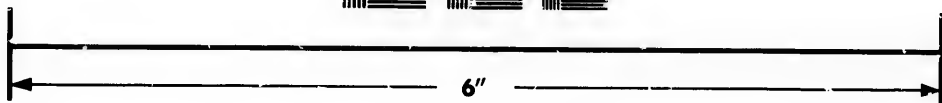
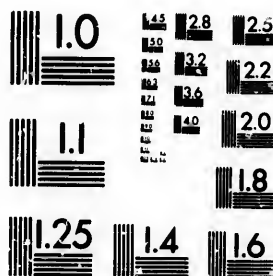


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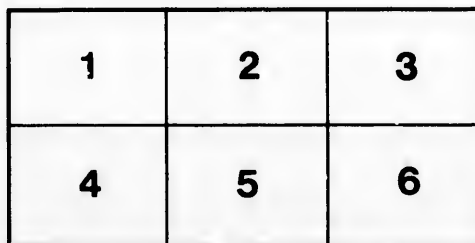
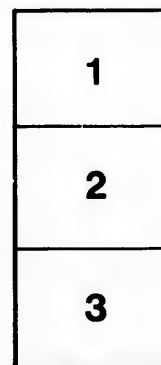
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REPORT
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SURVEY OF EXTENSION
OF THE
European and North American Railway
TO THE
AMERICAN BOUNDARY,
AND
BRANCH LINE TO FREDERICTON.

By E. R. BURPEE, C. E.



FREDERICTON:
PRINTED BY JOHN GRAHAM, "HEAD QUARTERS" OFFICE.
1865.

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PROVINCIAL SECRETARY'S OFFICE,

FREDERICTON, *April 27th.* 1864.

SIR,

I beg to inform you that his Honor the Administrator of the Government in Council has been pleased to appoint you as Engineer, to explore and Survey a line of Railway from the City of St. John to the Boundary of the State of Maine, *via* the Douglas Valley; and you are hereby authorised and empowered to employ the necessary Surveyors and Assistants to enable you to prosecute that Survey with all convenient speed.

I have the honor to be,

Sir,

Your obedient servant,

S. L. TILLEY.

E. R. Burpee, Civil Engineer, St. John.

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REPORT

OF THE

SURVEY OF RAILWAY EXTENSION.

St. JOHN, *April 24th*, 1864.

TO THE HON. A. H. GILLMOR, PROVINCIAL SECRETARY.

SIR,—Having been previously notified of the appointment confirmed in the foregoing letter, I had, in order that the work should be completed with as little delay as possible, already secured the services of Mr. Thos. Ramsey, long and favorably known as an explorer of experience, had organized a staff, and had made arrangements for a thorough survey, during the summer, of the different routes through Portland and Carleton, to connect with the present line from St. John to Shediac, so that immediately on the receipt of formal instructions, I was enabled to commence work in both directions, and from that time until the last of January of the present year, was fully occupied with the out door work on the main line and a branch to Fredericton. Since, the work on both has been plotted, quantities calculated and estimates of cost prepared, and I am now happy to be able to report that a line has been found, which, although, perhaps, susceptible of improvement, yet presents few engineering difficulties, can be constructed at a very moderate cost, and traverses a district of country which will produce a remunerative tariff, capable of being largely increased.

General Route of the Line.

The line, shown by the deep red line on the map accompanying the other drawings and this report, starts from the present depot of the European and North American Railway, passes either through Portland to the Suspension Bridge, where it crosses the St. John river, or from the present water terminus extended to harbour line, by means of a ferry, it may connect with some of the lines on Western side and through Carleton, with the main line a short distance West of the bridge. Thence skirting the West shore of South Bay and the St. John river for 16 miles, it reaches the mouth of the Nerepis, and follows its left bank for 8 miles; then leaving that river and crossing the road to Fredericton it enters the Douglas Valley, from which it passes by the North side of Gaspereaux Lake and the valley of the Back Creek, until it crosses the South Branch of the Oromocto river. Thence by a direct course, it crosses the North West Branch of the same river near Hart's Mills, $43\frac{1}{2}$ miles from St. John;—from which point the branch line to Fredericton diverges. Leaving this place it takes a Westerly course and follows the North West Branch of the Oromocto and its tributary, the Yoho, for some distance. Crossing the latter and two branches of the Lyons' stream, it intersects the main post road between Fredericton and St. Stephen, 26 miles distant from the former, and 53 from the latter place. Thence it reaches the shore of Cranberry Lake, crossing an arm, of which it makes, by a direct line, the outlet of the large Maguadavic lake; from thence, bending somewhat to the South, it passes the North side of Mink Lake and Mount Prospect, and crossing the "New Brunswick and Canada Railway" 42 miles from St. Andrews, it reaches the American boundary on the St. Croix river, not far from the outlet of the Cheputneticook lakes, the distance being $88\frac{1}{4}$ miles from St. John.

By this route a line has been procured, which requires no grade exceeding 53 feet per mile, or curve of less radius than 1637 feet, and which will be found to compare favorably with most lines on this continent both as to total amount of grades, curvature and cost.

Characteristic Features of the Line and Works.

Leaving that part of the line East of the Suspension Bridge, and the different means of connecting with the terminus of the European and North American Railway to be afterward considered, I will proceed to remark on the characteristic features of the line from that point Westward, and as there is no very great difference in the length of the terminal lines, it is to be understood that in all cases, where distances from St. John are given, they are reckoned from the present depot of the European and North American Railway, and by the line through Portland, over the falls.

From the Suspension Bridge around the South Bay as far as Sutton's Mills the work will not be difficult, but on reaching that point it will be necessary to cut through a spur of limestone rock, 40 feet in depth by 200 feet long, the material can be used to form part of a heavy embankment required across an arm of the bay. It is also proposed here to erect an iron bridge of 50 feet span, this being the natural outlet of the water from Spruce Lake. Thus far, it is possible to shorten the line at least $1\frac{1}{4}$ miles, and reduce the curvature very considerably, by adopting a line across the South Bay near the line of piers of the Boom Company, but it was found, on examination, that to build a wharf or embankment sufficient to withstand the wash of the water in so exposed a situation, with the necessary bridges and dams, besides interfering with the operations of the Boom Company, would entail an outlay exceeding that on the longer line, by at least \$100,000.

From South Bay to Vernon's mill pond the work will be light, but thence to Law's stream, the eastern boundary of King's County, a distance of about 3 miles, serious obstacles are to be encountered because of the highlands, which, (skirting the South side of the St. John,) here jut out abruptly into the river, forming Stevens' Cove on the East and Clark's Cove on the West side of Clark's Mount. To avoid a tunnel either through this hill, or the point of high land immediately West of Clark's Cove, which was resorted to in former surveys to overcome the difficulties here met with, much time was spent in a thorough examination of the country for some distance from the river. A practical, and I may add not immoderately expensive line, was found by crossing to the South side of the Fredericton road, (at Stevens'), and recrossing a short distance before reaching Law's stream,—the summit being overcome by a grade of 49 feet per mile, for a distance less than one mile on the Eastern side and about half a mile on the Western side, while the line was generally straight.

A survey and estimate has also been made of an alternative line at this point (shown by a blue line on the plan,) which, passing round the edge of Clark's Point, avoids the summit to be surmounted by the inland route, but being half a mile longer, requiring curves of less radius than 1450 feet, and on the whole being not less expensive, is not recommended.

For the next 4 miles the country is rough and much broken, so that the work will be necessarily above the average per mile, although the grades are within the prescribed limits and the curvature is moderate. Law's and Scovil's mill streams are each in deep valleys, requiring heavy embankments and bridges of 25 feet span. The highland, extending out into the St. John river at Brandy Point, is passed by taking advantage of a natural valley, most favorably situated, immediately South of that point in a direct line with the general course.

After this, the ground is much more favorable, and little needing special remark is met with, until reaching the vicinity of Eagle Rock, some distance up the Nerepis and 20½ miles from St. John.

I may here remark, however, that to avoid the necessity of frequently crossing the post road on this section, in order to secure the safety of the travelling public, a large amount of road diversion will be required.

At Brundage's Point, 13 miles from St. John, a cutting of 400 feet long and 40 to 50 feet deep is shown on the section, apparently of material suitable for ballast. The existence of a good ballast pit at this point would be highly advantageous, but should the material prove to be not so good as anticipated, the excavation can be diminished by slightly altering the location, which, to a small extent, would increase the curvature.

As the nature of the country at Belyea's, two miles farther on, is such as to admit in location of little choice of ground, considerable expense may be expected in damage to property, but, should the present line, on final location be adhered to, the damage may be considerably reduced, by lessening the width of the cutting and bridging a sufficient portion of it, to allow the proprietor accommodation for his ordinary business. This bridge would also serve for the road leading from this place across the Nerepis river to Brittain's Point.

In the vicinity of Eagle Rock, it will be necessary to encroach slightly upon the Nerepis river, for about 200 feet, where the slope will require to be protected by rip-rap, and probably piling for a very short distance. There will, here also, be a cutting of about 50 feet depth, but as at Brundage's Point, the material can be advantageously used as ballast.

The line now enters the level country near the junction of the Douglas stream with the Nerepis, crossing the Fredericton road near the residence of Charles Bayard, Esq.; leaving which, with a short curve of 2700 feet radius, it crosses the two branches of the Douglas stream, (each requiring a bridge of 24 feet span,) and enters the Douglas valley. An alternative line is here suggested, (as shown on the plan by the blue line,) which, although adding slightly to the curvature, will cause considerable saving in construction, without injuring the character of the road.

After this, the line skirts the foot of Douglas mountain and the hills on the West side of the valley, avoiding as much as possible the soft ground in the vicinity of Harcourt Lake, and reaches the summit of land between the waters of the Nerepis and Oromocto rivers, 27 miles from St. John, and at an elevation of 171 feet above high tide. The whole of the works on this section are more than ordinarily light, the curvature small, and only once is the maximum grade of 52.80 feet per mile attained.

Leaving this summit, the line first crosses and then recrosses the back creek, the northern side of which it follows nearly to its mouth; thence in about two miles of straight line it crosses the South Branch of the Oromocto, at the head of tide water, and 40 miles from St. John. The work on a portion of this section is somewhat broken, but not heavy or expensive. Several alternative lines have been run in this distance, but although they reduce the amount of curvature and length of time a little, the necessity for heavier grades and increased expense in construction more than counterbalance these advantages. The crossing of the South Branch of the Oromocto, at a place everyway favorable, is proposed to be effected by an iron girder bridge of 100 feet span; thence to Hartt's mills, on the North West Branch of the Oromocto, the country is level, and consequently the works light, and grades easy.

From this point two lines were presented for consideration. One up the North West Branch of the Oromocto river, and by the South side of the Oro-

mocto lake, across the Maguaguadavic river to the "New Brunswick and Canada Railway;" the other in a nearly direct West course across the country to the North of that lake through Harvey Settlement, and crossing the Maguaguadavic much nearer its source, to the "New Brunswick and Canada Railway."

From explorations made by parties, under Mr. Wilkinson, in 1850, it seemed quite clear no line could be obtained on the former direction, from the Oromocto lake, across the valley of the Maguaguadavic to the high ground between it and the Digdeguash, without grades exceeding 53 feet per mile, and more than ordinarily heavy work, and it also was evident that the distance must be longer than by the Northern route, while to overcome the necessity for heavy grades and expensive work, by going farther to the South the line would have to be made of even still greater length. I determined, after having had the ridge of highland on the West side and North of the Oromocto lake, (which separate the waters of the Oromocto from those of the Maguaguadavic,) and the valley of the North East Branch of the Maguaguadavic, explored by a small party during the progress of the survey East of Hartt's mills, and having found that a shorter practical line could be had on the North side of the lake, to leave the Southern route to be further examined at some future time should circumstances warrant it, and proceeded with the Northern route.

Having adopted this course, it was necessary to cross the North West Branch of the Oromocto, so soon as a suitable place could be selected. This was found at a very short distance above Hartt's mills, and at a point every way favorable, the width of the valley being contracted and the bed of the stream rock. It is proposed to effect this crossing by means of an iron girder bridge of two spans of 75 feet each.

After crossing the stream, a table land is soon gained, when a straight and easy line is found up the West side of it for some distance, passing Tracey's mills 47 miles from St. John, and crossing Porcupine Brook near its confluence with the Oromocto, where a heavy embankment of 52,000 cubic yards, and bridge of 24 feet span will be required. Immediately, on leaving this stream, a deep and long cutting occurs, and the maximum grade of 53 feet per mile is required for one mile. It is probable, that by increasing the curvature, so as to cross Porcupine Brook a little farther from its mouth, the summit of land between it and the Yoho could be attained by means of a shorter grade and at less expenso.

As the country from this point Westward was a complete wilderness, wholly unexplored and without roads, it was a tedious and somewhat difficult task to decide upon the best route, but after a thorough survey of the Yoho stream, and exploring a large tract of the adjacent country, the line now adopted reaching the Cork Settlement road $58\frac{1}{2}$ miles from St. John, was found to be the most favorable, the work being under the average, with few and easy curves and grades generally less than the maximum.

There will be required over the two branches of the Yoho, bridges of 24 feet span.

Leaving this point the greatest difficulties were encountered, requiring a most thorough examination of the country, and it is highly probable that further explorations may furnish improvements in the lines ultimately adopted, or lead to results more satisfactory respecting those which have been abandoned.

From this point, two routes to the "New Brunswick and Canada Railway" again present claims for consideration. The first crossing the Lyons' Stream near its forks; thence by the head of Dead Brook, to what is known as the Long Swamp on the Fredericton and St. Stephen road, (through which it was intended to pass the Harvey Settlement ridge,) and crossing the North East

Branch and main Magaguadavic Rivers, and following the head of Davis Brook to the South side of Mount Prospect, it would reach the New Brunswick and Canada Railway about 41 miles from St. Andrews. The second route, following the Lyons' Stream to Cranberry Lake; thence maintaining nearly the same elevation, by keeping as nearly as possible to the head of all the Magaguadavic waters, and passing on the North side of Mount Prospect, joins the New "Brunswick and Canada Railway," not far from the point at which the former does.

The first mentioned route being the shorter by about 2 miles, was looked upon with much favor, and was not given up until much time had been spent in exploring it, and the lateness of the season rendered it imperative to adopt some one. Although no difficulty was found in getting a good line from the Cork Settlement road to Dead Brook, all our explorations as yet, lead to the conclusion, that to make the summit of the Long Swamp, a grade of 60 feet per mile would be required, which, notwithstanding the work would be light, it is not though fit to recommend. It was also ascertained, after having run a number of trial lines, that neither the valley of the North East nor Main Magaguadavic Rivers could be crossed, so as to reach the "New Brunswick and Canada Railway" South of Mount Prospect, without steeper grades and much heavier work than would be desirable. Finding then, that both of these streams flow and fall rapidly, while the highland on their banks retains its full height, so that a good line in this direction was not likely to be found without much further exploration, if at all, and considering the season was so far advanced, it was decided to keep, as nearly as possible, the elevation attained at the Cork Settlement, and cross both those streams as near their sources as possible.

This led to the adoption of the Northern or second named route on which for 8 miles two lines have been surveyed as shown on the plans, both of which come within the required limits as to grade and curvature.

That by Cranberry Lake (upon which the estimates are based,) crossing the Harvey Road at an elevation of 55 feet lower than any other can, is shorter by a few feet, is much the straightest and presents the smallest amount of heavy gradients. It traverses a heath for two miles, (some three or four hundred feet of which may require to be covered with poles or bush before a bank is laid thereon,) and then after some distance in a swamp, rises with a grade of 52 $\frac{1}{2}$ feet per mile from the head of Lyons' Stream through a gorge, the contracted limits of which will admit of very little alteration on final location, to the Post Road from Fredericton to St. Stephen, at an elevation of 471 feet above tide level.

Leaving the Post Road it immediately traverses a cove of Cranberry Lake, with a curve of 1637 radius passes a point of rock, (which makes out from the Southern shore and requires to be excavated to a depth of 45 feet,) and then crossing an arm of the lake 800 feet wide, it rises with an easy grade of 20 feet per mile for 5000 feet to an elevation of 488 feet above high tide, the summit between St. John and the "New Brunswick and Canada Railway." The depth of water in the Lake where the line crosses was found to be 16 feet, and with the material furnished from the rock cutting it would not be difficult to make through it a substantial wharf or embankment. The quantity of rock estimated to be excavated at this point is 40,000 cubic yards, (by far the heaviest cutting on the line,) but by increasing the curvature, the quantity of excavation and also the depth of water can be lessened considerably, while at the same time the requirements of a first class road will be adhered to.

The alternative line shown in blue on the plan runs almost entirely on firm ground, but, as it involves the necessity of an increased number of sharp curves,

a higher summit by 40 feet, and consequently a greater length of heavy grades, without reducing the length or to any considerable extent the cost of the line, it is not recommended.

Leaving Cranberry Lake, the line is straight to the Maguaguadavic river, which it is proposed to cross by an iron girder bridge of 50 feet span. On this length the grades are easy and the work light, while there is little doubt but it can be still further improved on final location. The North-East Branch is crossed near the mouth of Deadwater brook and will require a bridge of 30 feet span.

The Maguaguadavic river is crossed a short distance below the outlet of the big Maguaguadavic Lake, and although approached on either side by a grade of 52 $\frac{1}{4}$ feet per mile, still requires an embankment of 89,000 cubic yards. The valley through which this river flows is much lower than the lands on either side, which will account for this section being among the most difficult and expensive on the line. This valley widens and its depth increases in descending from the Lake, so that the only chance of finding a more favorable crossing must be confined to the short space between the present location and the Lake, where no doubt, from what examinations have been made, the embankment may be considerably diminished in quantity.

After leaving the valley of the Maguaguadavic the country is much more favorable, and following the location we cross Mink Brook nearly one mile from where it enters the Maguaguadavic Lake, and keeping on the right bank of a lake of the same name at its head, skirting the foot of Oak Mountain until the South fork of the Cranberry Brook is crossed near its source, and then traversing heaths and swamps for two or three miles we reach the vicinity of Mount Prospect. Passing this mountain on the narrow strip of level but stoney land between it and Foster Lake, with a short curve of 5270 feet radius toward the South, we cross the head of White Beaver Brook and without difficulty reach the "New Brunswick and Canada Railway" on the level. On the whole of this distance, 10 miles, the location is almost entirely straight, the grades easy and the work not expensive.

Leaving the railway the line keeps still to the South in order to avoid the hills on the Western shore of the second Digdequash Lake, and at the 84th mile from St. John passes a summit of 500 feet above tide level by 2 miles of the maximum grade, then turning to the right and descending with easy grades reaches the American Boundary at the St. Croix, (88 3.5 miles from St. John,) which river it crosses at an elevation of 381 feet above high tide.

Some portions of the work on this section of the line are heavier than an average of the whole, but there is little doubt it can be made lighter on final location. To effect the crossing of the St. Croix will require an iron bridge of two spans of 80 feet each, the expense of one-half which would necessarily devolve upon the company constructing that portion of the line on the American side of the boundary.

Description of Terminal Lines through Carleton and Portland.

Before entering upon the question of cost, it is deemed preferable to make a few remarks on the different lines connecting with the terminus of the European and North American Railway, and with the waters of St. John harbour.

A line tolerably favorable, has been surveyed to the terminus of the E. & N. A. Railway, crossing the St. John river about 150 feet above the bridge. From this, it curves to the left and follows the hillside to the vicinity of the iron works on the Straight Shore, thence crossing the timber ponds and the Straight Shore road near Hawes' Cottage, passing over Sheriff street, under Simonds' street, and following from Acadia street, along the rear of the houses on Main street, (Portland,) it reaches the long wharf and thence commences to

curve to the right. Then reversing it passes over Mill street, and through the wooden buildings attached to Harris' foundry, joining the present railway near Dorchester street crossing. From near the suspension bridge to within 700 feet of the present station, the grade descends at a uniform rate of 35 feet per mile. Bridges will be required over Mill street and the long wharf, under Simonds' street, over the Straight Shore road, and trestle work over a portion of the mill pond. The whole of the excavation required will be rock, and through Portland it is proposed to tunnel 250 feet in length.

This may be considered as favorable a line as can be found to connect with our present railway by the Eastern side of the river, but it is very evident that apart from the bridge over the St. John river the works alone are heavy and must prove expensive.

With a view, if possible, to obviate this objection as well as to furnish more accommodation for heavy freight and lumber traffic, several others have been surveyed on the Western Side of the river, which are shown on the plan of the harbour and its vicinity.

The first of these leaves the main line at a point "A" (on the plan) 140 West of the bridge by a sharp curve, and passing through the grounds of the Lunatic Asylum, and a little to the West of Peters' mill, follows the bank of the river to Front Row, in Carleton; thence passes between high and low water mark, crossing two or three wharves and the head of Buttermilk Channel to Navy Island. This is only about $1\frac{1}{2}$ miles in length and is the shortest line from the West to the harbour in deep water. It is, however, liable to some objections. The curves near the Suspension Bridge are only of a radius of 1437 feet, and the elevation of ground at the point where it leaves the main line is such that the maximum grade of one foot per hundred is required to within 700 feet of the terminus in order to make a descent to a level with the wharves, while at the same time the works are both heavy and of an expensive nature.

Another line diverges from this some distance before reaching Front Row, then crossing King and Union streets and the heads of the wharves East of Union street, it extends to deep water at Sand Point. This line is about 800 feet longer than the first, which will admit of some diminution in the inclination and will lessen the quantity of work near the Suspension Bridge, but it is liable to the same objection in respect to curvature and to the short distance between the foot of the grade and the terminus.

A trial line was run from station 26 on the main line, crossing the Manawanish road to the back of Clark's house, then recrossing the road and along the slope of the hill below Tilton's to near the back of the Church on King Square, and thence into Lancaster street, as shown by the light red line on the plan.

This was found to be impracticable on account of the height of the land at the road crossing West of King Square.

It then became quite evident, the only chance of obtaining a more favorable line must be to pass on the West side of Carleton Heights. A line was therefore started from point "B" or station 35, on the main line running through the ridge of land on which is the road to St. Andrews, around the highlands to Negro Point, and thence through Carleton to Navy Island. As this line is about 2 miles longer than the others it may be a question if its length does not more than compensate for the advantages it possesses in grades, curvature and works. It is, however, certain this line can be carried from Negro Point to deep water at Sand Point with a saving both in distance and expense, while at the same time (should a terminus be made there,) it would assist in forming a

breakwater for the protection of the harbour. And should it be found practicable on examination to carry it through the ridge on the Manawagonish road further to the West, so to connect with the main line near Sutton's mills, it will compare to advantage with the other lines.

It is pretty certain that the lines through Carleton cannot be departed from to any great degree, but a more extended survey than the time and means at my disposal warranted might furnish information that would improve them and at the same time diminish their cost. Indeed in works of so heavy a nature and likely so seriously to affect the value of property through which they pass, the slightest improvement in location would, in construction, many times repay the expense of any survey that *could be made*.

It has been proposed to bridge the harbour from Navy Island to the Round Reefs near Hilyard's wharf, but in order not to prevent the navigation of the St. John river as at present conducted, it would be necessary to attain such an elevation (as shown by the profile plans,) as would prevent a junction with our present railway, except by grades steeper than could be recommended, beside which the cost of the structure and its approaches would probably exceed one million dollars. If, therefore, it should not be deemed expedient at first to erect so expensive a work as a bridge at the Falls to connect through Portland, with the present line, the much more expensive one from Navy Island is out of the question, and there only remains to choose the best line on either side to deep water and connect by ferry.

Terminal Lines on Eastern side St. John Harbour.

Having disposed of the different feasible lines on the West side, it only remains now to discover at what point it is best to obtain access to deep water on the Eastern side of the harbour from the present railway.

Four distinct plans for doing this have been proposed at different times. One line leaving the railway near the Marsh Bridge passes round the back of the City to the breakwater nearly opposite Sand Point; a second from the present station by a tunnel under the property of the late Judge Chipman to the Market Square; thence by Water street to Reid's Point; a third from the crossing of Mill street, by the head of Union street slip to North Market wharf; and a fourth from the present water terminus across Long and St. Helena wharves to Rankin's wharf nearly opposite Navy Island.

The line by the Back Shore to the Breakwater was surveyed under the late Chief Engineer of the European and North American Railway, and subsequently, by the City Engineer, and in both cases with a view of its being made applicable as a route to a terminus at the Breakwater. Now, whatever may be its fitness for that purpose, or its claims with a view to extending the business limits of the City and increasing the value of its property, it seems unnecessary to spend time in surveying a line that must be very expensive, when the only object sought was the easiest and safest means of extending our present line of railway Westward.

That the second line through Chipman's Hill, whatever its advantages in location, would be too expensive, is obvious, so that only the third and fourth remain for consideration.

Of these, the third is the shortest and probably would be the cheapest in construction, but it is a matter of some doubt if sufficient room can be found without interfering too much with the business proper of the place.

The fourth is the most direct and (Navy Island being the terminus on the Western side,) would reduce the width of the ferry to about 1500 feet, over a portion of the harbour as sheltered from storms and as free from currents as could be found on any other practicable route.

Should either of these lines be adopted, there are so many questions involved which do not come within the province of an engineer to decide, that it is impossible for me to more than indicate that either is feasible and can be constructed (damage to property excepted,) at a very moderate expense.

Estimate of Cost.

The cost of the whole line is influenced so much by the location of this terminus, that I have thought it more satisfactory to make an estimate on the cost of the main line from the American Boundary to the Suspension Bridge, and append estimates which at best can only be approximate of the several terminal lines.

The calculations for the quantities in the following estimate are based upon the requirements of a first class road; the width of roadbed on embankments being 18 feet, with a slope of $1\frac{1}{2}$ to 1, and in cuttings from 24 to 30 feet, according to the material, with the same slope; ballast 1 foot for depth under the sleepers, and a rail weighing 63 lbs. to a lineal yard. A fair allowance has been added to the quantities of earthwork for shrinkage, ditches, &c., while the facilities for approaching the line with plant, and the abundance of good building material for the works (in most cases within a few yards,) are such that the prices affixed are supposed to be ample for their performance. The station accommodation is not intended to be of so expensive a character as on the present railway, but is calculated on a liberal scale, for the country traversed, and the equipment estimated would, properly managed, be sufficient to meet the requirements of a larger traffic than I have ever yet calculated upon.

Estimate of the Cost of the Main Line of Railway from the Suspension Bridge at St. John to the American Boundary.

65 miles of clearing at 200 dollars per mile,	\$13,000	
50 miles of fencing at 700 dollars per mile,	35,000—	\$48,000
2,020,000 cubic yards earth in embankment, at 25 cents,	505,000	
196,400 cubic yards solid rock excavation, at 1 dollar,	196,400—	701,400

Masonry.

696 cubic yards Ashlar in bridge abutments, at 8 dols.,	5,568	
5,205 cubic yards dry rubble bridge abutments, at 7 dols.,	36,435	
15,710 cubic yards culvert masonry, at 4 dollars,	62,840	
6,000 cubic yards rip rap protection walls, at 1 dollar,	6,000—	110,840
1,010 lineal rods of road diversion, at 2 dollars,	2,020	
18 public road crossings,	5,750	
100 farm and other crossings,	1,250—	9,020
155 tons Iron girder bridging in place, at 150 dols. per ton,		23,250
86.74 miles single track, including ballast, sleepers, and laying, at 8,000 dollars per mile,	693,920	
5 per cent. additional for sidings,	34,697—	728,617
Land damages on 100 farms, at 100 dollars each,	10,000—	10,000

Stations.

1 Engine house at terminus,	15,000	
2 Engine houses, intermediate, at 8,000 dollars each,	16,000	
3 principal stations, at 2,500 dollars,	7,500	
5 second class stations, at 1,000 dollars,	5,000	
10 flag stations, at 300 dollars,	3,000	
8 woodsheds and water tanks, at 400 dollars,	3,200—	49,700
Engineering and superintendence, at \$1,000 per mile,		86,750

Forward,

*Forward,**Rolling Stock.*

10 locomotives, at 10,000 dollars each,	100,000	
3 snow-ploughs, at 1,000 dollars each,	3,000	
16 first class passenger cars, at 2,650 dollars each,	42,400	
8 second class passenger cars, at 1,750 dollars each,	14,000	
4 baggage and express cars, at 1,500 dollars each,	6,000	
70 box freight cars, at 700 dollars each,	49,000	
170 platform cars, at 600 dollars each,	102,000—	316,400
		<u>\$2,083,980</u>
Add for contingencies and unforeseen expenses, 15 per cent.,		312,600
		<u><u>\$2,396,580</u></u>
Total,		

Estimate of Terminal Lines, and Bridge over St. John River.

The following are approximate estimates of the cost of different terminal lines connecting the main line with deep water and the present line of railway, damages to property apart.

In the estimate for the line through Portland, the most important item of expense is the bridge over the St. John river, which it is proposed to make on the suspension principle, similar to that at Niagara.

The site, about 150 feet above the toll bridge, is very favorable, the rock on which the towers would rest being at considerable elevation above high tide, and presenting every appearance of being well fitted to receive them and the anchorages. The Eastern bank will require excavation, and the Western some embanking, in order to bring the roadway 75 feet above high tide, as required by law, to permit the free navigation of the St. John river. The span will be 620 feet, being longer than any tubular bridge, and about 200 feet shorter than the suspension bridge at Niagara, which answers the double purpose of railway and carriage road. Comparing the natural advantages in the site, the diminution in span, the work it would have to perform, and the facilities for construction with those at Niagara, the conclusion arrived at is that the cost of the proposed structure would not exceed \$200,000.

By erecting abutments from extreme low water on either side, the span can be reduced to 500 feet, at which a tubular or girder bridge would become practicable, and in stiffness and consequent adaptability for rapid transit, might possibly present advantages sufficient to warrant the extra expense required in its construction. From surveys made, an approximate estimate of the cost of both a suspension bridge of 620 feet, and a tubular one of 500 feet span, has been made, and will be found appended to this report.

Estimate of a Line from West side of St. John River, through Portland to the present Line of Railway.

70,000 cubic yards rock excavation, at 1 dollar,	\$70,000
400 lineal feet trestle bridging, at 20 dollars,	8,000
2,600 cubic yards rock excavation in tunnel, at 5 dollars, \$13,000	
650 cubic yards masonry, lining tunnel, at 8 dollars, 5,200—	18,200
Bridges over Mill street, Long Wharf, and two over Straight Shore road,	33,000
Over bridge Simonds street,	1,000
<i>Forward,</i>	

<i>Forward,</i>	
Level crossings, Sheriff street, road to Bentley's house,	1,000
Ruddock's, and post road,	20,000
1 7-8 miles superstructure and sidings,	
	\$151,200
Suspension bridge over St. John river,	200,000
Total,	\$351,200

Estimate of Cost on a Line by Carleton Shore to Navy Island and by Ferry to Rankin's Wharf, to the present Line of Railway.

60,000 cubic yards earth excavation, at 25 cents,	\$15,000	
35,000 cubic yards solid rock, at 1 dollar,	6,000	
Bridge under post road,	2,000	
Bridges over road to Peter's mill and Front row,	5,000	
2,000 lineal feet wharfing and bridging, at 30 dollars,	60,000	
Bridge over Buttermilk channel,	60,000	
Terminal wharves and floats,	30,000	
2 miles superstructure and sidings, at 8,000 dollars,	16,000—	\$253,000

On Eastern Side to Rankin's Wharf and Ferryboats.

3,500 lineal feet pile bridging and wharf, at 10 dollars,	35,000	
Superstructure on same,	6,000—	41,000
2 ferry-boats for carrying cars, at \$25,000 each,		50,000
		\$344,000

Estimate for Line by Carleton Shore to Sand Point and Ferry.

60,000 cubic yards earth excavation, at 25 cents,	\$15,000	
40,000 cubic yards solid rock, at 1 dollar,	40,000	
2,500 lineal feet of wharfing and bridging, at 20 dollars,	50,000	
Road bridges and culverts,	15,000	
2 miles of superstructure,	16,000	
Terminal wharves, &c.,	30,000—	\$166,000
Approaches on Eastern side, as by former estimate,		41,000
Ferry-boats, as before,		50,000
		\$257,000

Estimate for the Line by Negre Point to Navy Island, with Ferry to Rankin's Wharf.

50,000 cubic yards of rock excavation, at 1 dollar,	\$50,000	
130,000 cubic yards earth excavation, at 25 cents,	32,500—	\$82,500
Road crossing Manawagonish road,	200	
Road crossing Lancaster street,	400	
Road crossing Main street,	500—	1,200
Bridge over road to Sand Cove,	2,000	
3 over bridges, Queen and St. John streets,	4,500	
Under bridge, Rodney street,	2,500—	9,000
Culverts,		2,000

Forward,

<i>Forward,</i>	
Bridge over Buttermilk channel,	60,000
5 miles superstructure and sidings,	40,000
Wharfing, &c., on Navy Island,	30,000
	<u>\$224,700</u>

Deduct saved on construction of Main Line.

30,000 cubic yards earth excavation, at 25 cents,	\$7,500	
2,000 cubic yards rock excavation, at 1 dollar,	2,000	
164 cubic yards culvert masonry, at 4 dollars,	656	
7-10 miles of superstructure, at 8,000 dollars,	5,600—	15,756

\$208,944

Add for approaches on Eastern side of harbor and ferry-boats, 91,000

\$299,944*Estimate for a Line from Negro Point to Sand Point, and by Ferry.*

30,000 cubic yards of rock excavation, at 1 dollar,	\$30,000	
120,000 cubic yards of earth excavation, at 25 cents,	30,000—	\$60,000
Culverts,		1,500
Bridge for road to Sand Cove,		2,000
Crossing Manawagonish road,	300	
Crossing extension of Lancaster,	300—	600
Wharfing, &c., at Sand Point,		60,000
4 3-4 miles superstructure,		38,000

\$162,100*Deduct saved in construction on Main Line.*

30,000 cubic yards earth excavation, at 25 cents,	\$7,500	
2,000 cubic yards rock excavation, at 1 dollar,	2,000	
134 cubic yards culvert masonry,	656	
7 1-10 miles of superstructure,	5,600—	15,756

\$146,344

Add approaches on Eastern side, and ferry-boats, as before, 91,000

\$237,344

A considerable saving may be made in a line to deep water, by stopping the Carleton Shore line at or near Front Row, and making the level of the terminus or wharves about 20 feet above tide level, in which case the cost, with the necessary hoists for heavy freight, would probably not exceed \$100,000.

It may be remarked here that damage to property, unless borne by the districts respectively traversed, would form on some of the lines a considerable additional charge. The line through Portland will be the most expensive in that respect, while that by Negro Point to Sand Point will be very trifling.

In comparing the merits of a continuous line by bridge over the Falls and through Portland, with that through Carleton and by ferry, it must be remembered that a large additional expense will be continually incurred in running the ferry-boats. It admits of very little doubt but that this expense, and the loss of traffic from detention in transit of passengers and light freight, would much

60,000
40,000
30,000

224,700

more than meet the interest on the extra expense required for the construction of a bridge, so as to make the connection with the present railway complete.

Estimating, therefore, on a through line from the present railway to the American boundary, we have the following results:—

86½ miles from boundary of the State of Maine to Suspension Bridge, costing, as per estimate,	\$2,366,580
1 86-100 miles through Portland and over bridge at Falls, as per estimate,	351,200
88 6-10 miles,	<u>\$2,747,780</u>

15,756

208,944
91,000

299,944

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\$60,000
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By this estimate it appears the European and North American Railway can be extended to the American boundary, and fully equipped, for \$2,750,000, or a little over \$30,000 per mile. The cost of the New England roads average about \$44,000 per mile, and the present European and North American Railway nearly the same. The Grand Trunk cost about \$40,000, and the Nova Scotia railways about \$50,000, while both of these are inferior in character to the proposed line. After allowing an ample margin for additions usually made in rolling stock on all roads after completion, and which tend to swell the cost of those now in operation, the average of lines on this continent cannot be set down at much less than \$40,000 per mile.

To show that the difference in the cost of these, and the estimate for Western Extension, is not without reason, it is only necessary to mention a few particulars which tend largely to swell the cost of other roads, but, in this case, are either very small or unknown. Save that, on the first ten miles from the Suspension Bridge, the grading is very light, the country traversed after leaving the St. John river being mostly on the heads of those streams emptying into the Bay of Fundy, causes the amount of bridging to be uncommonly small, lakes and bogs, ordinarily requiring large sums in draining, filling, &c., are almost entirely avoided, and in case of connecting with the European and North American Railway, the outlay for terminal buildings (usually amounting to a large sum per mile,) will not be required.

By a reference to the tables, it will also be seen that the line presents many features highly favorable to its being operated at a moderate cost. The length of curved line is only 25 miles, or little over one-fourth of the whole distance, while but a very small portion of this curved line is on a less radius than 2,900 feet. Of heavy grades, only 14 miles are varying from 45 to 52 3-4 feet per mile, and, of this distance, 10½ miles descend Eastward, or toward St. John, a result of great importance with reference to the carrying capacity of the road, and in view of the heavy lumber traffic expected in this direction.

Deviations from Route Adopted.

Some deviations from the course adopted, and still within the requirements of a line *via* the Douglas Valley, being urged at different times, as possessing peculiar advantages, have occupied a portion of my attention, and require some notice here.

Route by South Side of Oromocto Lake.

First among these, I would refer to that, already noticed, up the North-West Branch of the Oromocto river, and by the South side of the Big Oromocto Lake, across the valley of the Maguaguadavic, and by Trout Brook to the St. Andrew's Railway.

It was ascertained during the course of the summer's work, that the level of

the water in the Maguaguadavic and Cheputneticook Lakes differed but little from that of those of the Oromocto and Kedron, and also, that the bed of the Maguaguadavic River fell at the rate of 15 feet per mile after leaving the lake. The distance on the course of the river to the point where it must be crossed by a line South of the Oromocto Lake, was known to be not less than ten miles, while from the shore of the lake it could not be more than three. The conclusions arrived at from this information was, that the obstacles in the way of getting a line in this direction were of a serious nature, but, in order to leave the matter as little doubtful as possible, Mr. Stewart was dispatched with a small party in January last, to traverse and level what was pointed out as being the most favorable ground accessible on both sides the Maguaguadavic.

This line, as also one run by J. Wilkinson, Esq., C. E., and another by Wm. Mahood, Esq., in 1860, are shown on the General Map, and profiles of each accompany the other drawings.

The result of this exploration is as follows:—The Maguaguadavic at this point of crossing is in a deep valley, 220 feet above tide level, while the lake is 371, and the table land on the West side of the valley 465. As the high ground on the South of the Oromocto Lake extends a considerable distance toward the river, it appears impossible to make the descent without two miles of maximum grade, and work of a very heavy nature. On the West side of the river the ascent may be accomplished by three and half miles of the same grade, and with less expensive works than was at first supposed, but still the distance will be longer and the cost greater than on the adopted line. It has been proposed to carry the line farther toward the South, below the Kedron Lakes, and although by thus increasing the distance the valley of the Maguaguadavic is reached with easier work, yet it is heavier and the grades are steeper in leaving it and gaining the elevation of the high ground to the Westward than would be desirable. In fact, all the information I have been able to gather respecting this country, leads unavoidably to the conclusion that no line can be found here without sacrificing something, either in distance, works, or grades, and this without furnishing any corresponding benefit in traffic.

Spruce Lake Route.

Another deviation from the adopted line has been proposed near St. John. Leaving the Suspension Bridge, and following nearly the course of the St. Andrew's road four miles, it then turns to the right of Spruce Lake, and following the right shore of Menzie's Lake, passing between Belvidere and Nelson Lakes, and to the right of Loch Alva, it joins the adopted line a little below Eagle Rock on the Nerepis, and near the entrance to the Douglas Valley. This line was explored by parties for A. C. Morton, Esq., C. E., in 1853, with a view to avoid the expensive rock cutting and tunnelling on the line following the shore of Grand Bay. By a profile of their survey, which is in my hands, it appears this line would be nearly two miles longer, and though some of the work is not expensive, yet to ascend the high grounds to the North of Spruce Lake, and again make the descent to the valley of the Nerepis, would require steeper grades and more expensive works than any on the adopted line. As this exploration was hasty, and, no doubt, susceptible of improvement, it was at first my intention to have examined this district, with a view to finding a less expensive line than by the river, but having succeeded in avoiding the necessity for tunnelling, and having obtained a line which presents no excessively heavy work, and has more favorable grades than could be hoped for on the Spruce Lake route, I did not consider myself justified in expending the time and money required for its thorough exploration, while the necessity of devoting all the remaining portion of the season fit for such work, to the survey of the Fred-erickton branch, would have prevented my doing so, had it been deemed advisable.

FREDERICTON BRANCH.

The survey of this line, made in the months of November and December, 1864, and January, 1865, leaving the main line at the crossing of the North-West Branch of the Oromocto, skirts along between the high ground and freshet level until after passing the Rushagonis River, $10\frac{1}{2}$ miles from Hartt's Mills, thence rises to a summit 105 feet above tide level at Baker's Brook; crossing which it descends with a grade of 53 feet per mile for 5,000 feet, and through a very easy and level country reaches Mill Stream, near its head, and following its left bank on a nearly straight line, with light works, and (with the exception of 3,000 feet of the maximum,) easy grades, approaches the St. John River near Morrison's Mills, and thence, with very easy work and nearly a straight line, enters the town at the rear of the principal streets, and doing little damage to property.

By making the terminus at Odell's Grove, the whole distance is $21\frac{1}{2}$ miles from Hartt's Mills, which is considerably shorter than the travelled road, and the nearest approach to an air line that I think will be found practicable.

The line was extended to the grounds of the Agricultural Society, which, though adding very little to the cost of the line, is nearly one-half mile longer.

The ground in Fredericton, and its immediate vicinity, is so favorable for railway construction that there will be no difficulty in taking the line to any point in it that the necessities of trade, or the interests of the community, may desire.

Of the characteristic features of the work there is very little to be said. As will be seen by reference to the tables appended, the curvature and gradients are both favorable, while the works are more than ordinarily light. An iron bridge of 100 feet span is proposed over the Rushagonis, which, with three small bridges at other points, will cover all demands for that class of work.

This line traversing nearly its entire length through barrens and unimproved land, damages to property, except in the vicinity of Fredericton, will be light.

The following estimate, based upon the requirements of the same class of road as the main line, shows that it can be constructed for \$495,357, or about \$22,000 per mile.

Estimate of Cost of Fredericton Branch Line.

20 miles of clearing, at 200 dollars,	\$4,000	
$21\frac{1}{2}$ miles of fencing, at 700 dollars,	15,050—	\$19,050
397,840 cubic yards earth excavation, at 25 cents,	99,460	
5,000 cubic yards rock excavation, at 1 dollar,	5,000—	104,460
<i>Masonry.</i>		
472 cubic yards masonry in crumb rubble, at 8 dollars,	3,776	
635 cubic yards masonry in dry rubble, at 6 dollars,	3,810	
2,300 cubic yards masonry, culverts, at 4 dollars,	9,200—	16,786
45 tons iron girder, Rushagonis, at 150 dollars,		6,750
$21\frac{1}{2}$ miles superstructure, at 8,000 dollars,	174,000	
5 per cent. for sidings,	8,700—	182,700
Rolling stock, at 8,000 dollars,		88,000
Stations,		8,000
Land damages,		5,000
		<hr/>
		\$430,746
Superintendence and contingencies, 15 per cent.,		64,611
		<hr/>
		\$495,357

E. R. BURPEE.

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APPENDIX.

Estimate for Railway Suspension Bridge, 620 Feet Span, over St. John River at Falls.

1100 cubic yards masonry in towers, at 20 dollars,	\$22,000	
1,500 cubic yards masonry in abutments and anchorages, at 12 dollars,	18,000—	\$40,000

Cables and Suspenders.

12,000 strands No. 10 wire, 1,000 feet long, 600,000 lbs., at 15 cents,	90,000	
20,000 lbs. wrapping wire, at 20 cents,	4,000	
24,000 lbs. wrought iron in suspenders, at 12 cents,	2,880—	96,880

Saddleplates and Anchorage.

25 tons cast iron, at 80 dollars,	2,000	
30,200 lbs. anchorage chains, at 12 cents,	3,624—	5,624
600 lineal feet truss, at 20 dollars,	12,000	
4,800 cubic feet timber in floor girders, at 60 cents,	2,880	
Flooring,	4,000	
Stays and painting,	2,000—	20,880
Excavation for towers, anchorage, &c.,		2,000

Add contingencies,

\$165,384
16,538

\$181,922

Estimate for Tubular Girder Bridge across St. John River, 500 Feet Span.

2,700 cubic yards masonry, at 20 dollars,	\$54,000
1,500 tons iron work in girder, at 150 dollars,	225,000
Suspension staging, say,	182,000
	<u>\$461,000</u>

TABLE OF ALIGNMENT FROM THE SUSPENSION BRIDGE TO THE AMERICAN BOUNDARY.

Distance from Suspen- sion Bridge Line, in feet.	Length of Straight Line, in feet.	Magnetic Course.	LENGTH OF EACH CLASS OF CURVE.										Whole No. of Degrees in Curve.	REMARKS.		
			Curves under 1°.	1° Curve,		1½° Curve,		2° Curve,		2½° Curve,		3° Curve,				
				Radius 5730 feet.	FEET.	Radius 3820 feet.	FEET.	Radius 2865 feet.	FEET.	Radius 2232 feet.	FEET.	Radius 1910 feet.			FEET.	
																Radius 1435 feet.	FEET.
900													27°			
1450	550	N. 82° W.											900		34.15	
2600													1150			
3500	900	N. 47½° W.														
5484														1984		59.30
6800	1316	S. 73° W.														
8000										1200						24
8900	900	N. 83° W.														
9900														1000		30
10250	350	S. 67° W.														
11350														1100		33
12600	1250	N. 80° W.				1½°										
14600						2000										25
15900	1300	N. 55° W.														
17600																
19350	1750	N. 12½° W.									1700					42.30
20350														1000		30
25100	4750	N. 17° E.														
27175										2075						41.30
28350	1175	N. 25° W.														
29050						700										7
31000	1950	N. 32° W.														
33170														2170		65
34000	830	S. 83° W.														
35800																
37500														1800		54
40370	2870	N. 10½° E.													1700	59.30

APPENDIX.

III.

[illegible]

TABLE OF ALIGNMENT FROM THE SUSPENSION BRIDGE TO THE AMERICAN BOUNDARY.—CONTINUED.

Distance from Suspension Bridge in feet.	Length of Straight Line in Feet.	Magnetic Course.	LENGTH OF EACH CLASS OF CURVE.							Whole No. of Degrees in Curve.	REMARKS.
			Curves under 1°.	1° Curve, Radius 5730 feet.	1½° Curve, Radius 3820 feet.	2° Curve, Radius 2865 feet.	2½° Curve, Radius 2332 feet.	3° Curve, Radius 1910 feet.	3½° Curve, Radius 1435 feet.		
			FEET.	FEET.	FEET.	FEET.	FEET.	FEET.	FEET.		
92350			....	1450	....	....	....	....	14.30	
93000	650	N. 32½° W.	....	....	....	....	....	....	150	
93633			....	....	....	....	....	633		
65375	1742	N. 4½° W.	....	....	....	....	....	....	25.30	
96650			....	....	....	1275	....	....	
98040	1390	N. 21° E.	....	....	....	....	....	....	22	
98770			....	....	....	....	....	730		
99550	780	N. 43° E.	....	....	....	....	....	....	30	
100550			....	....	....	....	....	1000		
100625	75	N. 13° E.	....	....	....	....	....	666	20	
101291			....	....	....	....	....	....	69	
101600	309	N. 33° E.	....	....	....	....	....	2300	14	
103900			....	....	....	....	....	....	8.35	
108700	4800	N. 36° W.	....	....	933	....	....	....	3.30	
109633			....	....	....	....	....	....	21	
113522	3889	N. 22° W.	....	....	....	....	....	....	23	
114380			....	858	....	....	....	....	13	
120350	5970	N. 30½° W.	....	350	....	....	....	....	81	
120700			....	....	....	....	....	....
127900	7200	N. 34° W.	....	....	....	....	....	700		
128600			....	....	....	....	....	....
129300	700	N. 13° W.	....	....	....	....	....	773		
130073			....	....	....	....	....	....
131200	1127	N. 36° W.	....	....	....	....	....	433		
131633			....	....	....	....	....	....
132000	367	N. 23° W.	....	....	....	....	....	....
135240			....	....	....	....	3240	....		

APPENDIX.

V.

[illegible]

TABLE OF ALIGNMENT FROM THE SUSPENSION BRIDGE TO THE AMERICAN BOUNDARY.—CONTINUED.

Distance from Suspension Bridge in feet.	Length of Straight Line, in Feet.	Magnetic Course.	LENGTH OF EACH CLASS OF CURVE.								Whole No. of Degrees in Curve.	REMARKS.
			Curves under 1°.	1° Curve, Radius 5730 feet.	1½° Curve, Radius 3820 feet.	2° Curve, Radius 2865 feet.	2½° Curve, Radius 2292 feet.	3° Curve, Radius 1910 feet.	3½° Curve, Radius 1637 feet.			
			FEET.	FEET.	FEET.	FEET.	FEET.	FEET.	FEET.			
279000	12900	N. 69 W.	....	1100	....	....	....	....	....	11	
280100	15700	N. 80 W.	....	....	....	....	....	....	....	6	
295800			....	600	....	....	....	....	....
296400			....	....	....	....	....	....	....	38	
298000	1600	N. 74 W.	....	3800	....	....	....	....	....
301800			....	....	....	....	....	....	....	15.30	
321975	20175	N. 36 W.	....	1550	....	....	....	....	....	36	
323525			....	....	....	....	....	....	....
326050	2525	N. 51½ W.	....	....	....	....	....	....	....
327250			....	....	....	....	....	....	....	32	
329720	2470	N. 15½ W.	....	....	....	....	....	....	....	42	
332200			....	....	....	....	....	....	....
333400			....	....	....	....	....	....	....	24.50	
333598	198	S. 60 W.	....	....	....	....	....	....	....
334585			....	....	....	....	....	....	....	6.45	
3369225	34640	S. 84½ W.	....	....	....	....	....	....	....
3369900			....	675	....	....	....	....	....	28.30	
380500	10600	N. 88½ W.	....	....	....	....	....	....	....
383350			....	2850	....	....	....	....	....	8	
412406	29050	S. 63 W.	....	....	....	....	....	....	....
413200			....	800	....	....	....	....	....	34	
423000	9800	S. 71 W.	....	....	....	....	....	....	....
426400			....	3400	....	....	....	....	....	12	
428800	2400	S. 39 W.	....	....	....	....	....	....	....
429400			....	....	....	....	....	....	....
429950	550	S. 49 W.	....	....	....	....	....	....	....	29	
431400			....	....	....	....	....	....	....

APPENDIX.

VII.

426400	2400	S. 39 W.	3400	600	1450	3000	3400	3800	4200	4600	5000	5400	5800	6200	6600	7000	7400	7800	8200	8600	9000	9400	9800	10200	10600	11000	11400	11800	12200	12600	13000	13400	13800	14200	14600	15000	15400	15800	16200	16600	17000	17400	17800	18200	18600	19000	19400	19800	20200	20600	21000	21400	21800	22200	22600	23000	23400	23800	24200	24600	25000	25400	25800	26200	26600	27000	27400	27800	28200	28600	29000	29400	29800	30200	30600	31000	31400	31800	32200	32600	33000	33400	33800	34200	34600	35000	35400	35800	36200	36600	37000	37400	37800	38200	38600	39000	39400	39800	40200	40600	41000	41400	41800	42200	42600	43000	43400	43800	44200	44600	45000	45400	45800	46200	46600	47000	47400	47800	48200	48600	49000	49400	49800	50200	50600	51000	51400	51800	52200	52600	53000	53400	53800	54200	54600	55000	55400	55800	56200	56600	57000	57400	57800	58200	58600	59000	59400	59800	60200	60600	61000	61400	61800	62200	62600	63000	63400	63800	64200	64600	65000	65400	65800	66200	66600	67000	67400	67800	68200	68600	69000	69400	69800	70200	70600	71000	71400	71800	72200	72600	73000	73400	73800	74200	74600	75000	75400	75800	76200	76600	77000	77400	77800	78200	78600	79000	79400	79800	80200	80600	81000	81400	81800	82200	82600	83000	83400	83800	84200	84600	85000	85400	85800	86200	86600	87000	87400	87800	88200	88600	89000	89400	89800	90200	90600	91000	91400	91800	92200	92600	93000	93400	93800	94200	94600	95000	95400	95800	96200	96600	97000	97400	97800	98200	98600	99000	99400	99800	100200	100600	101000	101400	101800	102200	102600	103000	103400	103800	104200	104600	105000	105400	105800	106200	106600	107000	107400	107800	108200	108600	109000	109400	109800	110200	110600	111000	111400	111800	112200	112600	113000	113400	113800	114200	114600	115000	115400	115800	116200	116600	117000	117400	117800	118200	118600	119000	119400	119800	120200	120600	121000	121400	121800	122200	122600	123000	123400	123800	124200	124600	125000	125400	125800	126200	126600	127000	127400	127800	128200	128600	129000	129400	129800	130200	130600	131000	131400	131800	132200	132600	133000	133400	133800	134200	134600	135000	135400	135800	136200	136600	137000	137400	137800	138200	138600	139000	139400	139800	140200	140600	141000	141400	141800	142200	142600	143000	143400	143800	144200	144600	145000	145400	145800	146200	146600	147000	147400	147800	148200	148600	149000	149400	149800	150200	150600	151000	151400	151800	152200	152600	153000	153400	153800	154200	154600	155000	155400	155800	156200	156600	157000	157400	157800	158200	158600	159000	159400	159800	160200	160600	161000	161400	161800	162200	162600	163000	163400	163800	164200	164600	165000	165400	165800	166200	166600	167000	167400	167800	168200	168600	169000	169400	169800	170200	170600	171000	171400	171800	172200	172600	173000	173400	173800	174200	174600	175000	175400	175800	176200	176600	177000	177400	177800	178200	178600	179000	179400	179800	180200	180600	181000	181400	181800	182200	182600	183000	183400	183800	184200	184600	185000	185400	185800	186200	186600	187000	187400	187800	188200	188600	189000	189400	189800	190200	190600	191000	191400	191800	192200	192600	193000	193400	193800	194200	194600	195000	195400	195800	196200	196600	197000	197400	197800	198200	198600	199000	199400	199800	200200	200600	201000	201400	201800	202200	202600	203000	203400	203800	204200	204600	205000	205400	205800	206200	206600	207000	207400	207800	208200	208600	209000	209400	209800	210200	210600	211000	211400	211800	212200	212600	213000	213400	213800	214200	214600	215000	215400	215800	216200	216600	217000	217400	217800	218200	218600	219000	219400	219800	220200	220600	221000	221400	221800	222200	222600	223000	223400	223800	224200	224600	225000	225400	225800	226200	226600	227000	227400	227800	228200	228600	229000	229400	229800	230200	230600	231000	231400	231800	232200	232600	233000	233400	233800	234200	234600	235000	235400	235800	236200	236600	237000	237400	237800	238200	238600	239000	239400	239800	240200	240600	241000	241400	241800	242200	242600	243000	243400	243800	244200	244600	245000	245400	245800	246200	246600	247000	247400	247800	248200	248600	249000	249400	249800	250200	250600	251000	251400	251800	252200	252600	253000	253400	253800	254200	254600	255000	255400	255800	256200	256600	257000	257400	257800	258200	258600	259000	259400	259800	260200	260600	261000	261400	261800	262200	262600	263000	263400	263800	264200	264600	265000	265400	265800	266200	266600	267000	267400	267800	268200	268600	269000	269400	269800	270200	270600	271000	271400	271800	272200	272600	273000	273400	273800	274200	274600	275000	275400	275800	276200	276600	277000	277400	277800	278200	278600	279000	279400	279800	280200	280600	281000	281400	281800	282200	282600	283000	283400	283800	284200	284600	285000	285400	285800	286200	286600	287000	287400	287800	288200	288600	289000	289400	289800	290200	290600	291000	291400	291800	292200	292600	293000	293400	293800	294200	294600	295000	295400	295800	296200	296600	297000	297400	297800	298200	298600	299000	299400	299800	300200	300600	301000	301400	301800	302200	3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TABLE OF GRADIENTS ON THE MAIN LINE FROM SUSPENSION BRIDGE TO THE AMERICAN BOUNDARY.

Distance from Suspension B	Length of Grade.	Inclination per 100 Feet.	Inclination per Mile.	Rise in Feet.	Fall in Feet.	Height above Datum.	REMARKS.
0						100.00	Suspension Bridge
200	200	Level.				100.00	
3300	3100	0.50	26.40	15.50		115.50	
3500	200	Level.				115.50	
5700	2200	0.43	22.70		9.50	106.00	
7100	1400	Level.				106.00	
11600	4500	0.80	42.24		36.00	70.00	
13500	1900	Level.				70.00	
16300	2800	0.70	36.96		19.60	50.40	Sutton's Mills.
17600	1300	Level.				50.40	
19200	1600	0.40	21.12		6.40	44.00	
21000	1800	Level.				44.00	
27500	6500	0.70	36.96	45.50		89.50	
27700	200	Level.				89.50	
31700	4000	0.90	47.52	36.00		125.50	
31900	200	Level.				125.50	
36400	4500	0.90	47.52		40.50	85.00	
37000	600	Level.				85.00	
38823	1823	0.85	44.88		15.50	69.50	
43900	5077	Level.				69.50	
48700	4800	0.85	44.88	40.80		110.30	
49000	300	Level.				110.30	Brandy Point.
54600	5600	0.85	44.88		47.60	62.70	
54900	300	Level.				62.70	
56850	1950	0.22	11.61	4.30		67.00	
60400	3550	0.62	32.75		22.00	45.00	
61800	1400	Level.				45.00	Brundage's Point.
63000	1200	0.50	26.40		6.00	39.00	
69000	6000	Level.				39.00	Belyea's
74000	5000	0.20	10.56		10.00	29.00	
74700	700	Level.				29.00	
79700	5000	0.22	11.61	11.00		40.00	
80600	900	Level.				40.00	
82200	1600	0.50	26.40		8.00	32.00	
98000	13000	0.20	10.56	26.00		58.00	
103000	5000	0.74	39.07	37.00		95.00	Eagle Rock.
104500	1500	Level.				95.00	
107966	3466	0.75	39.60		26.00	69.00	Bavard's.
110000	2034	Level.				69.00	
114400	4400	0.60	31.68	26.40		95.40	
119800	5400	Level.				95.40	
121000	1200	0.20	10.56		2.40	93.00	
123860	2860	Level.				93.00	
134100	10240	0.85	44.88	87.00		180.00	
135700	1600	Level.				180.00	
137700	2000	0.60	31.68	13.00		193.00	
137900	200	Level.				193.00	Summit between Douglas
146300	8400	0.50	26.40		42.00	151.00	Stream and Oromocto.

APPENDIX.

IX.

TABLE OF GRADIENTS ON THE MAIN LINE FROM SUSPENSION BRIDGE TO THE AMERICAN BOUNDARY.—CONTINUED.

Distance from Suspension Bridge	Length of Grade.	Inclination per 100 Feet	Inclination per Mile.	Rise in Feet.	Fall in Feet.	Height above Datum.	REMARKS.
147000	700	Level.				151.00	
150000	3000	0.20	10.56		6.00	145.00	
152700	2700	Level.				145.00	Gaspercaux. Lake.
158700	6000	0.10	5.28	6.00		151.00	
159400	700	Level.				151.00	
163590	4190	0.55	29.00		23.00	128.00	
166800	3210	Level.				74.00	
179657	12857	0.42	22.17		54.00	74.00	
182600	2943	Level.				57.00	
186000	3400	0.50	26.00		17.00	57.00	
190200	4200	Level.				80.00	
193600	3400	0.675	35.64	23.00		80.00	
194100	500	Level.				58.00	
199100	5000	0.44	23.23		22.00	58.00	
199300	200	Level.				32.00	
202470	3170	0.82	43.29		26.00	32.00	S. Branch Oromocto River.
205880	3410	Level.				45.00	
213100	7220	0.18	9.504	13.00		45.00	
217200	4100	0.75	39.60	30.57		75.75	
219600	2400	Level.				75.75	
221500	1900	0.45	23.76		8.55	67.20	
222000	500	Level.				67.20	Hartt's Mills.
226584	4584	0.65	34.32	29.80		97.00	
235154	8570	Level.				97.00	
239000	3846	0.65	34.32	25.00		122.00	
242600	3600	Level.				122.00	Tracey's.
247420	4890	0.90	47.52	44.00		166.00	
248500	1010	Level.				166.00	
251833	3333	0.60	31.68		20.00	146.00	
253000	1167	Level.				146.00	
259000	6000	0.75	39.60	45.00		191.00	
260900	1900	Level.				191.00	
263900	3000	0.30	15.84	9.00		200.00	
277400	13500	1.00	52.80	135.00		335.00	
282476	5076	Level.				335.00	Yoho.
294200	11724	0.95	50.16	111.40		446.40	
295200	1000	Level.				446.40	
297200	2000	0.68	35.90	13.60		460.00	
298600	1400	Level.				460.00	
302600	4000	0.875	46.20		35.00	424.00	
304000	1400	Level.				425.00	
307200	3200	0.75	39.60		24.00	401.00	
308400	1200	Level.				401.00	Lyons' Stream.
310200	1800	0.50	26.40	9.00		410.00	
310400	200	Level.				410.00	
314400	4000	0.20	10.56		8.00	402.00	
316200	1800	Level.				402.00	
320000	3800	0.50	26.40	19.00		421.00	

TABLE OF GRADIENTS ON THE MAIN LINE FROM SUSPENSION BRIDGE TO THE AMERICAN BOUNDARY.—CONTINUED.

Distance from Suspension B.	Length of Grade.	Inclination per 100 feet.	Inclination per Mile.	Rise in Feet.	Fall in Feet.	Height above Datum.	REMARKS.
321300	1300	0.31	16.36	4.00		425.00	
329412	8112	0.90	47.52	73.00		498.00	Harvey Settlement Road.
334900	5488	Level.				498.00	
339400	4500	0.38	20.06	17.10		515.10	
348100	8700	0.47	24.82		40.90	474.20	
350800	2700	0.60	31.68		16.20	458.00	
352000	1200	Level.				458.00	N. E. Maguaguadavic.
355385	3385	0.65	34.32	22.00		480.00	
358500	3115	Level.				480.00	
362500	4000	0.85	44.88		34.00	446.00	
365600	3100	Level.				446.00	
367900	2300	0.65	34.32	15.50		461.00	
368000	100	Level.				461.00	
373000	5000	0.90	47.52		45.00	416.00	
373300	300	Level.				416.00	Maguaguadavic River.
376000	2700	0.90	47.52	24.30		440.30	
376200	200	Level.				440.30	
379233	3033	1.00	52.80		30.30	410.00	
379800	567	Level.				410.00	
380800	1000	0.55	29.04	5.50		415.50	
381100	300	Level.				415.50	
383400	2300	0.50	26.40		11.50	404.00	
387900	4500	Level.				404.00	Mink Brook.
389900	2000	0.85	44.88	17.00		421.00	
390800	900	Level.				421.00	
391800	1000	0.60	31.68		6.00	415.00	
395200	3400	Level.				415.00	
396200	1000	0.40	21.12	4.00		419.00	
401300	5100	Level.				419.00	
408000	6700	0.18	9.50	12.06		431.06	
411105	3105	0.90	47.52	27.94		459.00	
417000	5897	Level.				459.00	
419400	2400	0.50	26.40		12.00	447.00	
420500	1100	Level.				447.00	
423800	3300	0.85	44.88	28.00		475.00	
424200	400	Level.				475.00	
426800	2600	0.50	26.40		13.00	462.00	St. Andrews Railway.
428300	1700	Level.				462.00	
435200	6700	1.00	52.80	67.00		529.00	
435400	200	Level.				529.00	
439733	4333	0.50	31.68		26.00	503.00	
442200	2467	Level.				503.00	
444500	2300	0.78	41.18		18.00	485.00	
449000	4500	Level.				485.00	
454500	5500	0.95	50.60		52.25	432.75	
456100	1600	Level.				432.75	
458400	2300	1.00	52.80		23.00	409.75	St. Croix.

TABLE OF ALIGNMENT OF FREDERICTON BRANCH RAILWAY.

Distance from Suspension Bridge in feet.	Length of Straight Line in Feet.	Magnetic Course.	LENGTH OF EACH CLASS OF CURVE.							Whole No. of Degrees in Curve.	REMARKS.						
			Curves under 1°.	1° Curve, Radius 5730 feet.	1½° Curve, Radius 3820 feet.	2° Curve, Radius 2865 feet.	2½° Curve, Radius 2292 feet.	3° Curve, Radius 1910 feet.	3½° Curve, Radius 1437 feet.								
												FEET.	FEET.	FEET.	FEET.	FEET.	FEET.
2400			....	....	....	....	....	2400	....	72	
6300	3900	N. 54 E.	....	....	....	....	....	....	....	17.30	
7175			....	....	....	875	....	....	....					
12150	4975	N. 36½ E.	....	....	....	....	....	....	....	12	
13420			....	....	1270	....	....	....	....				
14700	1280	N. 55½ E.	....	....	....	....	....	....	....	35.30	
16475			....	....	....	1775	....	....	....					
29500	13025	N. 20 E.	....	....	....	....	....	....	....	27	
30850			....	....	....	1350	....	....	....					
32200	1350	N. 47 E.	....	....	....	....	....	....	....	25.30	
33475			....	....	....	1275	....	....	....					
33775	300	N. 21½ E.	....	....	....	....	....	....	....	26.30	
35100			....	....	....	1325	....	....	....					
37766	2666	N. 48 E.	....	....	2100	....	....	....	....	31.30	
39866			....	....	....	....	....	....	....	
67160	27294	N. 16½ E.	....	....	....	....	....	....	....	13.30	
67840			....	....	....	680	....	....	....					
74700	6860	N. 3 E.	....	....	....	....	....	....	....	42	
76800			....	....	....	2100	....	....	....					
78466	1666	N. 45 E.	....	....	....	....	....	2900	....	87	
81366			....	....	....	....	....	....	....	
81616	250	N. 42 W.	....	....	....	....	....	1900	....	57	
83516			....	....	....	....	....	....	....	
86250	2734	N. 15 E.	....	....	....	....	....	....	....	20.30	
87275			....	....	....	1025	....	....	....					
105600	18325	N. 5.30 W.	....	....	....	....	....	....	....	15	
106350			....	....	....	750	....	....	....					

TABLE OF ALIGNMENT OF FREDERICTON BRANCH RAILWAY.—CONTINUED.

Distance from Suspen- sion Bridge in feet.	Length of Straight Line in feet.	Magnetic Course.	LENGTH OF EACH CLASS OF CURVES.								Whole No. of Degrees in Curve.	REMARKS.
			Curves under 1°.	1° Curve, Radius 5730 feet.	1½° Curve Radius 3820 feet.	2° Curve, Radius 2865 feet.	2½° Curve, Radius 2292 feet.	3° Curve, Radius 1910 feet.	3½° Curve, Radius 1637 feet.			
										FEET.		
106800			....	....	....	450	....	....	....	9	
113300	6500	N. 11½ W.	....	....	....	1300	....	....	....	26	
114600			....	....	....		....	....	....
115600	1000	37½ W.	....	....	....		....	....	....
Total,	92125				3370	12905			7200			

APPENDIX.

XIII.

TABLE OF GRADIENTS ON THE FREDERICTON BRANCH RAILWAY, FROM HARTT'S MILLS TO FREDERICTON.

Distance from Junction.	Length of Grade.	Inclination per 100 Feet.	Inclination per Mile.	Rise in Feet.	Fall in Feet.	Height above Datum.	REMARKS.
0						70.00	Hartt's Mills.
1000	1000	0.50	26.40	5.00		75.00	
8400	7400	0.50	26.40		37.00	38.00	
17300	8900	Level.				38.00	
18500	1200	0.33	17.42	4.00		42.00	
18900	400	Level.				42.00	
22025	3125	0.16	8.448		5.00	37.00	
26200	4175	Level.				37.00	
28200	2000	0.40	21.12	8.00		45.00	
28400	200	Level.				45.00	
29400	1000	0.70	36.96		7.00	38.00	
30000	600	Level.				38.00	
31000	1000	0.70	36.96	7.00		45.00	
31200	200	Level.				45.00	
32200	1000	0.70	36.96		7.00	38.00	
44300	12100	Level.				38.00	
44700	400	0.25	13.20		1.0	37.00	
49800	5100	Level.				37.00	
50400	600	0.50	26.40	3.00		40.00	
55500	5100	Level.				40.00	Rushagonis.
56500	1000	0.50	26.40	5.00		45.00	
60150	3650	Level.				45.00	
64000	3850	0.675	35.64	26.00		71.00	
67700	3700	1.00	52.80	37.00		108.00	
71700	4000	Level.				108.00	
73300	1600	0.845	44.61	13.50		121.50	
78300	5000	Level.				121.50	
79740	1440	0.80	42.24	11.50		133.00	
80000	260	Level.				133.00	Summit Cutting.
85100	5100	1.00	52.80		51.00	82.00	
85400	300	Level.				82.00	
89000	3600	0.72	38.00	26.00		108.00	
89200	200	Level.				108.00	
91000	1800	0.50	26.40		9.00	99.00	
93200	2200	Level.				99.00	
96400	3200	0.74	39.07	23.70		122.70	
100300	3370	1.00	52.80		33.70	89.00	
103600	3300	0.1325	7.00		4.40	84.60	
110900	7300	0.575	30.44		42.00	42.60	Fredericton.
114100	3200	0.144	7.60			47.20	

ABSTRACT OF GRADES ON MAIN LINE.

	Falling Eastward in Feet.	Falling Westward in Feet.	Total in Feet.
Level.			134939
From 0 to 10 feet per mile.	12700	7220	37727
" 10 " 20 " "	24250	13200	37450
" 20 " 30 " "	28357	35190	73547
" 30 " 40 " "	40015	31882	71897
" 40 " 45 " "	23510	22223	45733
" 45 " 52.80 " "	34531	15000	49531
of 52.80 " "	20200	5333	25533
	193,563	130,048	458,550

ABSTRACT OF GRADES, FREDERICTON BRANCH.

	Falling Eastward in Feet.	Falling Westward in Feet.	Total in Feet.
Level.			52915
From 0 to 10 feet per mile.	3200	6425	9625
" 10 " 20 " "	1200	400	1600
" 20 " 30 " "	4600	7400	12000
" 30 " 40 " "	11650	11100	22750
" 40 " 45 " "	1600	1440	3040
of 52.80 " "	3700	8470	12170
	25,950	35,235	114,100

Total
Feet.

4939
7727
7450
3547
1897
5733
9531
5533

,550

Total
Feet.

2915
0625
1600
2000
2750
8040
2170

,100

