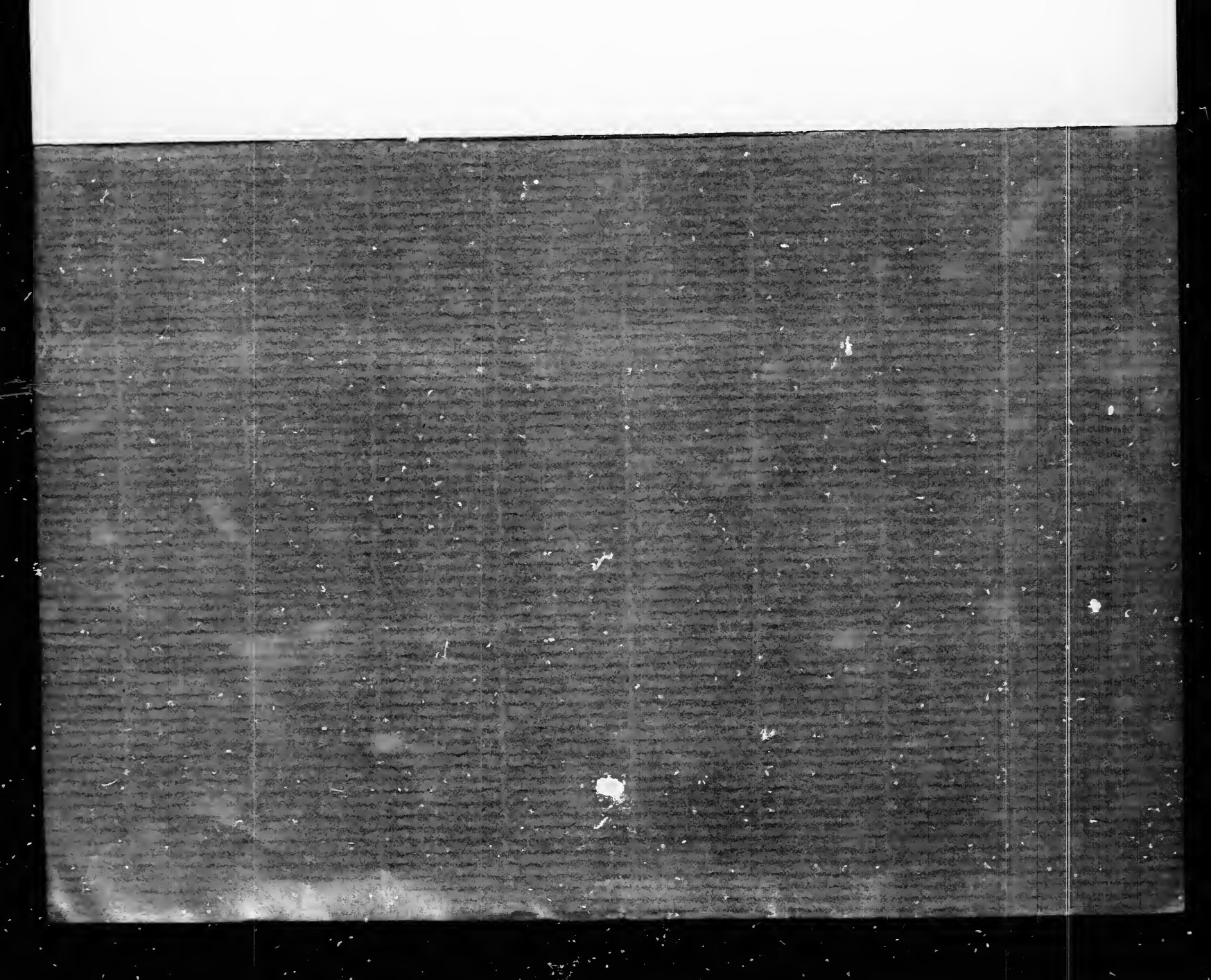
SUPPLEMENTARY REPORT

BY

T. C. Clarke, Esq., M.Inst.C.E., M. Am. Soc. C.E.,

Consulting Engineer.

OTTAWA:
Printed by Paynter & Abbott, 48 Rideau Street.
1898.



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1898.

McLeod Stewart, Esq.,
Montreal, Ottawa & Georgian Bay Canal Co., Ottawa, Canada.

DEAR SIR :—

I have the honour to submit the following Report, bringing down to the present date the matters treated upon in my Report of 1860.

Great changes have taken place since that Report demonstrated the feasibility of improving the Ottawa and French Rivers into one of the greatest channels of commerce. What was then only a scientific discussion has now become a matter of great importance to two nations.

Including together the present exports from the basin of the Great Lakes, both in the United States and Canada, there is enough traffic in sight to warrant a large expenditure in opening a new route, if the conditions are such that the cost of transportation between the Lakes and the Ocean can be diminished. Canada alone does not at present furnish enough traffic. The Ottawa route must be treated as an international one.

Two remarkable changes have taken place during the last ten years, which have each resulted in greatly lessening the cost of water transportation; one, upon the Lakes, and the other between the North Atlantic ports of the United States.

The construction of the locks at the outlet of Lake Superior has developed a traffic vast in size, and differing from all others in the world, in that it enables vessels to get full cargoes in both directions during the whole season of open navigation.

The U. S. lake ports will all be deepened to 20 feet very soon. Steamers now carry cargoes of 6,000 tons of grain and iron ore eastward to South Chicago, Cleveland and Buffalo, and take back cargoes of coal to upper Lake ports. It is a well-known axiom that the larger the vessel the cheaper it can handle freight. These 6,000 ton steamers have carried grain from Chicago to Buffalo for $1\frac{36}{100}$ cts. per bushel, which is less than one half of one mill per ton-mile. Hence there has arisen a popular demand for ship canals of 20 or even 25 feet deep, from the Lakes to the Ocean. Even if such canals were built and could be used free of tolls, no such economy of transportation by large steamers could take place as in the open lakes.

The rate of speed of thirteen miles an hour would be reduced to five, as in the Suez Canal. Canal traffic would not give full cargoes in both directions, and more detention in port would be necessary than at Cleveland or Duluth where whole cargoes of 6,000 tons of coal or ore have been handled by machinery in less than one day. The large steamer is a very expensive machine, and if she were not able to make as many trips per season as she now does, much of her economy would be lost.

It does not now seem possible, except at a prohibitory cost, to deepen the Ottawa navigation to 20 feet, and fortunately it is not necessary.

The second change, which has resulted in lessening the cost of transportation between Atlantic ports, suggests the true method of improving the Ottawa.

Some ten years since all coal was carried between the shipping ports of Philadelphia and New York to other Atlantic ports, chiefly those of New England, in single collier steamers, at a cost of $1.50 to $1.75 per ton.

Now it is carried in tows of three or four large barges drawing from 16 to 18 feet of water, towed by a single powerful tug boat. This tug does not wait in port for coal to be loaded or unloaded, but each tug has many barges, and she picks up her tow of full or empty barges without detention, as a locomotive does cars. In this way many trips are made per season. The distance between Philadelphia and Boston and return is about 800 miles, and coal is now carried for an average of 75 cents per ton, which is nine-tenths of a mill per ton-mile.

This economy of transportation has increased the coal traffic to some twenty-five millions of tons annually, which is as great as the tonnage annually passing through the Detroit River. The use of these tows of barges is fast increasing upon the Upper Lakes.

All these facts have been clearly set forth by Maj. T. W. Symons, U.S. Engineer Corps, in his admirable and exhaustive report to the U.S. Congress in 1897. He shows that if the Erie Canal were deepened to 11 feet and grain were carried in tows of barges of 1500 tons capacity, it could be carried from Chicago to New York, including reason

able transhipment charges at Buffalo from large steamers into canal boats, for less than steamers of 20 feet draft could carry it through the Erie Canal if that could possibly be deepened to over 20 feet, and steamers run continuously from Chicago to New York. In both cases tolls are not taken into account.

The estimated cost of the 11 ft. canal is 50 million dollars and of the 20 ft. 200 millions.

The great value of the Ottawa navigation is this: Out of the 975 miles between Chicago and Montreal 591 miles is an inland or perfectly protected navigation, leaving but 384 miles of open lake. In open lake a speed of 4½ miles an hour can be made by tows of barges. In the protected portion an average speed of ten miles an hour can be made. The cost of insurance by this route would be much less than by any other.

By the Welland and St. Lawrence route, there are 991 miles of open lake navigation, and but 297 of inland or protected navigation. The depth of the Welland and St. Lawrence canals would limit the draft of barges to 13½ ft. which is too shallow for navigation in lakes such as Erie, subject to sudden violent storms. The rates of insurance would be greater, and the longer time required, owing to greater length, and slower movement through the unprotected parts, would more than make up for the 22 days of longer open navigation by the Welland route.

I recommend that the scale of the Ottawa navigation be fixed as follows:—Locks 300 ft. long x 45 ft. wide x 14 ft. deep, capable of passing steel barges 280 ft. long, 42 ft. beam and carrying 3100 tons net on 13½ ft. draft of water.

The excavated channels should be fifteen feet deep and have five times the area of the vessel, with sufficient room for two vessels to pass each other, which would give a width of 160 ft. on the bottom and 170 ft. at low water level.

The cost of carrying grain from one of the Lake ports, say Chicago, to Montreal by the Ottawa route, would be as follows:—

CAPACITY.

A tow would consist of three steel barges, each 280 x 42 x 20 feet, moulded depth, carrying, on 13½ feet draft, 3,100 net tons. These would be towed by a powerful tug steamer capable of towing the barges at the rate of four and one-half miles per hour in open lake, and ten miles per hour through the sheltered lakes and rivers of the Ottawa navigation. The tug steamer would be capable of carrying a cargo of 1,200 tons, making a total capacity of 10,500 tons.

TIME.

Open Lake—	
Chicago to a point near the mouth of St. Mary's River—380 miles at 4½ miles per hour	72.2 hours.
Inland Lakes and Rivers—	
St. Mary's River to French River, 160 miles	
Ottawa navigation ..... 401 "	
561 " at 10	56.1 hours.
Canals ..... 29.3 miles at 2.9	10. hours.
Lockages 1½ minutes per foot for each vessel $\frac{1\frac{1}{2} \times 4 = 6 \times 682 \text{ ft.}}{60 \text{ min.}}$	68.2 hours.
Total	206.5 hours

206.5 x 2 = 413 hours.
In port 91 hours.

504 hours, or 21 days round trip.

The open season of navigation on this route, is limited by the closing of Lake Nipissing and gives an open season of 213 days, or *ten* round trips.

COST.

1 tug	$125,000		
4 barges (1 extra) at $75,000 ...	300,000		
	$425,000	interest and depreciation at 5 per cent	$21,250
Insurance on hulls, 2 per cent			8,500
" on cargo			
Going East 10 x 10,500.....	105,000	Tons.	
" West 1/3	35,000	"	
	140,000	Tons at $20. $2,800,000 at 25c. per 100	7,000
Expenses of tug—full subsistence, wages and small repairs, $100 per day for 213 days			21,300
4 barges at $7.50 per day—30 x 213			6,390
Profits 10 per cent			6,440
			$70,880

which divided [illegible] Tons gives as the cost about 50c. per ton, or 1½ cts. per bushel.

It is abs[illegible]l to the success of this project that there should be ample elevator facil[illegible]ut of Montreal, so that ocean steamers should suffer no detention. With[illegible]or of the capacity of one million bushels as lately has been built by the G[illegible] Railway at Buffalo, the whole cost of elevating and storage should not exceed t[illegible]ers of a cent, making the total cost per bushel two and one quarter cents, which is far below the cost by any existing route, or than can be obtained on the Welland and St. Lawrence route when the canals are completed.

This extremely low cost is based on the assumption of full cargoes going East, and one third full going West. The larger the amount of business done, the more nearly will this be realized, and the financial success of the scheme would be enhanced, if the Ottawa navigation could be extended upon the same scale, through Lake Champlain to New York, the feasibility of which the U. S. Deep Water Ways Commission are now, it is believed, investigating. By this route the distance from Chicago to New York, would be about 1353 miles, of which 380 miles would be open lakes, 847 miles inland navigation, and 126 miles of canals.

By similar calculations to those above given, eight trips could be made in an open season of 235 days, and the cost would be 2 cts. per bushel, to which should be added the present elevator and other charges at the port of N.Y., which are very high, amounting to 1½ cts. per bushel, or a total of 3½ cents per bushel. Maj. Symons estimates that when the Erie canal is deepened to nine feet and the locks lengthened, wheat can be carried from Chicago to N. Y., for 3.67 cts., to which add N. Y., terminal charge. 1.50 cts., a total of 5 17 cts.; showing the superiority of the Ottawa route.

The cost of interest, maintenance and repairs, lock tending, electric lighting, etc on the Ottawa route, would be borne by moderate tolls, and leases of water power, des cribed hereafter.

As compared with the estimated cost of the Ottawa navigation in 1860, there will be an increase of quantities and a diminution of cost in item prices.

The increase of the size of the locks from 250 x 45 x 12 to 300 x 45 x 14, will increase quantities. Also the enlargement of the prism of the excavated canal from 146 x 13 to 160 x 15, will increase quantities.

The locks at Grenville and Carillon will have to be enlarged. The Lachine locks will also have to be lengthened unless it is decided not to use the present crowded Lachine Canal, and improve one of the branches of the Ottawa north of the Island of Montreal.

Another increase of cost is due to the fact that Lake Nipissing cannot now be raised by damming its outlets, as was proposed in 1860.

The country around the summit lakes is now well settled and has many cultivated farms. The town of North Bay, which would have to be moved back to prevent overflow, has some 2500 inhabitants. Thirty miles of the Canadian Pacific Railway would have to be moved or raised.

The level of Lake Nipissing must still be maintained from French River to the Mattawan, 57 miles. This means lowering the level of Trout and Turtle Lakes to coincide with that of Nipissing, which can be done. This is the only way in which sufficient water for lockages can be obtained. The total lockage will be reduced from 715 to 682 feet.

The amount of excavation will be increased, but it is believed that the extra cost of this will not exceed what would have to be paid for damages if Lake Nipissing were raised.

The plan of 1860, which raised existing levels by dams on the French and Matawan Rivers and on the Ottawa as far east as Chats Lake, can still be followed, as the shores are steep and rocky, and but little land will be overflowed. There are a few places where sites of locks and dams may have to be changed, but not at an increased cost.

In 1860 the whole Upper Ottawa was a wilderness. All materials and supplies above Deep River must then have been transported partly by teams and partly in batteaux towed by horses, or poled by men. Now, the Canadian Pacific Railway can deliver materials, supplies and men all along the route, and at far less cost.

Several locks of low lift can now be concentrated into one, as in accordance with the best modern practice. This will reduce cost.

I am in favour of locating the locks so that a duplicate lock can be built hereafter alongside of the one first to be built.

I now advise constructing the locks of concrete (made from the stone near by) and Portland cement. The lock walls can be protected by waling pieces of steel and oak, thus saving much costly cut stone masonry.

The most important item of economy comes from the fact that the cost of the rock excavation, which is the largest item of cost, can be greatly reduced by the improvements which have been made during the past few years in the use of power drills, high explosives, and better kinds of machinery for handling materials.

The air compressors and other machinery can in many cases be driven by electric power derived from the river. The latest price paid for rock excavation on the Chicago Drainage Canal was 9c. per cubic yard, while the average price estimated for the Ottawa improvements in 1860 was generally from $1.50 to $2.00 per yard.

I am not now prepared to revise the figures of cost made in 1860, as this cannot be done without further examinations and surveys, which will take several months to properly carry out.

There are several very important ecomonies in construction that can now be made available, which could not in 1860.

It is proper to point out that the most important change in the situation since 1860 has come from the development of electrical transmission of power. The dams which were designed by me in 1860 were then, and are now, absolutely necessary to give sufficient depth for navigation. These dams will also be the means of developing and controlling water power for electric appliances.

I can state unreservedly that I know of no other place in any manufacturing country, Niagara Falls not excepted, where there is such an amount of water power as this scheme can make available, both for manufacturing purposes and possibly for moving vessels rapidly through the locks.

It is proposed to construct 20 dams on the Ottawa with an average of 20 feet fall each. The low water discharge of the Ottawa never falls below 1,500,000 cubic feet per minute, of which one third should be allowed to run over the crests of the dams to

prevent decay, leaving 1,000,000 cubic feet per minute to run through flumes and do effective work. By the usual formula

$$\frac{\text{Dams} \quad \text{cu. ft. per min.} \quad \text{fall.}}{20 \times 1{,}000{,}000 \times 62\tfrac{1}{2} \text{ lbs.} \times 20} \quad \text{we have 566,360 horse power.}$$
$$44{,}000.$$

Adding that available on the Mattawan and French Rivers there will probably be, at a minimum, not less than 700,000 horse power.

The *average* discharge of the weirs would give not less than *four* times this amount.

All this can be made available, by the comparatively small expenditure necessary for flumes and the foundations of penstocks and turbines. The cost of the installation of electric plant would vary greatly with the situation.

All of which is respectfully submitted by

(Sgd.) THOMAS C. CLARKE,

Consulting Engineer Montreal,
Ottawa & Georgian Bay Navigation.
Member Institution of Civil Engineers,
and of the American Society of
Civil Engineers.

New York, Feb. 16, 1898.