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ALFRED GREENFIELD, Provincial Secretary.

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Superintendent's Office,
Nelson, 21st April, 1868.

THE SUPERINTENDENT directs the publication of the following Report for general information.

ALFRED GREENFIELD,
Provincial Secretary.

RAILWAY FROM NELSON TO THE WEST COAST.

REPORT UPON THE BEST LINE FOR A RAILWAY BETWEEN NELSON AND COBDEN, WITH A BRANCH TO WESTPORT; AND UPON THE PROBABLE COST OF CONSTRUCTING THE SAME.

To His Honour OSWALD CURTIS, Superintendent of Nelson Province.

Cause of delay in Report.

SIR,—The extraordinary weather which prevailed in the Buller and Grey districts from September of last year, to the middle of January, of the present year, so interrupted my examination of those districts, and so debarred the progress of my party, as to lead to my being detained in the field very much longer than I anticipated.

2. Unfortunate as this detention has been in many ways besides that of its cost, it is, on the whole, not to be regretted, for it has enabled me to see the country under the most unfavourable circumstances, and has shown me by the most unerring of all guides, the proper levels to be adopted, viz., that of seeing the highest known floods of the chief rivers of the district. Highest known Floods seen.

3. The heavy floods which have occurred repeatedly in the Rivers Buller and Grey, and their tributaries, during my passage through the interior of the country, will have a highly important bearing upon the general elevation which the line of the proposed railway should have over the ordinary water line of those rivers, and also upon the character of the bridge structures best calculated to successfully resist the action of similar floods; and, consequently, these considerations will have a material effect on the gross cost of a line of railway that will be safe and secure from damage by floods under all circumstances. High Floods regulate general level of line.

4. Had I not seen these floods, I could not have credited any description of their heights and localities, and I should have probably fallen into the error of recommending works at unsuitable levels, and so, perhaps, have been instrumental to the expenditure of a large sum of money in a fruitless effort to secure permanency to works, the evils of which no reasonable amount of after expenditure could have corrected. I am, therefore, glad that I Floods point out true level for railway.

have seen these floods, for I have secured a full knowledge of their heights and effects which free me from the chance of making any serious errors in reference thereto.

Knowledge of floods adds to estimated cost.

5. I may, however, say that this knowledge will add to the amount of my estimate of the cost of the works. At the same time, I may observe that I am so fully impressed with the grave responsibility of the task which your Government has done me the honour to place in my hands, that I shall endeavour to approach the estimates with the greatest care, and submit to your Honour as truthful a representation of the character of the country to be dealt with, and the probable cost of the undertaking, as the nature of a preliminary survey will permit.

Without sections, Estimates speculative.

6. But it must be borne in mind, that without absolute sections before you, all estimates must be in some degree speculative and uncertain; and though the utmost care may be taken by the most practical Engineer, without plans and sections before him he may fall into errors. Hence it is that I have urged your Honour's Government to prepare detailed plans and sections, so that estimates of the probable cost of the works might be deprived, as much as possible, of uncertainty.

Necessity of detailed Survey.

7. Having failed to convince you that such an expense was necessary, I have found it my duty to substitute what may be called a sketch map of the country, exhibiting the general direction of several routes, the curves that are likely to be obtained, and the special works that will in all probability be found necessary.

Sketch Maps of Line substituted for Survey.

8. In no other way could I conveniently endeavour to convey to capitalists in England, the general character of the works they would be called upon to execute, as by a "sketch map." I do not, by any means, wish you to think that such a document is certain of being considered satisfactory, for it can only convey a sketch of the *probable* position of the line, and the works necessary. It does, in fact, represent my *opinion*; whereas a survey and section might show other results, somewhat at variance with my opinion.

Endeavors to avoid errors in Estimates.

9. Having laid before your Honour the possibility of errors arising in estimates based upon imperfect data, and the delay that may arise in negotiating for its construction, in the absence of accurate surveys and levels, I have endeavoured to apply myself, so as to reduce these risks to a minimum; and with this view the Chief Surveyor's department has prepared copies of such existing surveys of the districts through which the several routes pass as I required, upon which I have laid down, from sketches made in the field, the direction curves and other information referring to the proposed works, none of which could be conveniently or so well described in this report.

Four Sketch Maps made.

10. Four sets of *sketch maps* have been prepared. One on a small scale, shewing the direction of several routes which have been examined. A second on a larger scale, shews a route from Nelson to Cobden, *via* the Big Bush and the valley of the River Inangahua. A third, shewing an alternate line branching at the River Matakitaiki, *via* the Maruia Plains, and forming a junction with the first route at the meeting of the Upper and Little Grey Rivers. A fourth shews the branch to Westport, commencing at the River Inangahua, and descending the valley of the Buller River to Westport. These *sketch maps*, in the absence of plans and sections, will convey to the eye some idea of the nature of the country through which the line may pass, the nature of the excavations that may be necessary, and the chief works required.

11. Before determining upon the general direction of a line of railway, it is necessary that three material points should be kept in view. These points are—

Points in determining upon a Line.

- A.—To have the line as direct between the termini as possible, consistent with proper gradients.
- B.—To adopt the least expensive line.
- C.—To secure the special objects for which the line is projected.

Now these points for consideration are frequently inconsistent with each other, and must be abandoned; for, on referring to the index map (A), it will be observed by the black dotted right line from Nelson to Cobden, that the most direct practical line would be the one indicated by the red line as far as Fox-hill, and thence through Spooner's range, *via* the valleys of the Rivers Motupiko, Hope, and Buller, and crossing the mountain ranges lying between the Rivers Matakitaiki, Maruia, and Inangahua, and thence by the valleys of the Little and Main Grey to the town of Cobden.

12. All other conditions being the same, this is the true line for a railway from Nelson to Cobden, and it would have the important advantage when made, of having its working expenses reduced to the least amount. Its length, rolling stock, stations, and officers, would be reduced to a minimum cost; and, therefore, the first point sought is gained; but the other points cannot be attained, for the line would be exceedingly expensive, by reason of two tunnels being necessary, one of which would probably be three miles long. Neither would it so well secure one of the objects of its construction—namely, opening up communication with the available land of the interior, as other lines would; but the other object of opening the coal and gold districts would be accomplished. I do not expect that a detailed survey would materially alter these apparent difficulties, and, as the cost would be very large, I dismiss the further consideration of this route as a whole.

True line from Nelson to Cobden described—First Route.

13. The second route I have examined is the one I have shown with a red line. Its course is by the Big Bush, Black-valley, entering the valley of the River Buller near Lake Rotoiti, descending the banks of that river by the Devil's Grip until it reaches the valley of the Inangahua, which it ascends, and, after crossing the saddle, descends by the banks of the Little and Big Grey Rivers to the town of Cobden.

Second Route.

14. With one exception this route does not depart materially from a direct route from Nelson to Cobden, caused by carrying the line by the Big Bush, where a remarkable change in the direction of the line may be observed on the plan A.

Advantage of Line by Big Bush and Lake Rotoiti.

15. The advantages of carrying the line by the Big Bush, Lake Rotoiti, and so on to a junction with the alternate line at the River Hope, are three-fold:—

- A. It passes through a district partially occupied.
- B. Better gradients may be secured.
- C. It affords facilities for a junction with railways from Marlborough and Canterbury provinces, and so gives to Nelson the greater certainty of being situated upon a trunk-line of railway extending through the Middle Island—a matter of much importance, as affecting the future commercial prosperity of Nelson, but involving considerations affecting very materially the cost per mile of the entire length of railway from Nelson to Cobden.

Importance of Nelson being on a Trunk Line.

16. These considerations I purpose touching upon in the course of my report; but supposing they did not present themselves, carrying the line by the Big Bush and Lake Rotoiti adds at least eight miles to

Line by Big Bush and Lake Rotoiti longest.

its length as compared with the alternate line by Spooner's Range, upon which, in all probability, the most severe gradient would be 1 in 55.

Alternate Line by Spooner's Range.

17. The alternate line by Spooner's Range would be more costly, mile per mile, than the longer line by the Big Bush; but I am not prepared to say what this extra cost per mile would be; for though several attempts have been made to arrive at this point, by ascending the Rivers Motupiko, Hope, and Owen, in order to examine the district, the weather was always unfavourable to my having that clear and well-defined view of the country that I desired. The extra cost per mile of the alternate line would not, however, form a heavy addition to the gross cost of it; and the advantage of the alternate line would be confined to the reduction of working expenses.

Trunk Line by Big Bush, 180 miles.

18. If the line is carried by the Big Bush, the distance from Nelson to Cobden would be about 180 miles.

By Spooner's Range, 172 miles.

19. And if carried by Spooner's Range, the distance would be about 172 miles.

Line by Big Bush very easy for about 61 miles from Nelson.

20. So far as earthworks are concerned, on the longest route by the Big Bush and Lake Rotoiti, until you arrive at the Devil's Grip on the River Buller, a distance of sixty-one miles from Nelson, they are very light; there are only two small saddles to deal with, both being very narrow, and they may be approached and passed through with ease, securing gradients of about 1 in 60, by short cuttings of about forty feet deep.

Earthworks on the Buller most costly.

21. All the earthworks on the Buller, below the Devil's Grip, will be more costly than any other portions of the line, and this cost will increase as you descend the river, being the greatest on the branch to Westport.

Buller has bold banks from Devil's Grip to Westport.

22. The Buller River, from the Devil's Grip down to near Westport, presents generally bold banks rising abruptly from the water's edge, in some places nearly perpendicular, and in other, and more numerous places, falling back to slopes ranging from one to one, to three to one.

23. Granite rock appears in many places.

24. There are numerous lengths of the river banks flat.

Ballasting found on Line.

25. On the whole length of line gravel of the finest quality for ballasting abounds, so that the cost of providing ballast will be moderate.

Earthworks chiefly Side-cutting.

26. All the cuttings necessary, with a few exceptions, will be *side-cuttings*, so that no long leads are necessary, as most of the material excavated can, when desired, be disposed of by the shovel only.

Timber for Sleepers and Bridges abounds.

27. Timber for sleepers and bridge purposes can be had all along the line, excepting from Nelson to Fox-hill, a distance of about twenty-two miles.

Special works on Buller.

28. From the Devil's Grip to the River Newton, there are some special works necessary to secure good curves on the line of railway, by regulating and controlling the wide bends of the river bed, where its course is in various channels, only used when in flood. The cost of these works would be about £10,000.

Some heavy Bridges to be erected.

29. There are numerous important bridges to be provided, some of which are costly; for instance, over the Rivers Wairoa, Wai-iti, Hope, Owen, Matiri, Newton, Buller, Inangahua, and Grey. These are all large rivers, subject to heavy floods.

Should be one span.

30. From the observations I made in the early part of this report regarding the height and velocity of the floods to which these rivers are subjected, it is necessary that, when practical, the water-way of these bridges should be in one span; for it is not at

all desirable for any bridge structure over such rivers to have supports in the water-way; but there are some four cases where this is not practical with timber as the material.

31. With the material that can be procured along the line, there is no difficulty in constructing timber bridges with clear water-ways of 200 feet, to carry a single line of rails, at from £16 to £20 a foot lineal, according to the width of gauge. Exact estimates of the cost of these bridges cannot be given in the absence of detailed drawings, but the prices I have named in the estimate attached will be ample to construct substantial bridges to carry a single line of rails.

Bridges of 200 feet span may be of Timber.

32. While on the question of these large bridges, I would draw your Honour's attention to the ease with which they could be constructed to accommodate both railway and ordinary road traffic. It would, in my opinion, be a desirable stipulation to make with any company undertaking the construction of the line, that this public convenience should be secured, which could be done at a very small additional cost, and without one traffic interfering with or endangering the safety of the other.

Bridges for both Railway and ordinary traffic.

33. Upon the whole length of this route there is only one tunnel apparently necessary. This is on the south bank of the Buller, about one mile below the junction of the Lyell with the Buller.

Only one Tunnel necessary.

34. I am not sure but that a detailed survey would show that even this solitary tunnel could be dispensed with; for its construction is only necessary in order to shorten the distance of the line about three miles. The length of the tunnel would be about 600 yards.

Detailed Survey may avoid Tunnel.

35. Some excavations, and a well-drained and metalled horse-track, extending from Jacklin's store to the Saddle, has lately been finished by Mr. O'Connor, which enables me to form some opinion of what material this tunnel will consist. It will have to be carried through rock, which is granitic; and water will, I think, be found very troublesome in the execution of the work. It is, therefore, a question which detailed surveys, sections, and borings, can alone determine, as to the prudence of making the increased length of line in substitution for the tunnel, in preference to the shorter line having a tunnel. I shall, however, in my estimates provide for the tunnel being constructed.

Nature of Tunnel work.

36. When the proposed route leaves the valley of the Buller, it ascends the broad and comparatively level valley of the River Inangahua, where the works may be said to be very light, and no real difficulties present themselves; for though there is a high saddle dividing the watersheds of the Inangahua and Little Grey Rivers, the conformation of the dividing range is such as to allow the ascent to the saddle to be attained with a gradient of about 1 in 60, and the saddle, which is remarkably narrow, may be passed with a cutting of about 45 or 50 feet.

Works in Valley of Inangahua light.

37. From this point the descent by the valley of the Little Grey River is easy, and the earth-works are very light. I should observe that it is preferable to keep the line on the right bank of the Inangahua as you ascend, and the right bank of the Little Grey as you descend, as affording easier gradients and the least expensive line.

Line easy in Valley of Little Grey.

38. For similar reasons, from the junction of the Little Grey with the main or Big Grey, I propose bridging the Big Grey at this point, keeping the south-west bank of the river until the River Arnold is reached. This part of the line passes through a level district, and opens a large extent of rich flat land.

Bridging Big Grey.

Big Grey re-crossed near the Arnold.

39. The Grey is proposed to be recrossed near the junction of the River Arnold, and the line carried to Cobden on the north-east bank, passing through those magnificent coal-mines known as the "Brunner Mines," and thus opening communication with a vast coal-field of enormous importance and value.

Reason for bridging Grey twice.

40. You will observe that the River Grey is bridged twice, apparently without necessity. This I have done because the north-east bank, between the proposed bridges, presents more difficulties than the opposite bank. The land is high and of small agricultural value, while on the south-west bank the land is flat and rich, and, at no distant day, will be of great value; besides which, gold-digging is carried on extensively on this bank, at Noble's Gully, Nelson's Creek, Red Jack's Creek, as well as up the River Arnold, and other places; and, as I think the extra bridges will be as cheaply constructed as the difference of the cost of a line on each bank lying between the points of crossing, while a more valuable country is put in more easy communication with the railway than otherwise would be the case, I prefer bridging the Grey twice, so as to secure what I conceive to be the most desirable line.

Line passes through Coal, Sandstone, and Limestone.

41. From the River Arnold to the town of Cobden the line would be chiefly in side formation, passing through coal, sandstone, and limestone.

Gradient 1 in 60.

42. I do not anticipate that the ruling gradient along the entire route need to be more severe than 1 in 60, which is a good working gradient for such a country as is under consideration, and one on which full control may be had by brakes over a descending train. I should, therefore, recommend that the maximum gradient should not be greater than this.

Beyond 1 in 60 Locomotives severely taxed.

43. When you get to gradients steeper than 1 in 60, the effect of gravity becomes largely increased, and the power of a locomotive engine is severely tested to overcome this force, while that of the brakes is greatly reduced in descending the incline.

Friction of 1 ton on Level.

44. On a well constructed railway, in fair working order, the friction to overcome one ton drawn on the level, ranges from seven to ten lbs. Calling it ten lbs., the force to overcome the friction of the 200 tons drawn on the level, would be 2,000 lbs.

Power lost when level departed from.

45. Leaving out of consideration (for the sake of simplicity), the effects of resistance of the atmosphere, weight of the engine, as well as fractions, the following table will shew what an extent of power is lost when a railway departs from a perfect level and a right line. I need hardly say that the resistance from curved rails is not taken into account in this table:—

Effects of gravity.

46. TABLE TO ILLUSTRATE THE EFFECTS OF GRAVITY. (LOAD DRAWN ON THE LEVEL, 200 TONS.)

Gradient.	Friction taken at 10 lbs. per ton.	Effects of Gravity.	Resistance from Friction and Gravity.	Tons which can be drawn by the same Engine.
Level	2,000	Nothing	2,000	200
1 in 100	2,000	4,480	6,480	62
1 in 90	2,000	4,977	6,977	57
1 in 80	2,000	5,600	7,600	53
1 in 70	2,000	6,400	8,400	48
1 in 60	2,000	7,466	9,466	43
1 in 50	2,000	8,960	10,960	37
1 in 40	2,000	11,200	13,200	30
1 in 30	2,000	14,600	16,600	24

47. From this table can be observed the rapid increase of the consumption of the engine's power to overcome gravity as the gradients are increased; and it follows that (leaving the speed the same throughout, and not noticing the weight of the engine itself) if a locomotive exerts its full power on the level, the gross tons that it can haul from terminus to terminus, will be confined to that which it can draw up the steepest gradient on the line.

Consumption of power to overcome gravity.

48. Hence the importance of adopting a reasonable gradient as the ruling one, so that engines of moderate weight may be able to draw the gross load required; for, if this is not observed, and heavy engines become necessary; then it must be noticed that a more substantial and more costly permanent way is unavoidable.

Reasonable Gradient important.

49. Besides these considerations, there are others which should influence the fixing of the ruling gradient. It must be remembered that when a locomotive is drawing a load upon a level, it has only the friction of the moving parts of itself, which is constant, and that of the load drawn, which varies, to overcome; but upon an incline it has not only the gravity of the profitable load it draws to overcome, but that of its own weight as well, which is an unprofitable load; and, therefore, the more steep the gradient is, the more weight the engine must have to haul a given load, and, consequently, the greater the loss of power to overcome the gravity of the engine. Now loss of power is loss of money.

Other reasons for a ruling Gradient.

50. All this has reference to ascending gradients, but to safely descend long gradients is of equal importance, and though there is scarcely a limit to the power of brakes, their application is costly; so that safely descending long and severe gradients is simply a question of cost.

Descent of long Gradients.

51. Experience has shown me that in practice, 1 in 60 is the steepest gradient that can be descended in safety by heavy mineral trains with a reasonable application of brakes, and from the foregoing table (No. 1), it may be observed that the braking power required on gradients below 1 in 60 becomes rapidly increased; for to bring a descending train to a state of rest upon a gradient of 1 in 70, the power of the brakes necessary, is represented by 8,400 lbs.; on 1 in 60, by 9,466 lbs.; on 1 in 50, by 10,960 lbs.; while 1 in 40, is 13,200 lbs.

Gradients more than 1 in 60 not desirable.

52. I have now given you a general description of one of the routes, and its alternate line, which I have examined, with some observations suggesting caution regarding fixing the ruling gradient, and I have to state that upon this route no real engineering difficulties exist; such works as may, in comparison with the rest of the line, be considered costly, are on the River Buller, both in this route and in the others where the valley of the Buller is made use of.

No engineering difficulties on second route.

53. For so long a line the works will be remarkably easy to construct at a very moderate cost, but in order to illustrate the character of the chief works necessary, I have attempted to give a short description of them in the book of "Sketch Maps," marked B; to which I beg to refer.

Works easy for so long a Line. Chief works described.

54. The third route which I have examined, is common to the one last described, until the junction of the River Matakitaiki with the Buller,

Third Route.

55. Here the route ascends the valley of the Matakitaiki until the Glenroy River is reached, when the course changes from south to west, and the saddle of the range dividing the watershed of the Matakitaiki and Maruia, is passed by a tunnel about one mile long.

Valley of the Matakitaiki.

Maruia Plains. 56. From thence the descent to the Maruia Plains is at the rate of about one in fifty, as far as Frog's Flat; it then passes along the banks of the Warwick River, with very easy gradients, and over the Maruia Plains at gradients varying from one in 90 to one in 114.

Course follows River Mary. 57. From the Maruia Plains, I prefer following the course of the River Mary to that of the Brown Grey River; the entire of the swampy ground known as the "boggy saddle" is thus avoided, and a gradient of one in about sixty-five will probably be got down to the valley of the Upper Grey.

Difficulties on Upper Grey. 58. From the junction of the Brown Grey with the Upper Grey to the River Alexander, the line would in general be in side-cutting, and some difficulties present themselves in the way of extensive land-slips, and the very peculiar formation and junction of the remarkable terraces between the Rivers Alexander and Allen, and in other places.

To overcome difficulties very costly. 59. These difficulties could be overcome by extensive heavy cuttings, so far as the terraces are concerned, but as land-slips appear to me to be more numerous and more difficult to guard against in the valley of the Upper Grey, than in other routes I have examined, probably from the action of the river more than any other cause—and as the line must, in many cases, be on the immediate bank of the river, either much damage must frequently arise to the line so constructed, or expensive protective works would in the first instance have to be provided for, the cost of which would far exceed in amount that saved by the remarkable easy construction of the twenty-five miles or thereabouts, over the Maruia Plains.

To bridge River Maruia very costly. Route disproved. 60. For these reasons as well as the absence of any extent of land available for agricultural purposes in the valley of the Upper Grey, and the expensive character of the works necessary to bridge the Maruia River, in consequence of its great breadth and the lowness of its banks, I cannot recommend this route; but I have deemed it necessary for your Honour's information to shew its general direction in the sketch maps (C).

Branch to Westport costly. 61. The branch line to Westport (described in Sketch-book D) will be much more costly in construction than any equal length on either of the trunk-line examined; for with the exception of the rich flat land at "Sandy Camp," and a few miles near Westport, the whole works consist of very heavy side and a few full cuttings, many of which are rock.

Chief bridge to be over Buller. 62. The chief bridge to be erected would be over the Buller.

Line to be south of Buller as far as Grange's Point, where coal is found. 63. It is necessary that the line should be to the south of the Buller until Grange's Point is passed, for near this point is situated a bed of coal from eight to ten feet in thickness, which will probably be of considerable value, so that easy communication with it is of consequence.

Coal sent to Dr. Hector, and analyzed. 64. Regarding the value of this coal, a specimen which I took from the outer face of the seam has been submitted to Dr. Hector, Director of the Geological Survey of New Zealand, who reports as follows:—

65. *Pitch Coal*.—Very similar in appearance to the Stag-point coal [see first Coal Report, No. XIII, pages 32 and 33]. Homogeneous and massive, but crumbles on drying. Fracture, conchoidal and splintering. Colour, black in mass, but powdered brown. Lustre, pitch-like, ignites with some difficulty, but, when kindled, burns with a strong flame; smoke has rather a sulphurous odour. Amount of coke, per cent., 44.18; character of coke, incoherent; colour of ash, white.

ANALYSIS.

Water	11.45
Fixed Carbon	38.63
Hydro Carbon, &c.	44.37
Ash	5.55
	100.00

Per centage of fixed Carbon, deducting Water and Ash 46.54
Ditto Hydro Carbon ditto 53.46

From the above analysis I am of opinion that this specimen is of a medium value as a fuel, and from a newer formation than the Buller and Grey coal. Its age is probably the same as the coal from Brighton to West Coast [see page 15, Laboratory Report, 1887].

66. It must be understood that the specimen analyzed was taken from the surface of the coal-seam where it is exposed to view, so that we may fairly infer that the value of the coal would improve as the mine is penetrated.

67. Regarding its quality for steam purposes we know nothing; there is reason, however, for believing, that unless its character changes from hydrous to anhydrous, as the mine is opened, that it would not be a good steam coal. There can, however, be no doubt that, as it is at present the nearest known coal-field on the Buller, it would find a ready sale in Nelson as a good house coal, and might possibly compete successfully with imported coals for the use of coasting steam-boats, but would not be suitable for ocean-going steamers where space occupied is of consequence.

68. Having secured easy communication with the coal-bed at Grange's Point, the line continues on the south bank of the Buller chiefly through side-cutting, until near the Blackwater River, above which the Buller is crossed, and the line carried on the north bank in heavy side-cutting, in order to facilitate communication with the well-known coal-fields of Mount Rochfort, from which in a direct line it is distant about three and a-half miles.

69. The heavy side-cutting ceases within about seven miles from Westport, which town is then reached by a flat gradient over a plain.

70. The distance of the branch to Westport may be taken at twenty-seven miles.

71. Considering the subject in all its bearings, I am of opinion that, keeping in view what I have said in paragraphs 11 and 15, the best route for the main line from Nelson to Cobden, is that via the Valleys of the Inangahua and Little Grey.

72. Great lengths of this route are almost free from cuttings and embankments, and would be executed at a small cost per mile; while the excavations necessary on the banks of the Buller, though heavier and more costly than other portions of the line, are not by any means formidable.

73. The cost of the whole line will be influenced by the numerous heavy bridges and the tunnel that may be found necessary.

74. The route would, without doubt, pass through or touch upon a greater and more valuable extent of flat land than any other route I have examined, and so I recommend its adoption.

75. Now, as to the extent of the public lands on this route available for agricultural purposes, and which would come within a belt of 19½ miles broad, it is impossible for me to give any very reliable estimate, but I am safe in saying that the valley of the Buller below the Devil's Grip to near Westport, may be said to be almost devoid of any extent of flat land; there are here and there small patches, but the whole extent on the Buller would not perhaps exceed 18,000.

Coal from exposed surface.

Quality for steam purposes untried.

Buller crossed below Grange's Point.

Heavy side-cutting stops 7 miles from Westport.

Branch to Westport 27 miles.

Best Route by valleys of Inangahua and Little Grey.

Lengths free from cuttings & embankments.

Cost greatly augmented by several large Bridges.

Route through best Land.

Land available for Agriculture on Buller 18,000 Acres.

Good Land in Valley of Inangahua, 36,000 Acres.

76. The valley of the Inangahua possesses some excellent open flat land; the surface soil is rich and rests upon a porous subsoil of mixed clay and gravel. The facilities for drainage are therefore all that can be desired, and the district is well watered. The available flat land in this valley will probably reach 36,000 acres, independent of many hills quite capable of cultivation.

Valley of Little Grey, 38,000 Acres.

77. 38,000 acres may be available for agricultural purposes in the valley of the Little Grey.

Valley of Big Grey, 60,000 Acres.

78. The valley of the Big Grey may have 60,000 acres of flat land.

Total good Land, 152,000 Acres.

79. The total flat land may, therefore, be taken at 152,000 acres.

152,000 Acres does not show all the good Land.

80. It must be understood that this estimated quantity of flat land, does not include all that exists in the valleys named, but only that which would probably come within the limit of the land proposed to be given to the company constructing the line.

Flat Land, small proportion of Land proposed to be given.

81. It forms a small proportion of the 2,070,000 acres proposed to be given to the company, and does not by any means represent all the land that will be valuable. Large portions of the land that may be called hilly will, after a time, be fit for pastoral purposes, but to what extent this kind of land exists I am not prepared to say, as in a timbered country, to estimate the extent of the lands suitable for either agricultural or pastoral purposes is attended with difficulty and some uncertainty. I think, however, the gross quantity of flat land I have named will be found to exist, but the survey department of your Honour's Government will be enabled to furnish this with some degree of accuracy.

Value of the 152,000 Acres.

82. Now supposing this 152,000 acres of land was sold at £2 10s. an acre (a price it would easily realize if a railway were constructed), and the remainder of the land left unsold for the present; the proceeds from this would be £380,000—an amount, I need not say, quite inadequate to cover the cost of a railway of about 207 miles long.

Land not pay for Construction of Railway; Mines and Minerals must be included.

83. It is, therefore, clear to my mind that the 10,000 acres of land per mile proposed to be given in lieu of a guarantee of interest to a company constructing the line, would not be sufficient inducement unless the mines and minerals are likewise included.

Mineral wealth enormous.

84. If this were done the extent of wealth waiting collection, but which is now locked up in a range of country extending say nine and a-half miles on each side of the proposed line where public lands exist, would be found enormous, saying nothing of the value which the limestone, timber, and building-stone must ultimately realize.

Coal of Superior Quality abounds. Gold is found.

85. The country abounds with coal of very superior quality, and in seams of unusual thickness, some of which are ten, and others sixteen feet, while gold-diggers are now at work on the Rivers Owen, Buller, Matakitaiki, Inangahua, Grey, Arnold, and many other rivers of less magnitude.

86. I have endeavoured to show upon the "sketch maps" the various points where I have myself observed gold-diggers at work.

Value of Coal.

87. As regards the value of the coal, it is more the business of a mining surveyor to define it than mine; but that coal of a very superior quality does exist in vast fields, there can be no doubt whatever, for it crops out, and is visible to the eye.

Coal alone would pay for Construction of a Railway.

88. Putting the proceeds of railway traffic, as well as miners' rights, out of the question, the profits from coal mines on the Buller and Grey would, I have no doubt, pay the interest upon the capital

required to construct the line, less proceeds of land sales; and the undertaking would be a source of profits; but to prove what I advance, it is as well to go into some details.

89. On carefully examining the Brunner mine, on the River Grey, I found the thickness of the seam to be at least sixteen feet, so that if this thickness of seam extends throughout, the quantity of coal in the 1,280 acres now leased to a company, would yield about 27,000,000 tons of coal. The mine, however faultless now, may not continue to be so, though this does not appear to be probable; and if we take one-fourth of this estimated quantity, it will be a very safe and moderate computation, which gives us 6,750,000 tons of coal to be won.

90. The mine is self-drained; no engines or pumping apparatus are used, or necessary to be used. The roof is grit, and self-sustained; and the short distance of six and a-half miles, which the mine is from Cobden and Greymouth, should allow the coal to be sold at a much lower rate than the company now charge.

91. The charge for coal, put on board at Cobden wharf, is, as far as I can learn, twenty-five shillings per ton, which is made up in the following manner:—

Getting, and other charges	£0	6	6
Boating	0	14	6
Profit	0	4	0
Total	£1	5	0

92. A glance at the cost of water-carriage, for less than seven miles, will show how much both the company and public suffer from this costly item, for there can be no doubt but that, if a railway existed from the mines to the wharf at Cobden, the cost of carriage would be reduced to one shilling per ton; so that, leaving the other items undisturbed, coal should be delivered at Cobden at eleven shillings and sixpence per ton.

93. It is, however, known that, from various causes, the cost of getting exceeds what it ought to be, and there is every reason to believe that the coal may be sold at Cobden at 10s. per ton, made up thus:—

Getting and other charges	...	...	5
Carriage	...	...	1
Profit	...	...	4
Total	...	...	10

94. The coal found at Grange's Point on the Buller is about 121 miles from the town of Nelson; that from Mount Rochfort on the Buller (including, say, seven miles branch to coalfield) is about 142 miles from the port of Nelson; while the Brunner mines on the Grey are about 172 miles from the port of Nelson.

95. Now, as the company could coal their engines at first cost and free of carriage, the cost of haulage of coal per ton would not, I believe, exceed 1d. and 4-10ths. This amount would include locomotive expenses of all kinds, maintenance of permanent way, repairs of coal waggons, and office expenses, which includes staff.

96. Coals from these mines could therefore be delivered in Nelson at the following rates:—

Extent of Brunner Mine

Brunner Mine self-drained. Roof of Mine self-sustained.

Present cost of Coal at Cobden

Carriage of Coal excessive.

Coal might be sold at Cobden at 10s. per ton.

Distance of coalfields.

Locomotive coaled at first cost.

Price Coal could be delivered in Nelson.

(a.) From Grange's Point, on the Buller.

	£	s.	d.
Getting and other charges	0	5	0
Carriage, 121 miles, at 1 $\frac{4}{10}$ d.	0	14	1 $\frac{1}{2}$
Profit on coal	0	4	0
Total...	£1	3	1 $\frac{1}{2}$

(b.) From Mount Rochfort, on the Buller.

	£	s.	d.
Getting, &c.	0	5	0
Carriage, 142 miles, at 1 $\frac{4}{10}$ d.	0	16	8
Profit on coal	0	4	0
Total...	£1	5	8

(c.) From Brunner Mines, on the Grey.

	£	s.	d.
Getting, &c.	0	5	0
Carriage, 172 miles, at 1 $\frac{4}{10}$ d.	0	19	7
Profit on coal	0	4	0
Total...	£1	8	7

99. It is scarcely necessary for me to point out to your Honor that, if I am right in estimating very superior coals as capable of being delivered at the port of Nelson at £1 5s. 8d. per ton, the consumption for steam purposes for ocean-going steamers would at once become very large. A trade in coal would be created, on a large scale, that does not now exist. For instance, with a moderate expenditure on the harbor, there is no reason to doubt but that the Panama Steam Company's steamers would all coal at Nelson. That company now uses at Wellington 35,000 tons of coal per annum, costing them £1 13s. 6d. per ton, while coal, worth for steam purposes at least 4s. per ton more, may be delivered at £1 5s. 8d., making a difference of very nearly 12s., but say 10s. a ton, for the coal used by the company at Wellington, saying nothing of their coaling station at Opara.

100. The practical effect of this would be a saving of £17,500 per annum to the Panama Company, and a further income to the railway company of £7000 per annum. Consequent saving to Panama Company.

101. Regarding the quality of the coals procured from the Brunner mine and Mount Rochfort, there can be no question. The tests made at Woolwich Dockyard in 1865 put their superior value over North of England and Welsh coal beyond doubt.

102. An important report from such a responsible officer as the Chief Engineer of Woolwich Dockyard, is of such importance that I venture to embody Mr. Trickett's tests in this report, as best calculated to shew clearly the relative value of the Grey and Buller coals. I attach also tables prepared by Mr. Burnett, Mining Surveyor, shewing the relative value for steam purposes of North of England, Welsh, New South Wales, and the Grey and Buller coals, calculated on the basis given by trials of these coals at Woolwich Dockyard. Mr. Trickett's Report on Buller and Grey coals. Mr. Burnett's Tables on same.

Relative quality of Coals. 97. The first of these coals is of a fair quality for household purposes; the second and the third are very superior coals, exceedingly well adapted for ocean-going steamers.

50,000 tons could be sold at Cobden. 98. If a supply of coal could be depended upon at Cobden and Westport, and put on board at even 12s. per ton, I have no doubt but that 50,000 tons per annum would be shipped at each of these ports, and as the consumption of coal in Nelson for local purposes at the present time is nearly 13,000 tons, the profit on the sale of coal, exclusive of that arising from its carriage, would realise £22,600 per annum.

[For Table see next Page.]

Mr. Trickett's
Report in detail.103. REPORT of Trials of COAL sent from NELSON, New Zealand,
Woolwich Dockyard, 18th December, 1865.

Kind of Coal.	Date of Trial.	Pounds of Water evaporated to 1 Pound of Coal consumed.		Cubic feet of Water evaporated per hour.		Per Centage of		
		Calculated at actual temperature of feed water.	Calculated at 100° constant temperature of feed water.	Calculated at actual temperature of feed water.	Calculated at 100° constant temperature of feed water.	Clinker.	Ash.	both Clinker and Ash.
	1865.	lb	lb	Cubic feet.	Cubic feet.			
Grey Coal...	November 17	8.64	9.	37.61	39.19	.53	4.32	4.86
	November 29	9.09	9.49	40.85	42.64	.32	2.91	3.23
	December 1	9.09	9.47	42.2	43.97	.29	2.68	2.97
	December 4	9.5	9.9	43.43	45.25	.27	3.1	3.37
	MEAN ...	9.08	9.46	41.02	42.76	.35	3.25	3.6
Buller Coal	December 13	9.41	9.83	42.08	43.92	.91	3.3	4.21

REMARKS.

The Grey coal cakes in burning, and makes a hollow fire, forming a small quantity of light clinker, that does not adhere to the bars. Light ash only falls through the fire-bars, and a considerable quantity of white ash passes up the chimney, leaving a dark grey sandy kind of dust in the tubes and fire-box. The smoke is small in quantity, and the coal is tender, and likely to break small in being moved from ship to ship.

The Buller coal is a more open burning coal, and does not cake, forming a rather closer clinker than the other, and leaves a sooty deposit in the tubes and fire-box, more like the Hartly (North of England) coal, and gives off a black smoke.

No stoking tool was used in burning the sample of both kinds of coals, and nothing seems to be required

beyond throwing the coal on to the fires; and the quantities of each clinker is not greater than that of the North of England coal.

The evaporative power of this coal is about the average of that of North of England coal as supplied to the service; but it is not quite so rapid, and requires a rather longer time to boil off a given quantity of water.

The trial on the 17th November was made with the bars half an inch apart; the remaining trials with the bars about three-eighths of an inch apart.

(Signed) J. TRICKETT,
Chief Engineer.
A. PATRIDGE,
Assistant.

To the Commodore Superintendent.

MR. TRICKETT'S ADDITIONAL TRIALS.

(COPY.)

Woolwich Dockyard,
23rd January, 1866.

I beg to report that additional trials have been made of the New Zealand coal, and a comparative statement is forwarded herewith. The mean result of ten trials of North country coal and ten trials of

Welsh coal, at the same boiler, are given for comparison; from which it will be seen that the New Zealand coal evaporates more water per pound of coal than the North of England or Welsh, but does not evaporate it so rapidly; or, in other words, a larger fire-grate is required in the same boiler to evaporate a given quantity of water per hour with New Zealand coal than would be required if North of England or Welsh coal were used.

Mr. Trickett's Report in continuation.

104. TRIALS of NELSON (NEW ZEALAND) COAL, in comparison with NORTH COUNTRY and WELSH COAL, at the Trial Boiler, Woolwich, 23rd January, 1866.

Kind of Coal.	Date of Trials.	lbs Water evaporated to 1 lb Coal consumed, calculated from 100° constant temperature feed water.	Cubic feet Water evaporated per hour, calculated from 100° constant temperature feed water.	Per centage of Clinker.	Per centage of Ash.	Per centage of both Clinker and Ash.	Width of Bars.	REMARKS.
COAL sent in BOXES—reported 18th December 1865.								
NEW ZEALAND COAL.	1865.						Inch.	
Grey Coal.....	November 17.	9	39.19	.53	4.32	4.85	$\frac{1}{2}$	No stoking tool used. Fine ash. Light grey smoke.
Grey Coal.....	November 29.	9.49	42.64	.32	2.91	3.23	$\frac{3}{8}$	
Grey Coal.....	December 1.	9.47	43.97	.29	2.68	2.97	$\frac{3}{8}$	
Grey Coal.....	December 4.	9.9	45.25	.27	3.1	3.37	$\frac{3}{8}$	
	MEAN.....	9.46	42.76	.35	3.25	3.6	$\frac{1}{2}$ & $\frac{3}{8}$	
Buller Coal ...	December 13...	9.83	43.92	.91	3.3	4.21	$\frac{3}{8}$	Ditto.
COAL sent in BAGS—tried since the last was reported.								
	1866.							
Grey Coal.....	January 12 ...	9.46	40.36	.66	3.35	4.01	$\frac{3}{8}$	Not Stoked. Black smoke and fine ash.
Grey Coal.....	January 13 ...	9.46	43.24	.8	3.85	4.65	$\frac{3}{8}$	
	MEAN.....	9.46	41.8	.73	3.6	4.33	$\frac{3}{8}$	
Grey Coal.....	January 15 ...	9.4	44.58	.71	3.6	4.31	$\frac{3}{8}$	Stoked. Black smoke and fine ash.
Grey Coal.....	January 17 ...	9.39	43.99	.84	3.6	4.44	$\frac{3}{8}$	
Grey Coal.....	January 18 ...	9.46	44.87	.52	3.1	3.62	$\frac{3}{8}$	
	MEAN.....	9.42	44.48	.69	3.43	4.12	$\frac{3}{8}$	
N.B.—The coal sent in bags forms rather a rougher clinker than that in boxes.								
NORTH COUNTRY COAL.	Mean of Ten Trials.	8.72	50.32	2.17	3.71	5.89		Made for the purpose of comparison with the trials of New Zealand coal.
WELSH COAL.	Mean of Ten Trials.	9.11	47.75	1.94	4.22	6.16		Made for the purpose of comparison with the trials of New Zealand coal.

(Signed) J. TRICKETT,
Chief Engineer.

TABLES COMPILED BY MR. BURNETT, MINING SURVEYOR, FROM FOREGOING REPORTS.

TABLE I.
Mr. Burnett's 105. Result of Trials of the Quality of Coal from the Grey and Buller, compared with North of England, Welsh, and New South Wales Coal.
(All trials having been made at Woolwich Dockyard.)
Table, No. 1.

Kind of Coal.	Date of trial.	Width of Bars.	lbs Water evaporated by 1lb Coal, at a constant temperature of 100° feed water.	Cubicfeet Water evaporated per hour, at a constant temp. of 100° feed water.	Per centage of		
					Clinker.	Ash.	Ash and Clinker.
* Average North of England	...	...	8.25	47.00	1.00	4.00	5.00
North of England ... (Mean of 10 trials.)	...	...	8.72	50.32	2.17	3.71	5.89
Welsh ... (Mean of 10 trials.)	...	...	9.11	47.75	1.94	4.22	6.16
* New South Wales ... (Eleven different kinds.)	...	...	8.298	46.785	2.11	7.15	9.26
Grey—	1865						
In Boxes, dead small taken out Worst result ...	November 17	$\frac{1}{2}$ inch	9.00	39.19	.53	4.32	4.86
Best result	December 4	$\frac{3}{8}$ inch	9.90	45.25	.27	3.10	3.37
MEAN of 4 trials ...	...	$\frac{1}{2}$ & $\frac{3}{8}$ in.	9.46	42.76	.35	3.25	3.60
† Grey—	1866						
In Bags, dead small—							
Not stoked ...	January 12 ...	$\frac{3}{8}$ inch	9.46	40.36	.66	3.25	4.01
Not stoked ...	January 13 ...	$\frac{3}{8}$ inch	9.46	43.24	.80	3.85	4.65
MEAN ...	...	$\frac{3}{8}$ inch	9.46	41.80	.73	3.60	4.33
Stoked ...	January 15 ...	$\frac{3}{8}$ inch	9.40	44.58	.71	3.60	4.31
Stoked ...	January 17 ...	$\frac{3}{8}$ inch	9.36	43.99	.84	3.60	4.44
Stoked ...	January 18 ...	$\frac{3}{8}$ inch	9.46	44.87	.52	3.10	3.62
MEAN ...	...	$\frac{3}{8}$ inch	9.42	44.48	.69	3.43	4.12
GENERAL AVERAGE	...	$\frac{1}{2}$ & $\frac{3}{8}$ in.	9.43	43.05	.61	3.52	4.13
‡ Buller (One trial) ...	1865 December 13	$\frac{3}{8}$ inch	9.83	43.92	.91	3.30	4.21

* From a Woolwich Report, May 1st, 1862, published in the *Sydney Morning Herald*, 20th September, 1862, and republished in Mr. Burnett's Report on the Coal-field of New South Wales (*Nelson Government Gazette*, 21st February, 1865).

† The Grey coal *in bags* was sent to England by mistake; it was the *dead small* taken out when the boxes were packed. It shows satisfactorily that even the *dead small* of this coal is nearly as good as any part of it.

‡ The reason there was only one trial of Buller coal is, that, owing to the difficulty of conveying it from the seam to the Port, without road, only two tons were sent to England.

TABLE II.

Mr. Barnett's 106. Showing the RELATIVE VALUE for Steam Purposes of North of England, Welsh, New South Wales, and Grey and Buller Coal, calculated on the basis given by the Trials of these Coals at WOOLWICH DOCKYARD, viz.—If 100 lbs. of Average North of England Coal will evaporate a given Quantity of Water in an hour, this Table shows how the same work can be done by the other Coals.

EXAMPLE OF CALCULATION—BULLER.							
Water lbs.	Coal lbs.	Water lbs.	Coal lbs.	Water Cub. ft.	Time m. s.	Water Cub. ft.	Time m. s.
As 983	: 100	:: 825	: 83.92	As 43.92	: 60 00	:: 47.00	: 64 21
Kind of Coal.	Quantity of Coal used.	Time occupied in operation.	Incombustible matter remaining.				
			Clinker.	Ash.	Ash and Clinker.		
	lb	m. s.	lb	lb	lb		
Average North of England ...	100.00	60 00	1.00	4.00	5.00		
North of England ... (Mean of 10 trials.)	94.61	56 02	2.09	3.51	5.56		
Welsh ... (Mean of 10 trials.)	90.55	59 03	1.75	3.81	5.56		
New South Wales ... (Eleven different kinds.)	99.50	60 16	2.09	7.11	9.20		
Grey— In Boxes, dead small taken out							
Worst result ...	90.16	71 57	.48	3.96	4.44		
Best result ...	83.33	62 19	.22	2.58	2.80		
MEAN of 4 trials ...	87.21	65 56	.30	2.83	3.13		
Grey— In Bags, dead small— Not stoked—Mean of 2 trials...	87.21	67 27	.64	3.14	3.78		
Stoked—Mean of 3 trials ...	87.57	68 23	.60	3.00	3.60		
GENERAL AVERAGE ...	87.48	65 30	.44	3.10	3.54		
Buller (One trial.)	83.93	64 12	.76	3.76	3.52		

Mr. Burnett's
Table, No. 3.

TABLE III.

107. Showing the QUANTITY of WATER evaporated by an equal Quantity of different kinds of COAL, calculated from Tables I. and II., on the following basis, viz.—A given quantity (represented by 100) of Average North of England Coal will evaporate 4700 cubic feet of Water in an hour, and its value for steam-producing is represented by 100 per cent.

EXAMPLE OF CALCULATION—BULLER.									
Coal lbs.	Water Cub. ft.	Coal lbs.	Water Cub. ft.	% cent.	Time m.s.	Water Cub. ft.	Time m.s.	Water Cub. ft.	% cent.
As 83-93	: 4700	:: 100	: 5599	= 119.12	As 64' 12"	: 5599	:: 60' 00"	: 5232	= 111.31
Kind of Coal.	Quantity of Coal used.	Water evaporated.	Per centage of Water evaporated.	Time required.	Water evaporated per hour.	Per cent. of Water evapora- ted per hour.			
	lb	Cub. ft.		m. s.	Cub. ft.				
Average North of England ...	100	4700	100.00	60 00	4700	100.00			
North of England ... (Mean of 10 trials)	100	4967	105.68	56 02	5318	113.14			
Welsh ... (Mean of 10 trials)	100	5190	110.42	59 03	5277	112.27			
New South Wales ... (Eleven different kinds)	100	4723	100.48	60 16	4702	100.04			
Grey— In boxes, dead small taken out— Worst result ...	100	5212	110.89	71 57	4346	92.46			
Best result ...	100	5640	120.00	62 19	5430	115.53			
MEAN of 4 trials ...	100	5389	114.65	65 56	4904	104.34			
Grey— In Bags, dead small— Not stoked—Mean of 2 trials	100	5389	114.65	67 27	4793	101.97			
Stoked—Mean of 3 trials ...	100	5367	114.19	63 23	5080	108.08			
GENERAL AVERAGE ...	100	5372	114.29	65 30	4920	104.68			
Buller ... (One trial)	100	5599	119.12	64 12	5232	111.31			

TABLE IV.

Mr. Burnett's Showing the RELATIVE VALUE for Steam Purposes of the different kinds of COAL tried at WOOLWICH (see Report and Tables I., II., and III.), arranged according to their Evaporative Powers, on the basis that Average North of England Coal will evaporate 100 per cent of Water in an Hour.

(Reduced from Table III.)

PART I.		
POWER OF EVAPORATING WATER, WITHOUT REFERENCE TO TIME.		
1. GREY—		Per Cent.
Best result— $\frac{3}{8}$ inch Bars—Not stoked ...	...	120.00
2. BULLER—		
One Trial— $\frac{3}{8}$ inch Bars—Not stoked ...	...	119.12
3. GREY—		
Mean of Two Trials— $\frac{1}{2}$ and $\frac{3}{8}$ inch Bars—Not stoked ...	...	114.65
4. GREY—		
Mean of Four Trials—Dead small— $\frac{3}{8}$ inch Bars—Not stoked...	...	114.65
5. GREY—		
General Average of all Trials ...	...	114.29
6. GREY—		
Mean of Three Trials—Dead small— $\frac{3}{8}$ inch Bars—Stoked ...	...	114.19
7. GREY—		
Worst Result— $\frac{1}{2}$ inch Bars—Not stoked ...	...	110.89
8. WELSH—		
Mean of Ten Trials ...	...	110.42
9. NORTH OF ENGLAND—		
Mean of Ten Trials ...	...	105.68
10. NEW SOUTH WALES—		
Eleven different Kinds...	...	100.48
11. NORTH OF ENGLAND—		
Average ...	...	100.00
PART II.		
POWER OF EVAPORATING WATER IN A GIVEN TIME.		
1. GREY—		Per Cent.
Best Result— $\frac{3}{8}$ inch Bars—Not stoked ...	...	115.53
2. NORTH OF ENGLAND—		
Mean of Ten Trials ...	...	113.14
3. WELSH—		
Mean of Ten Trials ...	...	112.27
4. BULLER—		
One Trial— $\frac{3}{8}$ inch Bars—Not stoked ...	...	111.31
5. GREY—		
Mean of Three Trials—Dead small— $\frac{3}{8}$ inch Bars—Stoked ...	...	108.08
6. GREY—		
General Average of all Trials ...	...	104.68
7. GREY—		
Mean of Four Trials— $\frac{1}{2}$ and $\frac{3}{8}$ inch Bars—Not Stoked ...	...	104.34
8. GREY—		
Mean of Two Trials—Dead small— $\frac{3}{8}$ inch Bars—Not stoked...	...	101.97
9. NEW SOUTH WALES—		
Eleven different Kinds...	...	100.04
10. NORTH OF ENGLAND—		
Average ...	...	100.00
11. GREY—		
Worst Result— $\frac{1}{2}$ inch Bars—Not stoked ...	...	92.46

Value of the Coal enormous. 109. The value of the coalfields that would come within the belt of land, $19\frac{1}{2}$ miles wide, proposed to be given to a company constructing the line, would be enormous and beyond calculation, the present Brunner mines on the Grey being, as it were, a mere spot in proportion to the area forming the coalfields of the Grey and Buller.

Much of the country is auriferous. Land abounds with mines and minerals. 110. I have already stated that a large portion of the country through which the proposed line of railway would pass is auriferous, and that gold digging is now being followed in various places on the numerous rivers intersecting the proposed route; so that the land may be said to abound in mines and minerals of immense value, the development of which would not only enrich a company, but have a most material beneficial effect on the prosperity of the Province of Nelson.

Railway would create a mining district. 111. The opening of a line of railway would at once convert a great extent of the Province into a mining district—population would increase, and all the concurrent advantages would of necessity follow.

Country is quite practicable for a railway. 112. The country being quite practicable to carry a line of railway through, the question now arises as to what character the railway should be, and of what gauge. The first part of the question is readily answered, for Colonial works of all kinds, constructed in the early stages of the country's progress, should be of a description free from all ornament and high finish, but otherwise solidly constructed.

How the gauge of railway to be determined. 113. As regards the question of the gauge, this must, in some measure, be determined partly by the nature of the traffic which may be expected to arise, and partly from the formation of the country to be passed through, the curves in the line that are necessary to save a great outlay, and the financial position of the Province; the latter, perhaps, being the chief consideration.

If a mineral line, very narrow gauge is sufficient. High speed injurious. 114. If the great bulk of the traffic is certain to consist of minerals, high speeds are not only unnecessary, but absolutely injurious, and a very narrow gauge of, say, 3ft. 6in. would suffice; but if in the course of time the passenger and goods traffic became of equal importance with that of minerals, then a gauge of not less than 4ft. $8\frac{1}{2}$ in., or not more than 5ft. 3in., according to the nature of the traffic, may be desirable.

Cautions to be observed in adopting a very narrow gauge. 115. The advantages of forming a railway on so narrow a gauge as 3ft. 6in. are not real ones—they only appear to be so. Cheapness in the first cost of construction,—being best suited to sharp curves,—and the completion of which is more likely to come within the means which the Province has at its disposal, are certainly matters of much moment; but these apparent advantages must be received with some caution, as it is well known to practical engineers that there are extra charges and cost per cubic yard, in the excavations of a very narrow gauge, that are greatly reduced, and may be said to disappear, when the gauge is of a moderate width.

Time an element of consequence in all large works. 116. Time is an element of consequence in the construction of all large public works, regulating, as it does, the period for which the capital engaged in the formation of the undertaking lies unproductive. The quicker, therefore, that a large public work can be completed, the better for those having capital in the concern, and *vice versa*.

Illustration of the importance of time in constructing large works. 117. I may illustrate my meaning better, perhaps, by assuming a case, thus:—If a line whose gauge was 3ft. 6in. had 4,000,000 cubic yards of earthworks to be removed in full cuttings, and another line whose gauge was half as much more, that is, 5ft. 3in., had 6,000,000 cubic yards of earthwork to remove, then what I mean to convey to your Honour is, that though the gauges and quantity of earthworks are strictly proportional, not only would the 6,000,000 yards on

the broader gauge be removed as soon as the 4,000,000 yards on the narrower gauge, but it would be done at a less cost per cubic yard. Experience has clearly shewn, that within certain limits of gauge, this is a fact; and enquiry as to the result of constructing railways of 3ft. 6in. gauge in other colonies would, I have no doubt, sustain what I have advanced.

118. We must, however, guard against falling into error by applying this knowledge under all circumstances, for its correctness is only applicable when the cuttings on the line are *full* cuttings, that is, not *side* cuttings: for the width of a cutting regulates the size of the earth waggon that can be used, and the number of men that can be daily employed; and from this cause, cost of excavations, time of execution, and cost of management, are much enlarged.

119. But in "side cuttings," where there is no lead, or where the lead is very short, and where the material excavated may be cast away by the shovel, the distinction as regards relative cost of earthworks does not apply. Now, as the excavations on the line of route I propose would generally be in side cutting, and but few full cuttings be found necessary, it follows that the generally admitted fact that the excavations on a railway whose gauge is 3ft. 6in., are more costly in proportion to that of one whose gauge is 4ft. $8\frac{1}{2}$ in., or 5ft. 3in., only applies in the case of the proposed Nelson and West Coast railway, to a limited extent; but it is necessary, I think, that I should draw your attention to these facts, so that objections which capitalists may make, to the construction of so great a length on such a narrow gauge, may be removed.

120. A railway having a large traffic and a gauge of 3ft. 6in. has, compared with one whose gauge is 4ft. $8\frac{1}{2}$ in. or 5ft. 3in., some disadvantages.

- A.—Its safe working is less certain;
- B.—Its speed is more limited;
- C.—Its servants are more numerous;
- D.—Its rolling stock is of greater extent; and
- E.—Its cost of working larger.

121. It must be recollected that the chief cost of a railway, having a gauge larger than 3ft. 6in., is generally to be attributed in this colony, not so much to the increased cost of the excavations, as to that of the permanent way, by reason of the ballasting being greater in quantity, the sleepers larger, and the rails heavier. In the sketch (fig 1) given on the next sheet, which may be taken as a cross section representing the average of the sidelong ground to be passed over by the railway where it does not occupy the valley of the Buller, it will be observed, by an inspection of the figures, that the excavation and embankment necessary in the case of a railway having a gauge of 3ft. 6in. and one whose gauge is 4ft. $8\frac{1}{2}$ in. is only increased 15in. in width, and 21in. in width when the gauge is 5ft. 3in., *half* of which represents the extra width of the cutting on the hillside.

121a. This then would form a very moderate item in the increased cost of the broader gauges, and should not weigh in the choice of gauge; for we find, from the cross section before us, that for every mile of railway the gauge of 3ft. 6in. would require about 3450 cubic yards of excavation; that of 4ft. $8\frac{1}{2}$ in. about 3924 cubic yards; and that of 5ft. 3in. about 4540 cubic yards; the calculation being based on the assumption that the width of the carriage shall exceed the width of the rails by 2ft. 6in., and that a space of 3 feet is maintained throughout the line between the sides of the carriage and the edge of the formation level; so that the least width of roadway for the several gauges would be 12ft., 13ft. 3in., and 13ft. 9in. respectively.

Width of cuttings regulates time of execution

Where there is "side cutting" only, width of cutting does not regulate the time of execution.

Disadvantages of a gauge narrower than 3 feet 6 inches.

Permanent way chief cause of extra cost in increased width of gauge.

Earthworks do not form a very serious item in the extra cost of a broader gauge when the cuttings are "side cuttings."

Weight of rails necessary that would be suitable to traffic on the Nelson and Cobden line.

122. Now, as I said before, the permanent way is the item which increases the cost so largely, for while slow speeds are adopted, rails of 42lbs. weight per yard would suffice for the gauge of 3ft. 6in.; 54lbs. per yard would be required for a 4ft. 8½in. gauge; and 60lbs. per yard for the gauge of 5ft. 3in. In one case there would be an increase of 25 per cent. in the gross weight of the rails necessary, and in the other nearly 50 per cent, as compared with those necessary for the narrow gauge of 3ft. 6in.

Extra cost of broad gauge depends much upon the state of the iron market.

123. So that, as excellent timber exists in numerous places along the route, and superior ballast is procured on the site of the works, the extra cost of these items in the broader gauges is not a very heavy one, and the whole question of the relative cost of the broader gauges over one of 3ft. 6in., would mainly resolve itself into the state of the iron market at the time of constructing the line.

Narrow gauge best suited where curves are sharp.

124. The important advantage of adopting so narrow a gauge as 3ft. 6in., is the facility it gives of safely passing, with moderate speeds, severe curves on the line of rails. This is its chief point of recommendation, and, if slow speeds are to be followed, one of great consideration in a mountainous country like the Province of Nelson.

Advantages of a gauge of 4 feet 8½ inches.

125. The gauge of 4ft. 8½in. certainly presents, in my judgment, the most tempting arguments for its adoption; for, contrary to the narrow gauge of 3ft. 6in.,

- A.—Its working is more certain;
- B.—Its speed may safely reach the average of 20 miles an hour, on a line where the curves would be as sharp as a radius of 10 chains, and be very numerous;
- C.—Its servants would be less numerous;
- D.—Its rolling stock of less extent; and
- E.—Its cost of working less.

In case of a change of gauge becoming necessary.

126. Supposing, however, that the narrower gauge of 3ft. 6in. was adopted as the one best adapted for mineral traffic, and that in the course of time other traffic was so developed as to require higher speeds, then a broader gauge becomes at once necessary, and the question arises at what cost can this change of gauge be accomplished.

Works necessary to make a change of gauge.

127. The reason is obvious, for the curves would have to be decreased in severity, the ballasting must be widened, the sleepers be replaced by longer ones, and a heavier rail substituted for that which would suffice for a gauge of 3ft. 6in.

Change of gauge would be costly.

128. Now I have no hesitation in saying that such a change would be very costly indeed if the line was, in the first instance, laid out simply for a gauge of 3ft. 6in., and regardless of possible future increase of width being necessary; and this cost would be greatly augmented from the necessity of keeping the traffic on the line open while the alteration of gauge was being made.

Cost increased if traffic to be kept open during the change.

129. I need hardly say that, under such conditions, the cost of the new works would, of necessity, be very much in excess of what they would be if constructed under ordinary circumstances.

Nature of the curves on the proposed line.

130. So that we must come back to the consideration as to how far it is prudent to construct a railway of some 200 miles long, at a moderate cost, but of a very narrow gauge, with the certainty of being only able to accomplish a very limited speed, against a broader gauge, of say 4ft. 8½in., where higher speeds may be safely attained.

Speed proposed, when the

131. The curves on the trunk line that I propose, need not, I think, exceed a radius of ten chains, but on the branch to Westport curves whose radius is 7½ chains, are very frequent.

132. We must not, I think, on a gauge of 3ft. 6in., calculate upon attaining with perfect safety a speed

greater than about 12½ miles per hour on the average, which would enable the journey from Nelson to Cobden to be accomplished in about 14 hours, and from Nelson to Westport in about 11½ hours.

133. The adoption of the gauge of 3ft. 6in. would, in all probability, exclude Nelson from consideration in any trunk line of communication that must in a short time be established in the Middle Island, provided the main line was proposed to be constructed with a gauge greater than 3ft. 6in.

134. It is true that this question will not immediately arise, but that does not for a moment dispense with the necessity of anticipating its occurrence. To provide for it, as far as the province can do so, appears to me to be but common prudence.

135. It may be urged against what I now advance, that if ever the gauge of 4ft. 8½in., which I consider quite sufficient for all the purposes of traffic that are likely to arise on a line of railway from Nelson to the West Coast, may be less than what may be determined as the proper gauge for the whole of the railways of the Colony, or it may be more—if more, the change of gauge from a larger to a smaller is very simple—and if increased from 4ft. 8½in. to 5ft. 3in., the cost is not very material, as the same weight of rails would, under the circumstances, perhaps be made to suffice; at least there would be no necessity of an immediate change in the weight of rail, if the weight of the locomotives was not greater than—say 10 tons; so that the only expense necessary would be to increase the length of sleepers about 7in., and the width of the ballasting to the same extent, to secure the alteration from a gauge of 4ft. 8½in. to one of 5ft. 3in. The cuttings would, practically, remain undisturbed.

136. It appears, therefore, that in determining the gauge to be adopted, a variety of present circumstances, as well as those which are not only possible but probable to arise, must be duly weighed, and to me it seems that though there are very strong inducements to adopt a gauge as small as 3ft. 6in., its effects must be to localise and limit the good that would arise from its construction, and to exclude from the Province of Nelson all those great benefits which a through traffic secures to a district.

137. These are some of the many points which your Honour's Government have to consider respecting the best gauge for the proposed railway. If you are convinced that so long a line should be constructed as for a mineral traffic only, then adopt a gauge of 3ft. 6in.; but, if you think that a larger view of the question should be taken, as to how the gauge would benefit the whole of the Middle Island, that the traffic would be of a mixed character, and that a portion, if not the whole line, might be considered as forming a part of a trunk line to Canterbury and elsewhere, then adopt a gauge of 4ft. 8½in.

138. During my examination of the routes I endeavored to ascertain, by the existing water courses, the probable average cost per mile of culverts and small bridges. So long as the spans necessary are less than 35ft. they will not be separately noted—so that in the estimates which follow the cost of bridging will be in two items, viz.—a rate per mile for small bridges under 35 feet span, and the estimated cost of bridges of larger spans.

139. Before going into the consideration of the estimates, it is necessary for me to observe that, as the works in the valley of the Buller are of quite a different character from those on other parts of the line, I purpose making a separate estimate for each portion, so as to arrive at more accurate results; and for this purpose I attach a sketch of a cross section, which

Adoption of a gauge of 3 feet 6 inches might shut out Nelson from a trunk line.

Necessity of considering this point.

Change of gauge from broad to narrow easily done.

Determination of gauge must be regulated by several considerations.

Water ways, per mile, for small bridges and culverts.

Works in the valley of the Buller, are heavier than other portions of the line.

may be taken as an average of the side cuttings, for one-third the length of the line in the Buller valley, below the Devil's Grip—(see fig. 2). It must be observed that there are places where the cross sections would be less favorable than is shown in figure, while on the other hand there are many places where they would be more favorable, so that on the whole the sketch may be taken, excluding the retaining wall, as a fair average, as far as my judgment goes. The pitched facing to the embankment would be necessary in some cases where the natural slope terminates close to the edge of the river.

How line should enter Nelson.
Stations.

140. I may further add that, as regards the site of the station for Nelson, and the way the line should enter the town, I am of opinion that the passenger station should be at the bottom of Hardy-street, and the coal station at the port, and I prefer the line coming by Jenkins's Hill than by Thompson's Run.

Locomotive engines should not cross the port road.

141. There are strong objections to a locomotive engine crossing the Port road on a level, and then running parallel to the present road down to the Port. It would, at all times, be dangerous and inconvenient, and in consequence I propose the line shall not be used by locomotives nearer to the Port than Saltwater bridge. From thence coal trains are to be taken to the Port by horse-power.

Line by Thompson's run has some disadvantages.

142. A line entering Nelson by Thompson's Run, and having its terminus near to Saltwater bridge, would be equally as expensive as one coming by way of Jenkins's Hill, and would have the serious disadvantage of cutting off all convenient and safe communication with the water frontage at the port. It would be a great interruption to the trade at the Port, to have a locomotive plying along the whole water frontage, and would be very dangerous to the general public.

Line by Thompson's run may be allowed under certain difficulties.

143. In order, however, to keep a moderate check on demands for compensation from owners of private property through which the line would pass, if taken by Jenkins's Hill, I suggest the propriety of leaving the Company the right of constructing the line *via* Thompson's Run, if they fail in making reasonable terms with the owners of land on the line by Jenkins's Hill.

APPROXIMATE ESTIMATE FOR ONE MILE OF RAILWAY, EXCLUSIVE OF LARGE BRIDGES AND OF ALL WORKS IN THE VALLEY OF THE BULLER.

Estimate for one mile, with outbridges, when the gauge is 3 feet 6 inches.

144. The gauge being 3ft. 6in. :-

	£	s.	d.
Clearing 10 acres of bush, at £6...	60	0	0
Average excavation, 4000 cubic yards, at 1s. 3d...	250	0	0
Fencing	168	0	0
Draining	40	0	0
Two level crossings, complete	80	0	0
Accommodation gates	30	0	0
Ballasting, 2077 cubic yards, at 2s.	207	14	0
Sleepers, 1760 at 2s. 3d.	198	0	0
Rails, 66 tons, at £11	726	0	0
Fish-joints and spikes	30	0	0
Plate-laying, 1760 lineal yards, at 2s.	176	0	0
Total	£1965	14	0

Estimate for one mile when the gauge is 4 feet 8½ inches.

145. The gauge being 4 feet 8½ inches :-

	£	s.	d.
Clearing 10 acres of bush, at £6...	60	0	0
Excavations, 4600 cubic yards, at 1s. 3d.	287	10	0
Fencing	168	0	0
Draining	40	0	0
Two level crossings, complete	80	0	0
Carried forward	£		

Brought forward... £

Accommodation gates	30	0	0
Ballasting, 2444 cubic yards, at 2s.	244	8	0
Sleepers, 1760, at 2s. 6d... ..	220	0	0
Rails, 85 tons, at £11	925	0	0
Fish-joints and spikes	35	0	0
Plate-laying, 1760 lineal yards, at 2s.	176	0	0
Total	£2265	18	0

146. The gauge being 5 feet 3 inches :-

	£	s.	d.
Clearing 10 acres of bush, at £6	60	0	0
Excavations, 5290 cubic yards, at 1s. 3d.	331	2	6
Fencing	168	0	0
Draining	40	0	0
Two level crossings, complete	80	0	0
Accommodation gates	30	0	0
Ballasting, 2628 cubic yards, at 2s.	262	16	0
Sleepers, 1760, at 2s. 9d... ..	242	0	0
Rails, 95 tons, at £11	1045	0	0
Fish-plates, and spikes	40	0	0
Plate-laying, 1760 lineal yards, at 2s.	176	0	0
Total	£2474	18	6

147. To each of these estimates for one mile of railway we must add when the line is in the Valley of the Buller, below the Devil's Grip, as follows :-

For 3 feet 6 inch gauge, 15,580 cubic yards of excavation, at 3s., = £2337	- £250 =	£2087	0s.
For 4 feet 8½ inch gauge, 18,186 cubic yards of excavation, at 3s., = £2727 18s	- £287 10s. =	£2440	8s.
For 5 feet 3 inch gauge, 20,340 cubic yards of excavation, at 3s., = £3051	- £331 2s. 6d. =	£2719	17s. 6d.

We then arrive at the estimates of the entire line as follows, and the branch to Westport.

148. Estimate of trunk line from Nelson to Cobden; gauge, 3 feet 6 inches.

	£	s.	d.
125 miles of Railway, no part of which is in the Valley of the Buller, below the Devil's Grip, at £1965 14s. 0d. per mile	245,610	10	0
55 miles of Railway, the whole of which is in the Valley of the Buller, below the Devil's Grip, at £4052 14s. 0d. per mile	222,898	10	0
Small Bridges and Culverts, less than 30 feet span, about 6400 feet, at £4	25,000	0	0
Large Rivers.			
Wairoa 450 feet... at 16... ..	7,200		
Eighty-eight ... 80 ,, ... do.	1,280		
Wai-iti 200 ,, ... do.	3,200		
Kerr's 40 ,, ... do.	640		
Hope 80 ,, ... do.	1,280		
Granite 40 ,, ... do.	640		
Owen 120 ,, ... do.	1,920		
Matiri 300 ,, ... do.	4,800		
Newton 120 ,, ... do.	1,920		
Buller 300 ,, ... do.	4,800		
Dee 100 ,, ... do.	1,600		
Inangahua 200 ,, ... do.	3,200		
Curtis' 120 ,, ... do.	1,920		
Greenfield's 150 ,, ... do.	2,400		
Sharp's 100 ,, ... do.	1,600		
Adams' 50 ,, ... do.	800		
Little Grey 40 ,, ... do.	640		
Wood's 50 ,, ... do.	800		
Carried forward			

Estimate for one mile when gauge is 6 inches.
To be added per mile when works are in the valley of the Buller, and gauge is 6 inches.
To be added per mile when works are in the valley of the Buller, and gauge is 4 feet 8½ inches.
To be added per mile when works are in the valley of the Buller, and gauge is 4 feet 8½ inches.
Estimate of trunk line from Nelson to Cobden, when gauge is 3 feet 6 inches.

Brought forward £

Little Grey ... 50 " ... do. ... 800			
" " ... 200 " ... do. ... 3,200			
Big Grey 400 " ... do. ... 6,400			
Duffer's Gully . 50 " ... do. ... 800			
Ahaura river . 300 " ... do. ... 4,800			
Nelson's 200 " ... do. ... 3,200			
Red Jack's 60 " ... do. ... 960			
Maori's 50 " ... do. ... 800			
Twelve-Mile ... 40 " ... do. ... 560			
Big Grey 400 " ... do. ... 6,400			
Deep Gully ... 50 " ... do. ... 800			
Coal Creek 100 " ... do. ... 1,600			
	69,960	0	0
Protective works on the Buller ...	8,400	0	0
Retaining and Breast-walls, say ...	1,000	0	0
Viaduct at 99½ miles, or in lieu, cross the Buller twice ...	9,600	0	0
Road Bridges, and Diversion of Public Roads ...	2,000	0	0
Stations ...	9,000	0	0
Land ...	17,000	0	0
Telegraph, 180 miles, at £60 ...	10,800	0	0
Detailed Survey ...	6,300	0	0
Total ...	£627,569	0	0

Estimate of branch to Westport, when gauge is 3 feet 6 inches.

149. Estimate of branch to Westport:—

27 miles of Railway, all of which is in the Valley of the Buller, at £4052 14s. Od. per mile ...	109,423	18	0
Small bridges and culverts, 810 feet at £4 ...	3,240	0	0
Retaining and Breast-walls, say ...	3,000	0	0
Stations ...	1,600	0	0
Land ...	3,000	0	0
Telegraph, 27 miles at £60 ...	1,620	0	0
Detailed survey ...	945	0	0
Total ...	£122,828	8	0

Estimate for Rolling Stock, gauge being 3 feet 6 inches.

150. The Rolling Stock for such a Line would not be heavy, and may be taken as follows:—

10 locomotives, at £2,000 ...	20,000	0	0
10 passenger carriages, at £200 ...	2,000	0	0
5 guard vans, at £200 ...	1,000	0	0
40 cattle trucks, at £50 ...	20,000	0	0
300 coals trucks, at £40 ...	12,000	0	0
Repairing shop and machinery, say ...	5,000	0	0
Total ...	£42,000	0	0

Cost of trunk and branch, when gauge is 3 feet 6 inches.

151. The cost of the trunk line and the branch would therefore be about as follows:—

Trunk ...	627,569	0	0
Branch ...	122,828	8	0
Rolling stock ...	42,000	0	0
Total ...	792,397	8	0
Contingencies at £10 per cent. ...	79,239	14	0
Total ...	£871,637	2	0

Rate per mile.

152. Therefore, as the total distance is 207 miles, the cost per mile will not exceed £4,210.
153. Estimate for trunk line, gauge 4ft. 8½in.:

125 miles of Railway, no part of which is in the valley of the Buller, at £2,265 18s. Od. ...	283,237	10	0	Estimate of trunk line, when gauge is 4 feet 8½ inches.
55 miles of Railway, the whole of which is in the valley of the Buller, at £4,706 6s. per mile ...	258,846	10	0	
Small Bridges as before ...	25,000	0	0	
Large Bridges as before, but increased in cost according to increased width ...	77,247	0	0	
Protective Works on the Buller ...	9,275	0	0	
Viaduct ...	10,600	0	0	
Road Bridges, and Division of Roads ...	2,000	0	0	
Retaining Walls ...	1,000	0	0	
Stations ...	9,000	0	0	
Land ...	17,000	0	0	
Telegraph ...	10,800	0	0	
Detailed Survey ...	6,300	0	0	
Total ...	£710,306	0	0	

154. Estimate of Branch to Westport—

27 miles of Railway, all of which is in the Valley of the Buller, at £4,706 6s. per mile ...	127,070	0	0	Estimate of branch to Westport, when the gauge is 4 feet 8½ inches.
Small bridges as before ...	3,240	0	0	
Retaining and Breast-walls ...	3,000	0	0	
Stations ...	1,600	0	0	
Land ...	3,000	0	0	
Telegraph ...	1,620	0	0	
Detailed Survey ...	945	0	0	
Total ...	£140,475	0	0	

155. Rolling Stock ...

Rolling Stock ...	£46,395	0	0	Estimate for Rolling Stock, gauge being 4 feet 8½ inches.
156. Summary:—				
Trunk Line ...	710,306	0	0	
Branch Line ...	140,475	0	0	
Rolling Stock ...	46,395	0	0	
Total ...	£897,176	0	0	
Contingencies at £10 per cent. ...	89,717	12	0	
Total ...	£986,893	12	0	

157. Estimate of trunk line, gauge 5ft. 3 inches:—

125 miles of railway, no part of which is in the valley of the Buller, at £2,474 18s. 6d. per mile ...	309,365	12	6	Estimate for trunk line, when gauge is 5 feet 3 inches.
55 miles of railway, the whole of which is in the valley of the Buller, at £5,194 16s. per mile ...	285,714	0	0	
Small bridges as before ...	25,000	0	0	
Large bridges as before, but increased in cost according to increased width ...	80,162	0	0	
Protective works in the Buller ...	9,625	0	0	
Retaining and Breast walls ...	1,000	0	0	
Viaduct at 99½ miles, or in lieu, cross the Buller twice ...	11,000	0	0	
Road Bridges and diversion of public roads ...	2,000	0	0	
Stations ...	9,000	0	0	
Land ...	17,000	0	0	
Telegraph ...	10,800	0	0	
Detailed Survey ...	6,300	0	0	
Total ...	£766,966	12	6	

158. Estimate of branch to Westport—

	£	s.	d.
27 miles of railway, all of which is in the valley of the Buller, at £59,194 16s. per mile...	140,252	0	0
Small bridges and culverts ...	3,240	0	0
Retaining and Breast walls, say ...	3,000	0	0
Stations ...	1,600	0	0
Land ...	3,000	0	0
Telegraph ...	1,620	0	0
Detailed Survey ...	945	0	0
Total...	£153,664	0	0

159. Rolling Stock

	£	s.	d.
Rolling Stock	48,125	0	0

160. Summary:—

	£	s.	d.
Trunk Line ...	766,966	12	6
Branch Line ...	153,664	0	0
Rolling Stock ...	48,125	0	0
	968,755	12	6
Contingencies at £10 per cent ...	96,875	11	3
Total	£1,065,631	3	9

161. A summary of the cost of the Railway on different gauges will stand thus:—

	£	s.	d.	Per mile.
3 feet 6 inches gauge =	£871,637	2	0	£4,210
4 feet 8½ inches do. =	£986,893	12	0	£4,768
5 feet 3 inches do. =	£1,065,631	3	9	£5,148

162. It is extremely difficult to estimate the income to arise from the conveyance of passengers and goods through a new country, where the population of the interior, being chiefly connected with gold diggings, is very fluctuating, so that in the estimate of income that follows, the items for goods and passengers may be taken as somewhat empirical; but from tables very carefully prepared in 1866 by James Mackay, Esq., showing the traffic from Nelson to the West Coast for twelve months, and which that gentleman has very politely placed at my disposal, I draw the following result:—

Results from Mr. Mackay's tables.	
Kegs, bags, boxes, bales, and packages ...	44,197
Cattle ...	435
Sheep ...	5,230
Pigs ...	410
Goods not detailed in tons ...	1,360

163. We may fairly presume that one-half of both goods and passengers were for Hokitika and other places besides the Buller and Grey, and therefore would not have passed over the Railway had it existed. On the other hand, a large number of passengers and some goods go overland from Nelson for the interior, of which there exists no account; and if we take the settled districts into account through which the line would pass, I am of opinion that the passengers would be equal to at least 5000 going through an average distance of one hundred and sixty-one miles, immediately upon opening of the line.

164. Estimate of Income:—

	£	s.	d.	Estimate of Income.
Profits on 113,000 tons of coal, at 4s ...	22,600	0	0	
Carriage of 50,000 tons of coal from Brunner mines to Cobden = 6 miles at 1½ penny per mile ...	2,041	13	4	
Carriage of 50,000 tons of coal from Mount Rochfort to Westport, distance about 14 miles, at 1½ d. penny per mile ...	4,083	16	8	
Carriage of 13,000 tons of coal from Granges Point to Nelson, 122 miles at 1½ d. penny per mile ...	9,251	13	4	
	15,376	13	4	
Deduct £50 per cent for working expenses ...	7,638	6	8	
	7,688	6	8	
Gold Diggers' Licenses, say ...	4,000	0	0	
5000 through passengers, half to or from Westport and half to or from Cobden, average 161 miles at £2 the trip ...	10,000	0	0	
22,000 kegs, boxes, bags, bales, and packages, at 5s. each ...	5,500	0	0	
400 cattle, at £2 ...	800	0	0	
5,000 sheep, at 7s. ...	1,750	0	0	
400 pigs, at 7s. ...	140	0	0	
600 tons of goods, at 25s. ...	750	0	0	
Mails ...	200	0	0	
	19,140	0	0	
Deduct £50 per cent for working expenses ...	9,570	0	0	
Total income	£43,858	6	8	

165. Now, whatever gauge is adopted for the railway, I assume that the 152,000 acres of flat land will be sold during the construction of the railway, and that it would realise £380,000; so that the capital to be provided for the work would be—
 If a 3 feet 6 inches gauge ... £490,037
 If a 4 feet 8½ inches do. ... £605,890
 If a 5 feet 3 inches do. ... £684,631

166. If, then, a 3 feet 6 inches gauge was adopted, the dividend would be £9 19s. 9d. per cent; if a 4 feet 8½ inches gauge, £8 1s. 2d. per cent; if a 5 feet 3 inches gauge, £7 1s. 9d. per cent.

167. But let us assume an extreme case, that is, that none of the good land is sold for some time after the line is made, even then capitalists investing in the line would be quite safe, for a dividend of £5 0s. 7d. per cent. would be realised on the cost of a line whose gauge was 3 feet 6 inches, without the sale of any land whatever, or without any account being taken of increased sale of coal at Nelson beyond what now takes place.

168. If, however, the flat land were sold, there would still remain 1,943,000 acres of land belonging to the company, which, excluding the value of the minerals, would, at so low a figure as two shillings and sixpence per acre, represent £242,875 to be gradually realised for the shareholders.

I have the honor to be, Sir,
 Your obedient servant,
 HENRY WRIGHT,
 Civil Engineer, A.I.C.E.

Nelson, 31st March, 1868.