# REPORT

ON

THE PRESENT STATE,

AND

PROPOSED

# DEVIATIONS AND IMPROVEMENTS

OF THE

# WELLAND CANAL.

By Messrs. BAIRD & KILLALY,
CIVIL ENGINEERS, &c. &c.

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# ENGINEERS' REPORT.

*TO THE PRESIDENT AND DIRECTORS OF THE WELLAND CANAL COMPANY.*

GENTLEMEN:

Engineers act in conjunction.

Having agreed, in accordance with your application, conveyed to us by your Secretary's letter of 2nd June ultimo, to act in conjunction, upon an inspection and examination of the Welland canal, for the purposes provided for in the act of last session, relating to that work, we lost no time, consistent with our other engagements, in making a commencement thereof. Aware of the magnitude of the work to which our attention was directed, its great importance to the provinces generally, the sums of money already expended on it, the probable extent of the expenditure still required, and the large portion of public attention given to it, we approach the subject with a due feeling of the great responsibility thereby incurred.

Instructions of the Commissioners to the Engineers.

The tenor of your verbal instructions to us, in our interview with your honorable Board, at St. Catharines, 15th June last, as well as those conveyed to us in your letter

of the same date, being "*to examine into the state of the Welland Canal, its present route, and to report fully upon the propriety or necessity, as regards the public interest only, of altering the present route, or any part thereof, and the expense of making the same a permanent work, either in the present or any other route which we might recommend,*" we proceeded to the necessary inspections of the present works—of the adjoining country—of the various proposed terminations, &c. the result of which we shall now have the honor to submit for your consideration.

Engineers require to know from the Commissioners, the scale of canal by which they are to be governed.

At the outset, we were soon convinced of the necessity of coming to an understanding with your Board, as to the general scale upon which this work should be constructed—the decision upon this important point depending, as we conceive, more properly upon commercial and statistic information and principles, than upon civil Engineering. In reply to a letter of ours, upon this subject, dated 27th June, 1837, we received an answer from your Secretary, stating that "*he was directed to inform us, that the scale of Locks for the Welland Canal adopted by the Board, is* 110 *feet in length, and* 24 *feet in width.*" By this scale we have accordingly been governed, in the deviations and improvements proposed, shewn on the plans by *red* tinting, and hereinafter particularly described.

The Commissioners adopt locks of 110 feet in length by 24 feet in width.

Engineers proceed with a general and comparative examination of all the routes previously proposed.

The scale being fixed on, the next important point to which our attention was naturally directed, was a general and comparative examination of the merits and demerits of the several lines, which have been, from

time to time, proposed by various parties, each having its respective advocates; and then, a selection from them, of that one which might appear to us as most eligible for the public interest.

The principal of these are—

1st. That from Chippawa river, by the Falls, to Queenston. The routes deserving of consideration.

2nd. That from the Niagara harbor, to fall in with the present line, at or near Thorold.

3rd. The present course throughout.

4th. The general course of the present line, with occasional departures therefrom.

To each of the foregoing, we have devoted considerable and unbiassed attention, and shall proceed, as concisely as possible, to explain the grounds upon which we have been governed, in our ultimate decision.

The "Chippawa Line" was proposed to start from the Chippawa river, a little above the village of Chippawa—thence, keeping west of the line of railway, and nearly parallel thereto, until near Magarry's tavern, where it crossed it and the main road at nearly right angles, descending the abrupt break of land and turning northerly, in Mr. Street's meadow, it became necessary that it should be carried along and midway up the face of the cliffs between the river and the late Pavilion hotel, and a little below Captain Creighton's cottage—when, crossing the road leading to The Chippawa line.

the Clifton House, it shortly fell into the line of the Military reserve, along the brow of the precipice, which it followed nearly to the Whirlpool. The careful examination and levelling of this line, thus far, presented so many natural difficulties that, independent of any other consideration, we deemed it waste of time to pursue it farther. Those difficulties are—first, the uniform increase of cutting, from 13 feet at leaving the river at Chippawa, to upwards of 60 feet at the crossing of the high road at Magarry's tavern—thence to Captain Creighton's cottage, the line proposed creates the necessity of either, as it were, suspending the canal midway from the cliff, or of incurring an embankment on one side, of from 30 to 40 feet, under bottom of canal! From thence to its junction with the Military reserve, no difficulty presents itself; but from this point to the Whirlpool, the line is necessarily close along the brow of the precipice, and for the entire of this distance, an uninterrupted cutting through solid rock, of from 20 to 40 feet, would be required. We were, therefore, induced to consider the farther exploring of this line as fruitless.

Not feasible.

Following the order already laid down, the next route proposed, which claimed our attention, is that from the mouth of the Niagara river, to fall in with the existing line at or near Thorold. Of the various departures heretofore proposed from the course of the present canal, none appeared to us at all so deserving of serious consideration, as this. That there exists no peculiar obstructions to the execution of such a line, we are fully prepared to admit; and from our own gene-

The Niagara line.

ral inspection of the country, and our corroborating check levels, we are of opinion, that its course was judiciously selected and laid out by Mr. Roy—whose report on the subject, we consider a sound practical document; although we are not prepared to admit, to their full extent, some of the principles therein laid down.

The selection of the Port Dalhousie route, or that from Niagara river, to be governed by the merits and capabilities of the respective harbors.

Having, from actual levels, ascertained the perfect practicability of an internal line from Port Dalhousie, (apart from the vale of the 12 mile creek,) to the present canal near Thorold: and as this route exhibits no difficulties whatever, more than Mr. Roy's line to the same point, and has the advantage of being 5¼ miles shorter, the selection of one or other must, of course, be chiefly governed by a consideration of the respective merits and facilities afforded by the harbor at Niagara, and by that at Port Dalhousie.

Preference given to Port Dalhousie.

To this part of the subject, we beg to assure you, we have given our most serious consideration—we have brought our minds to bear upon the question with perfect impartiality: we have taken every pains to acquire an intimate knowledge of all the particulars connected with it, and have been guided in the preference we give to PORT DALHOUSIE, by its appearing to us as capable of being made to afford, in the greatest degree, the indispensable requisites for the termination of such a navigation upon lake Ontario, viz: a facility of ingress and egress to the craft frequenting the canal, under any circumstances of weather, and of perfectly safe lying when in port.

Disadvantages of Niagara harbor.

The disadvantages of Niagara harbor lie in the entrance thereto, and are—that in calm or light winds, (especially from the South, which frequently prevail,) it is found that sailing vessels cannot make the harbor, owing to the strong current which sets down, and are obliged to resort to the aid of steamers, or be under the necessity of waiting for a shift of wind. This serious inconvenience is experienced when the wind blows from any point from S. E. to S. W. Again, in gales blowing from N. E. or N., or any intermediate point, great difficulty is felt in clearing out to the lake, owing to the very circumscribed nature of the fair channel—so much so, that we have known, from our own observation, instances of vessels, (even steamers,) having to put back: and on the other hand, the same winds meeting the current, create so great a swell and cross sea upon the bar, as to render vessels unmanageable; and it has frequently occurred, that vessels bound for Niagara, have been obliged to put about, and run for Toronto or Presque Isle. The existence of these disadvantages, corroborated, as it is, by your own observation, and the information of intelligent and disinterested seamen, *and depending upon natural causes which cannot be removed*, leads us to recommend, without hesitation, that Port Dalhousie be adopted, as the most suitable place for the construction of a good, commodious and extensive harbor. At this stage of our Report, we wish particularly to record our decided objection to the selecting of a harbor so perfectly under the control of our neighbours, as Niagara harbor undoubtedly is, for the termination of the Welland canal.

Cannot be removed.

National impolicy of adopting for the canal, a termination wholly under the control of the Americans.

The third line referred to, (see page No. 5,) we do not follow, for reasons which will appear in the course of our observations upon the fourth, or modified line, which is the one we adopt, and which is particularly delineated on the maps. The present line throughout, not adopted.

Assuming Port Dalhousie as the northern termination of the canal, the deficiencies existing in it are—the scantiness of water on the bar, and the want of shelter against winds blowing from any direction between N. W. and N. E., both inclusive. Upon the plans which accompany this Report, we have marked, in a distinct manner, the piers and other works which we recommend as suited to obviate fully these defects; and we are of opinion, that, if properly carried into execution, Port Dalhousie harbor would be second to none upon the lake. By a reference to the plans, the Board will perceive, that we propose to place the first lock more to the southward than the existing one—to extend two piers in the directions shown, to the other extremity of the bar, leaving an entrance between them of 350 feet wide; the entire of which, as well as of the channel to the inner harbor, is to be cleared out to the depth of 14 feet below low water. The inner harbor to be dredged to the depth of 12 feet. These works, with the construction of the intended light-house upon the outer pier, and of the leading light on the position marked, would enable vessels to make in or out, at any time, and with any wind. We propose to combine at this, our first lock, the two falls of the present locks No.'s 1 and 2—thereby we obtain an immense extent of lying ground, for ves-

Present defects in Port Dalhousie.

Works proposed to remove the defects in Port Dalhousie.

Inner harbor.

Position of entrance lock.

Immense power at command, to keep the channel open, by the discharge thro' it, seven millions of cubic yards of water.

sels, a considerable shortening and straightening of the navigation course, and a power of discharging such a quantity of water, (above 7,000,000 yards,) directly through our new channel, as will, we are convinced, prevent it, at all times, from being silted up.

Present line followed to head of 11th lock.

The line direct from Port Dalhousie to near Thorold, alluded to when treating upon the Niagara line, is marked upon the general map, by a dotted line; but from considerations founded on the score of expense, as well as the facilities presented by this part of the valley of the 12 mile creek, for the adoption of the improved system of combined lockage, we have preferred following the present course of canal, to above the 11th lock. In this distance, it is sufficient for our present purpose to state, generally, that in sundry places we have much shortened and improved the line of navigation, got rid of many existing defects, made ample provision for the discharge of waste water, and modified the lifts of the locks so as to effect considerable saving in the execution, and particularly of the after maintenance of the works.

From 11th lock to Thorold, a deviation recommended.

Reasons.

From the head of the 11th lock to Thorold, the Board will perceive, on referring to the map, that a deviation from the present line is contemplated by us. We recommend this deviation, instead of following the present route, because it is more economical, affords ample opportunity of properly locating the locks, enables us to adopt a well combined system of lockage, and avoids the dangerous and unfit placing of the locks upon the shelving side of the mountain.

The lifts of the four locks at Thorold, including, also, the raising of the level thence to Allanburgh, we propose to surmount by two double locks. The reason for raising the water of this level, is to afford greater facility in navigating through "*the little deep cut*," the traction through it, at present, being very heavy—the necessary raising and strengthening of the embankments will be effected at much less expense than the taking out of the bottom, which is rock.

Thorold locks.

Water through "the little deep cut" to be raised 1 ft. 1 in.

Reasons.

The lifts of the two locks at Allanburgh, we combine into one, adding two feet six inches for an additional height of water intended to be put upon this level, which reaches to the termination of the canal at Port Colborne—the several embankments, of course, will require strengthening.

Allanburgh locks.

The water to be raised 2 ft. 6 in. thro' the level of "the Deep Cut."

We have heretofore studiously abstained from making any remarks upon several defects in the original laying out and execution of these works, which presented themselves to us in the course of our surveys; but here we cannot forbear from expressing our regret that, from want of skill and experience in the construction of this part of the canal, as we conceive, more than from the supposed impracticability, the original bold idea of carrying the waters of lake Erie into lake Ontario, had to be abandoned. We must, however, in this case, also, be governed by a principle which has guided us throughout, namely: to avail ourselves, as much as possible, of the outlay already incurred, and to make the most of the works as we now find them. The instructions of the Board to us,

Engineers regret the abandoning of the bold idea of carrying the water of lake Erie through to lake Ontario.

Originally practicable.

Engineers governed by the principle of making the most of the outlay incurred.

And interrupting the navigation as little as possible.

verbally, "*to interrupt the navigation as little as possible*," and the improper manner in which the immense excavation of the Deep Cut was disposed of, on the very edge of the canal, add so much to the difficulty of now attempting any serious deepening through it, we are forced to adopt the expedient of raising the water upon the level, strengthening the banks, and widening and improving the feeder, as hereinafter described.

Carrying the waters of lake Erie thro' "the Deep Cut," now impracticable, owing to its mismanagement.

Port Colborne.

Port Colborne, although in its present state much exposed, possesses great capability of being made an excellent harbor for schooners. This fact, coupled with the comparatively small additional outlay required upon the canal back to the aqueduct, points it out, under existing circumstances, as the termination to be selected on lake Erie, for the Welland canal, supposing it constructed upon the scale adopted by the Board. The works proposed by us, for the perfecting of this harbor, are so clearly shown upon the map, that they will at once be understood by the Board, upon a reference thereto.

Can be made an excellent harbor for schooners.

Engineers guided in the adoption of this termination in lake Erie, by the small outlay required, and the scale decided on.

Otherwise would prefer following the Chippawa and feeder in part, and entering the Grand river by Broad creek.

Had we not been necessarily governed by the principle alluded to, we should have preferred, even for a schooner navigation, locking down into the Chippawa at the aqueduct, following the reach of that river as far as the creek entering it from Marshville mill, by which we would ascend to the feeder, pursue it to the bend, thence to the Broad creek, and by it descend into the Grand river. This route would terminate in a harbor admitted to be the finest on the lake, for vessels of any class; but would cause an addition to the estimate, of about £50,000.

Grand river harbor the finest on the lake, for vessels of every class.

Additional cost of this route, £50,000.

In order to be enabled to add two feet six inches to the height of water upon the Deep Cut level, it will be necessary to expend about £10,800 upon the feeder—widening it and deepening it in sundry places, raising the banks thereof, removing the old bridges and stop-gates, and substituting new bridges and a guard-lock in lieu thereof, forming a catch water pier, and removing the projecting angle of ground at the junction of the feeder with the river, constructing regulating weirs to prevent the indraught to the mills at Dunnville from operating injuriously, as they now do, upon the flow of water down the feeder. These improvements, properly carried into effect, will vastly increase the command of water, and the requisite power of control over it.

To raise the water on the Deep Cut level, sundry improvements required on the feeder.

As connected with this subject, we beg leave here to remark, that by the deviation we have adopted at "the mountain," the strong and well-founded objections against the occasional passing of floods, and the constant flow of water through the canal, for milling purposes, is obviated wholly in that part of the canal where its injurious effects are seriously felt; as upon the completion of this deviation, the present course of the canal, from the 31st to the 11th lock, becomes exclusively the channel for the discharge of the surplus water.

Objection as to the passing of flood and mill water thro' the canal, obviated.

Having, in the foregoing, with sufficient detail, described the proposed alterations in the line, and the several works requisite to render this canal a permanent navigation, upon the scale adopted by the Board, at a

Cost of line from Port Dalhousie to Port Colborne

Total expense.

Doubts as to the scale adopted being suited to the prospective wants of the country.

cost of £287,147 11*s.* 3*d.** exclusive of the junction lock and graving dock, at Dunnville, (estimated at £13,156 11*s.*)—in all, £300,304 2*s.* 3*d.*—we cannot, with all due submission to the Board's instructions, dismiss the subject without expressing our fears, that this scale will not be found sufficient for the prospective wants of the country.

Scale not sufficient, in a commercial point of view.

We view the matter in a two fold light: first, as regards the great revenue produced by the vast tide of immigration constantly flowing west; this, it is well ascertained, is monopolized by the Erie canal, chiefly in consequence of the difficulties and hardships hitherto unavoidably experienced, from Montreal upwards—the causes of which, however, being now in progress of removal, so far as the lower end of lake Ontario, the obstruction to the uninterrupted transport of emigrants or merchandise, *without transhipment*, will rest at the head of that lake. This being the case, and having estimated the cost of constructing the Welland canal upon a scale suited to steamers capable of navigating the lakes, (say the locks to be 45 feet wide by 180 feet long,) we find, that by an increased expenditure of £250,000, an additional internal navigation of about 1,200 miles, would be thrown open to the steamers on lake Ontario.

An additional outlay of £250,000 would open 1,200 miles of internal navigation to the steamers of lake Ontario.

Scale not sufficient in a military point of view.

The second point of view we look at this question in, is as relates to the greatly increased advantages which would be possessed by this province, in case of war, was the

* Of this sum, £63,452 4*s.* 8*d.* will be required for the construction of Ports Dalhousie and Colborne.

Welland canal constructed of sufficient dimensions to allow of the concentration of our armaments on either lake, as circumstances might require—an advantage which recent events tend, in our minds, to enhance the value of.

We have the honor to be,

GENTLEMEN,

With much respect,

Your most obedient servants,

(SIGNED,)

N. H. BAIRD, } *Civil*
H. H. KILLALY, } *Engineers.*

*Toronto, February 23rd,* 1838.