

1882.
NEW ZEALAND.

PROPOSED WATER SUPPLY ON GOLD FIELDS.

(REPORTS ON)

Presented to both Houses of the General Assembly by Command of His Excellency.

No. 1.

PROPOSED WATER RACES ON MAEREWHENUA GOLD FIELDS.

J. A. McARTHUR, Esq., to the Hon. the MINISTER for MINES, Wellington.

Public Works Department, Head Office, Middle Island,
Dunedin, 5th May, 1882.

SIR,—

In accordance with your instructions, Mr. O'Connor was requested to report on the subject above quoted, and I have now the honor, by direction of the Engineer-in-Charge, M.I., to forward enclosed herewith a copy of Mr O'Connor's report for your information.

The Hon. the Minister for Mines, Wellington.

I have, &c.,
J. A. McARTHUR.

Enclosure in No. 1.

C. Y. O'CONNOR, Esq., to the ENGINEER-IN-CHARGE, Middle Island.

SIR,—

Public Works Office, Dunedin, 1st May, 1882.

In accordance with your instructions that I should report upon the probable cost and prospects of the water races proposed by the Maerewhenua Mining Association for the development of the gold fields near Livingstone, I proceeded to that district on 22nd ult., and took a general reconnaissance survey of it with barometer levels during that and the three following days. In this I was very materially assisted by the chairman and two of the members of the Mining Association, Messrs. Roberts, Frater, and Smith, who kindly accompanied me over the ground, and supplied me with much valuable information which it would otherwise have taken a long time to obtain. The work of locating the races was also very much facilitated by a sketch map obtained from the Survey Department, showing the levels of the principal hills, &c.

From the information supplied to me by the representatives of the Mining Association above alluded to, it would appear that there are two distinct water supplies required; one for the workings on the Livingstone (or south) side of the Maerewhenua, and the other for the workings on north side of same. Considering these separately, I find as follows:—

Water Supply for Livingstone (or south) Side of Maerewhenua.

This is proposed to be attained by a water-race from the south branch of the Maerewhenua river, constructed to carry about ten heads of water, together with reservoirs capable, in the aggregate, of holding that supply for sixteen hours out of the twenty-four. If ten heads were always to be had out of the creek, the effect of this arrangement would, therefore, be to enable a supply of thirty heads of water to be served out to the miners during each working day of eight hours.

Having roughly located what appeared to be the best course for this race upon the ground, as indicated, on plan attached, by a brown line, I find that its length would be about 11 miles, and its cost, including reservoirs, about £5,500. In this estimate there is included the probable cost of a syphon pipe, 17 inches in diameter, to carry the water across the Maerewhenua, at a point about five miles from the source of the race, it being thought better to keep the race for that distance on the opposite side of the stream from Livingstone, in order to save distance and fall by avoiding the long detours necessary to head Stoney Creek and Bushy Creek, and other tributaries of the Maerewhenua on Livingstone side.

I also estimate that the cost of maintenance and management of this undertaking would be about £400 per annum.

The price at present paid for water at Livingstone seems to average about 35s. per head per week of six working days of eight hours each.

Were ten heads of water constantly procurable from the creek, therefore, and were thirty heads always saleable during each working day of eight hours, at 35s. per head per week, the gross revenue of this undertaking would be £2,790 per annum, and the net revenue £2,390 per annum, which latter

sum would pay off the principal, with 10 per cent. interest thereon, in a little under three years, and I have no doubt that the auriferous ground immediately commanded by the race would last out more than that time, even if fully worked with thirty heads of water per day.

On the theoretical basis above assumed, therefore, it would appear that the undertaking would be highly remunerative, but it would be very delusive to suppose that any such results as these could be reasonably anticipated in practice, for the following reasons:—

First.—The supply of water constantly procurable from the creek would not, in my opinion, be anything like ten heads, and it would be very difficult to say, under existing conditions of water rights already granted, how much it would be, or to guarantee that it would amount to more than two or three heads. When I saw the creek at proposed source of race, on 23rd ult., it was running about eight heads, which may be about its average, but is certainly not its minimum, and out of that there has to be an allowance made for a water right held, higher up the creek, for six heads, which was not being exercised at all at the time I was there. Besides this, too, there are two other water rights, amounting together to sixteen heads, held still higher up the creek, which, I estimate, from the water I saw in the races, could only have been partially exercised during the time I was there, so that if all these existing rights were fully exercised there would only be available, during dry weather, for the race now proposed, such water as finds its way into the creek between the level of the three existing rights above mentioned and the source of proposed race, a quantity which could not be safely estimated at more than two or three heads. Unless the existing rights, or some of them, are abandoned, or otherwise arranged for, there would, therefore, be no guarantee that, although not fully exercised now, they would not be so at an early date, thus limiting the available supply of water which can safely be reckoned upon, under existing conditions, as constantly procurable for proposed race, to two or three heads.

Second.—It is found in practice that, in consequence of a variety of causes, such as the cleaning up of claims, or the abandonment of same, and such like, it is not possible to sell constantly all the water available in a race for gold-mining purposes, and the average of sales from these causes is generally reduced to about two-thirds of the available supply. This applies all the more strongly where the supply is a large one.

Third.—It very seldom happens that the price ruling for water at any given time is maintained when the supply is increased; and this is all the more the case when the supply is largely increased. It would not, therefore, be safe to estimate in the present case, that more than from 20s. to 30s. per head of water would be obtained for any considerable increase in present supply, or for any considerable time.

Taking now the minimum, as I before took the maximum of the possible results, there would be say $2\frac{1}{2}$ heads of water constantly procurable from the creek, which is equivalent to $7\frac{1}{2}$ heads per day of 8 hours, and assuming that two-thirds of this is sold constantly at 20s. per head per week, the gross revenue would be £260 per annum. As the maintenance and management then of even a very small race, if held by a company or the Government, would absorb all this revenue, there would be nothing left for interest; so that although the cost of construction (including reservoirs,) under these conditions would not probably exceed £4,000, it is evident that the result would be a loss of that amount.

Unless the existing conditions as regards available water became modified, therefore, it would appear that the proposed undertaking offers no prospects of being a financial success.

Water Supply for Workings on North Side of Maerewhenua.

This is proposed to be attained in a similar way to proposal for south side, namely, by a water race from the Otekaike River, constructed to carry about 10 heads of water (along one of three alternative routes), together with reservoirs capable in the aggregate of holding the supply from race for sixteen hours out of the twenty-four. The alternative routes are as follows:—

First alternative: "The short tunnel line," indicated on map in green.—By this proposal it is suggested to take all the water available at source of race out of the Otekaike River, and, after carrying it for a mile along the Otekaike Valley, and through a tunnel into the north branch of the Maerewhenua, to let it drop into that stream, from which it would be picked up lower down, together with such water as might be available in north branch of Maerewhenua itself, and carried on to the auriferous ground proposed to be commanded. The length of race which would have to be constructed for this project would be about $27\frac{1}{2}$ miles, of which 46 chains would be tunnelling, and its cost, including reservoirs, would be about £15,000. In order to pick up a little more water out of tributaries of the Maerewhenua, it might be desirable also, in connection with this proposal, to construct a catchwater race, as indicated on plan by green dotted line, and the length of this would be about 6 miles, and its cost about £1,000. The total cost would, therefore, be about £16,000.

Second alternative: "The long tunnel line."—This would commence at Otekaike River, at head of green line, and would follow same for 1 mile; then along strong red line for a distance of 10 miles; then along dotted red line for 87 chains; then down creek (called Ben Lomond Creek,) to green line at the figures 1520; then along green line to end. The length of race to be constructed in this case would be about 27 miles, of which 87 chains would be tunnelling, and its cost, including reservoirs, would be about £21,000.

Third alternative: "The contour line."—This would commence at Otekaike River, at head of green line, and would follow same for 1 mile, and then along strong red line to its end. The length of race to be constructed along it would be about 33 miles, and its cost, including reservoirs, would be about £12,000.

As the second of these alternatives is much more costly than either of the others, without possessing any special advantages commensurate with its extra cost; and as it would also, on account of the long tunnel, take much longer to construct than either of the other routes, I think it might safely be left out of consideration.

Confining the consideration then to alternatives one and three, it will be seen that the former is the more costly, but promises a larger water supply, and, being shorter by 6 miles, it would be somewhat cheaper to maintain. This latter consideration, however, would be almost, if not quite neutralized, if the proposed catchwater race is constructed, as that would make the length the same in both cases.

Were there 10 heads of water always available in the Otekaike, there would be no object in going to any extra expense to get more; but I doubt if there are always 10 heads in it. At the time I saw it, there was about that quantity, and it is said to diminish very little in even the driest weather; but I doubt if it could be safely reckoned on for more than 7 heads at its minimum, and the Maerewhenua, with the aid of catchwater race, would, I think, supply the other 3 heads.

If 7 heads is worth £12,000, 10 heads would be worth £17,143, so that on that basis it would seem that the first alternative, estimated to cost £16,000, has a slight advantage.

The advantage on that score is so very slight, however, that taking into consideration the disadvantage of the tunnel, which would take longer to construct than any similar length of contour race, and also taking into consideration that the contour race commands more of the country believed to be payably auriferous, I would recommend the latter, namely, Alternative No. 3, as being the best to undertake.

Regarding its prospects then, and taking in this case, as there is some foundation to go upon, a reasonable mean, instead of a maximum and a minimum as in first case analysed, the financial aspects of the question would probably be about as follows:—

I estimate that the cost of maintenance and management would be about £700 per annum.

Assuming that there would be on the average an available supply of 8 heads of water from all sources, this would be equivalent to 24 heads per day of 8 hours, and reckoning on two-thirds of this being constantly sold at, say, 30s. per head per week, the gross revenue would be £1,248 per annum, and the net revenue £548 per annum.

On this basis it would seem that the undertaking would only return $4\frac{1}{2}$ per cent. interest on its cost (£12,000), without anything for sinking fund; but I think I have rather under estimated than over estimated the probable results, as it is probable that more than 8 heads will be frequently available, and even an occasional extra supply of that sort might possibly be sold for irrigation purposes, if not for mining. It is possible, also, that the one-third of total quantity which I have reckoned upon as running to waste continuously through cleaning up of claims, &c., might also be disposed of for irrigation; and, if this were so, there would probably be a net revenue sufficient to pay 5 per cent., with a slight margin over.

As to the length of time during which the auriferous ground commanded would support such a race as the one proposed, it is of all the items which have to be estimated the most difficult one to arrive at; but, judging from enquiries which I made on the ground, and from observations of the workings done up to date, I should say that it would be well within the mark to estimate that the ground in this case would support the proposed race for fifteen or twenty years to come.

With regard to the levels which I have proposed for the races, as indicated by figures in corresponding colors alongside them on the map, it may be held by the miners interested that these are susceptible of improvement, and such is very probably the case, as the time at my disposal did not admit of my going into each race in very great detail; but any such probable alteration of level will not materially affect either the cost or the length of the races, as the creeks from which they take their source are so steep, that a considerable difference of level up or down is attained in a very short distance.

The levels stated on map, with the exception of those at trig. stations which were obtained from Survey Department, are all from barometer readings, so may not be absolutely correct; but they were taken with every reasonable care, and referred to a stationary barometer, so that I do not anticipate that any of them are very seriously in error. The heights are in all cases from sea level.

The fall estimated for races is 10 feet per mile throughout, except in the case of the syphon pipe across south branch of the Maerewhenua, where a fall of 10 feet in 10 chains is allowed.

In estimating the cost of the races, I have assumed that they would be cut all in the solid, as that has been the custom in all such works with which the Government have been in any way concerned. I find that in the locality in question, however, the most of the existing races are only partially cut in solid, the remainder of depth required being attained by building up on low side with sods, &c. This, of course, considerably reduced the cost, so that if constructed on that basis, the proposed races would cost less than I have estimated them at; but it is not a class of work which I should recommend, the saving in first cost being generally soon compensated for by heavier expense in maintenance.

In addition to the plan above alluded to, I enclose also a section of the Ben Lomond Saddle, through which the long tunnel was proposed to pass, in order that the length of a tunnel at any other level can be approximately ascertained if desired.

The Engineer-in-Charge, Middle Island.

I have, &c.,
C. Y. O'CONNOR.

No. 2.

MIKONUI WATER-RACE.

C. Y. O'CONNOR, Esq., to the UNDER-SECRETARY for GOLD FIELDS, Wellington.

SIR,—

Government Buildings, Wellington, 23rd May, 1882.

I have the honor to forward herewith a report by Mr. Martin, District Engineer for Westland, on the subject of the above race, and containing the information which Hon. Mr. Rolleston desired to be procured for him when in Dunedin a short time back.

As I quite concur in Mr. Martin's recommendations, there is no necessity for my writing a separate report, but I have added a few marginal notes to Mr. Martin's memorandum in further illustration of the ideas which he wishes to convey.

I have, &c.,
C. Y. O'CONNOR,
(For Engineer-in-Charge, Middle Island.)

The Under-Secretary for Gold Fields, Wellington.

Enclosure 1 in No. 2.

[NOTES taken down by Mr. Blair, from Hon. Mr. Rolleston's dictation, 29th January, 1882.]

1. Make out a short history of scheme to be sent to Mr. Hall; show expenditure involved; state prospects of undertaking; show how expenditure, already incurred, is of no use without acquiring Donnelly's Creek water, or else constructing long tunnel and other works beyond it; state time it would take to construct long tunnel; show what, if anything, would be gained by buying Donnelly's Creek water, and turning it down Government race instead of present race; what would be the value of additional pressure thus gained on Ross Flat.

2. A company has proposed to take up this undertaking. Should Government entertain this proposal, it would be necessary to give the Company some concessions, and arrange the terms upon which the undertaking would be made over to them. Will you suggest the form and scope of concession which you think it would be reasonable for Government to make, and which would afford reasonable prospect of a company being floated; also the terms of lease or grant to company.

Enclosure 2 in No. 2.

MEMORANDUM for Mr. MARTIN.

Public Works Office, Dunedin, 11th February, 1882.

As you have all the necessary information on your file of papers, will you please let me have short history, &c., of above race, as asked for by Hon. Mr. Rolleston, in paragraph 1 of memorandum attached, in order that Mr. Blair may be able to supply same as requested. It should be as brief as possible.

The history of the race should state the first attempt to float it into a company, and its survey by promoters of said company. Subsequent purchase of plans by Government. Treaties with Mr. Brogden. Extracts from report I made for Mr. Brogden's information. Authorization of survey, *via* Totara side. Extracts from report on that. Subsequent provisions made by Government for construction or subsidy to race. Also, provision made for guaranteeing interest, in (I think) the Appropriation Act of 1877. In all cases give dates.

As regards paragraph No. 2, you might also please suggest the basis on which you think the undertaking could probably be floated with a reasonable amount of Government aid, and, in consideration of such, the amount of protection which should be bargained for, on behalf of the public and the customers, for water.

C. Y. O'CONNOR.

Enclosure 3 in No. 2.

MEMORANDUM for ENGINEER-IN-CHARGE, Middle Island, Dunedin.

Public Works Office, Greymouth, 15th March, 1882.

In reply to memorandum of the 11th of February, I enclose herewith a separate memorandum complying with first portion of Hon. Mr. Rolleston's memorandum. I also send attached thereto a plan of the race indicating various information in connection with report.

I have made the memorandum as brief as I considered consistent with clearness, but, as it extends over a good many pages, have added marginal notes to facilitate reference.

With regard to the second item in Hon. Mr. Rolleston's memorandum, I may, in the first place, say that the probability of a company taking the thing up is not now very great. When the Minister was here the promoters saw him about it (which is probably the origin of his note), but they did not seem to know much of the merits of the undertaking they contemplated, and having since learned more about it, have, I fancy, almost abandoned the idea. It is possible, however, that liberal concessions might revivify it.

Although I believe that the Mikonui Race, merely as the Mikonui Race, would probably be a financial failure, I see no reason why it should not, in conjunction with concessions of auriferous ground, be payable. In fact, it has long seemed to me that to make water-races of great extent, as separate investments, is placing them in a very unfair and disadvantageous position. The reason is simply this: that the *true* price of the water is never paid; that the utmost the water-race can get is so many pounds per week for so many heads of water; that a uniform price being fixed per head per week, this price is generally based upon the least payable ground in the locality; that while the miners using the water may be, and often are, making fortunes, the water-race, without which the gold could not be got, receives only a comparative pittance which enables it to pay 1 per cent. towards interest, or something like that, and, in fact, the race, while sharing *all* the perils of the venture, participates in only a comparatively small share of its success. But if the water-race owners are also the miners, then a deficiency in the water-race accounts will come out of the profits of the claim, and by silent adjustment the true price of the water is paid. (a.)

(a.) This is quite true. In event of Government retaining auriferous land for endowment of water-race, its value might be realized by putting it up to auction for lease in short periods, and the true value might be ascertained by trials during intervals between leases.—C. Y. O'C.

As to the concessions which should be made to a company taking up this project, then, I think, they should take the form of grants of presumably auriferous land, so that if the race fails to repay itself by its water sales, they may have a chance of obtaining the requisite refund from the profits of their claim. (a.)

The next thing to decide would be to what estimated monetary extent these grants of land should be given. In considering this, the present circumstances of Ross Gold Field must be taken into account.

A large area of ground,—160 acres,—comprising the best part of Ross Flat, is, I believe, now held by the Ross Flat Gold Mining Company,*—(Comiskey & others,)—and they are also the owners of the Totara and Jones's Creek Water Race. This Company, who would under other circumstances, be the largest consumers from the Mikonui Race, own a water race of their own, and it would be largely in their power to dictate terms to the holders of the Mikonui Race as to what rates they should sell water for,—that is, they could without materially injuring their own prosperity, withhold purchasing it until they got it at the lowest rate which it is possible to reduce it. (b.)

Again, as to the sluicing-ground on the terraces around Ross, a large area,—over 20 acres,—of reputedly the best ground is held by two Companies (the Mont D'Or and the Greenland Companies), and they also have their own supplies of water, though the supplies are not such as to place the owners in the same position of independence as the Company on the flat. They would, however, be intermittent purchasers only, as in wet weather their own supplies would be sufficient for them, and it would only be in dry weather they would require to buy from the Mikonui race.

These considerations appear to me to point to low water rates and irregular sales, and hence waste and loss of water and small profits.

The claims above referred to comprise the principal workings in the locality; but the miners generally would, of course, so far as lay in their power, do their best to keep down water rates.

(c.) The best means in the power of a Company to command a reasonable price for water, would be ground of their own, upon which they could use it in case of an endeavour on the part of the others to avoid the payment of reasonable rates.

I think, therefore, a prudent investor putting his capital into a work of this kind, would require a concession of such an area of auriferous ground as might be estimated to recoup to him his outlay on the race.

Of course, it is not likely that he would have to use *all* the water himself, for want of purchasers, nor would it probably be to the public advantage that he should do so; but it seems to me that it would not be prudent for him to omit providing for this contingency, and I think this is a reasonable basis on which the concession might be computed.

From enquiries made, I think the profits from an acre of ordinary auriferous land in locality would be about £700, and (if the existing works are handed over as part of concession,) the probable expenditure required being £71,527, the area from which capital would be recouped would probably be about 100 acres. But of course, in selecting land, it would be impracticable to so select it that it should all be auriferous, so a large allowance would have to be made for this. It is difficult to say what should be allowed; but I think out of an area of 250 acres, carefully selected, 100 acres would be auriferous.

If the Company were required to pay back the cost of the work done (£11,500), the concession would require to be proportionally larger. They would also require sufficient land on each side of the race for its protection—say 3 chains on lower side, and 2 chains on upper (d.)

The conditions required by the Government in the public interests should, I think, be—(1.) That the long tunnel be started at once, and pursued with all proper diligence till completed. (2.) That the section from Donnelly's Creek downwards, be completed within twelve months. (3.) That the portion from head of race to upper end of long tunnel be commenced within two years, and completed within four years. (4.) That up to 15 heads in open race, and 10 heads in supply pipe, the water available shall be at all times open to public purchase at a rate not exceeding £ (e.) per head per week in open race, or £ (f.) in supply pipe, and under rules to be approved by Government. (5.) That, if Company fail to complete race within six years, or to finish the portions within allotted time, Government may take possession, and finish it, and hold it until returns have recouped their outlay. (6.) Government reserve right of purchase. (7.) That, if after completion, the conditions of working are broken, Government may enter and work it at cost of Company. (8.) That the race shall be capable of carrying at least 50 statute heads of water.

The concessions might take this form—(1.) That, unalienated lands may be selected, in blocks of not less than 20 acres, within four miles of Ross, and same reserved up to 250 acres total area. (2.) That, on completion of Donnelly's Creek section, 80 acres will be granted as a special claim under clause 93 of Mines Act; 80 acres more when 120 chains of long tunnel are driven; and 90 acres more on completion of race. (3.) The Company can take necessary land under Public Works Act, and the usual conditions to give them power to carry out work.

The above suggestions are, of course, only rough indications of the line in which concessions and conditions would probably go, the matter being in too early a stage yet to do more.

I am of opinion that the above concessions are the least upon which it would be worth while for any Company to take this thing up, and it is quite likely they would stand out for a good deal more.

F. W. MARTIN,
Resident Engineer.

(a.) There is no more objection to making endowments of land on gold fields for construction of water races than to making endowments in agricultural districts for construction of harbors.—C.Y.O.C.

(b.) I doubt this. Their supply is not large enough to enable them to fix a rate for the whole field.—C.Y.O.C.

(c.) Don't think Government would work a claim to advantage with day laborers. They might, however, lease the land, or let the working of it, on terms.—C.Y.O.C.

(d.) Except where passing through existing claims.—C.Y.O.C.

(e.) £3. (f.) £6 to £10.—C.Y.O.C.

* This Company also includes the claim held by R. W. Hanbury & Co., shown on tracing.—F.W.M.

Sub-Enclosure.

MEMORANDUM of History of Project and of present aspect of Case.

In 1869 a large number of people, believing that a water race from the Mikonui river to supply the gold workings at Ross would be remunerative, joined together to make a survey of the work, with the view of forming a company for its construction, with the expected aid of a subsidy from the Westland County Council, under the then existing regulations for aiding such enterprises. A copy of which regulations is attached.

A survey was accordingly made of the route now known as the "Mikonui Route." The general results of this survey were as follows:—That the total length of race would be a little over twenty miles, and its probable cost about £45,000. That there would be a good deal of timber work upon it, and that it would be subject to land slips, and rather expensive to maintain; also doubtful if the ground would hold in the water, being in some places very porous.

Many attempts were made by the late Mr. G. H. Tribe (then M.H.R. for Totara District), and others interested, to float a company, but without success.

The next step taken (the plans of Mikonui route having meantime become property of Government) was, in 1872, when Mr. James Brogden was contemplating the construction of it on behalf of his firm, in consideration of certain concessions (*vide* enclosures) to be made in the form of land grants. After some investigation, however, the matter fell through. A copy of a report by Mr. O'Connor, C.E., made at this time for Mr. Brogden's information, is attached.

The following is an abstract statement of the then aspect of case as given in report:—Cost for a forty-head race, £45,000; cost for a ten-head race, £18,000. That expenditure would probably recoup itself at end of twelve years, and that thereafter it might be expected to yield £10,000 a year for twenty or thirty years more.

As above stated, Mr. Brogden did not pursue the matter, but it was urged on the attention of the General Government, and a vote of £2,000 was taken in 1874 for a resurvey of the race, with a view to obtaining the absolutely best line. This survey was made in the early part of 1875, and its result was the abandonment of the Mikonui route, above alluded to, and the adoption of what is called the Totara route. The survey was reported upon on 27th August, 1875, by Mr. O'Connor, from whose reports the following particulars are abstracted:—

Totara route.—Total length, 15 miles 54 chains 61 links; estimated cost, £81,000; capacity estimated for fifty heads. Its advantages over the other routes are:—(1st.) Being much shorter. (2nd.) Being much easier maintained. As to the probable returns from the race, Mr. O'Connor refers to his report, for Mr. Brogden's information, before referred to.

At this stage it may be well to call attention to the fact that a prominent feature about this Totara route is what is known as the "Long Tunnel," and is frequently referred to in the papers on the subject. This, as will be seen, on reference to the plan of the race, is necessary, in order to pass from the valley of the Totara into that of Donnelly's Creek. It will be about two miles long, and will cost about £20,000.

The survey having been completed, and the report sent in, a vote of £6,000 was taken in the session of 1875, and in the November of that year the Hon. Mr. Richardson, then Minister for Public Works, directed that Mr. O'Connor should report on the best way to spend this money, and should also ascertain, from the local authorities, whether they would give the gold fields revenue of the district as a pledge for its construction. As to the first question, Mr. O'Connor, in his report to Engineer-in-Chief, on 11th December, 1875, says:—

"With respect to the best means of utilising the £6,000 for this work, which is at present voted, I have gone carefully into the question, and hoped at one time that I might have been able to meet the views of the inhabitants of the district in suggesting some practical method by which the portion of the race line, near Ross, could be constructed forthwith and turned to immediate advantage towards draining the flat. This, however, I find, on investigation, is not practicable, as it would take at least two heads of water running constantly to be of any use, and a reservoir capable of holding that quantity of water for sixty days (which it would have to do, as it might not be practicable to get water to fill it at intervals of less than sixty days) would be a costly work in the most favorable situation, and particularly costly in the situation in question. I have come to the conclusion, therefore, that no part of the race can be made practically available until it is all completed to the Mikonui, and I would recommend that the long tunnel should be pushed ahead with all possible speed, and that the remainder of the works should be kept in abeyance till it is necessary to commence them, in order to have them completed contemporaneously with the tunnel, viz., until the tunnel is half through, or thereabouts."

As to the Hon. Mr. Richardson's second question, a public meeting was held at Ross, on the 4th December, 1875, presided over by his Honor the Superintendent of Westland, and it was resolved that the inhabitants were in favor of pledging the gold fields revenue as security for the construction of the race.

It is not on record, however, that the revenue was ever actually dedicated to that purpose, or that this pledge was the basis of any further arrangements.

Instructions were issued in February, 1876, to go on with the long tunnel, and tenders were called, first for a part, and afterwards for the whole of it, but without any practical result, as the first contractors threw up their contracts, and Government did not accept any tender on the latter occasion, tender being too high. This was in December, 1876.

Up to this time it will be observed that no other proposal for commencing work, except by starting long tunnel, had been acted upon. The action taken from the end of 1876, to July, 1879, was as follows:—

"The Immigration and Public Works Appropriation Act, 1877," clauses 9 to 12 inclusive, provides for the Government advancing half the cost of the race, excluding the long tunnel, provided the local bodies guarantee 3 per cent. on the outlay. No practical result followed this provision.

In the similar Act of 1878 provision was made for a contribution of £20,000 to the undertaking, provided that the Borough of Ross would guarantee the completion of it without any further call on the colonial revenue.

The work, however, remained in *statu quo* till July, 1879, when it assumed a new aspect altogether, and, in fact, a new project may be said to have been instituted. This project was in place of commencing with the long tunnel and going to Mikonui River for water supply to construct the race from Donnelly's Creek downwards, and to buy out the existing water rights in the creek, and to utilize them at the higher level of the Mikonui Race.

In pursuance of this project contracts have been let at various times, up to date, for sections of the race, representing a total expenditure (including liabilities) of £11,478, including two sections now in progress.

The existing water rights were offered to the Government in October, 1879, for £6,000, and could then have been purchased for that amount, but their offer not being closed with in April, 1881, the Ross Flat Gold Mining Company purchased these water rights for the sum of £6,000, at which they were under offer to Government, and the rights are still in their possession.

The present aspect of the case then is as follows:—(1st.) About £11,478 has been expended and contracted for on race from Donnelly's Creek downwards, which may be said to be of very little value, as a supply of water could only be got in flood time, as at other times the water is the property of private owners, and there is no prospect of forming reservoirs to store the flood waters in. (2nd.) The source from which a supply of water might have been got by purchasing existing rights is precluded, as those rights have fallen into the hands of a company who are not likely to part with them, except at a very advanced figure, and perhaps not at all. (3rd.) The long tunnel, which would probably take about four years to construct, and without which water from another valley cannot be obtained, is not started yet. The maps herewith indicate the extent of the work done and under contract.

Financial Position.

The financial position of undertaking is at present as follows:—

	£	s.	d.
<i>Already spent from Donnelly's Creek to Ross</i>	9,000	0	0
<i>Contracted for on same part</i>	2,478	0	0
<i>Yet to be spent:—</i>			
To complete above portion	4,527	0	0
Supply pipe at Ross	6,000	0	0
Long tunnel	20,000	0	0
Long tunnel to Cedar Creek	7,000	0	0
Cedar Creek to head of race, including headworks	34,000	0	0
Total probable cost	£88,000	0	0

Summary.

	£	s.	d.
Spent or contracted for	11,478	0	0
To be spent	71,527	0	0
	£88,000	0	0

As above remarked, the Ross Flat Gold Mining Company, who own the water rights in Donnelly's Creek, are not likely to sell now, except at an advanced figure; but it is to be presumed that there is some price for which they would sell, and it may be well to investigate what the Government could afford to pay them on a purely commercial basis.

The water supply derivable from Donnelly's Creek, if carried at the level of Mikonui race, would probably produce following revenue:—

	£	s.	d.
8 heads, for 250 working days per year, at £4 per head per week of 6 days	1,333	0	0
40 heads, for 50 working days per year, at £4 per head per week... ..	1,333	0	0
2 heads, for 300 days per year for pumping purposes, at, say £10 per head per week	1,000	0	0
Total	£3,666	0	0
Deduct for water lost through irregularity of sales, say one-third... ..	1,266	0	0
	£2,400	0	0
Deduct expenses, say	800	0	0
Net revenue	£1,600	0	0

I think this revenue might reasonably be counted upon, for, say 25 years, and the discounted value (at date,) of an annuity of £1,600 for that period would be £22,500, computing interest, at, say 5 per cent. That is to say, it would be justifiable to spend £22,500, in order to secure an annuity of £1,600 of 25 years' tenure; but, as before pointed out, £11,478 has been expended (and contracted for), and £4,527 must yet be spent to finish the race to Donnelly's Creek, and £6,000 for supply pipe to Ross: total, £22,000, or there would be only £500 left to lay out on purchasing water rights. If,

however, the money already spent is left out of consideration, it would appear that anything up to, say £10,000, might, if required, be paid for the Ross Flat Gold Mining Company's race and water rights; and that if this were done, and the race finished to Donnelly's Creek, the venture would probably return 5 per cent. interest (and recoup capital,) on the money yet to be spent, but not on the money spent or contracted for. It is very improbable, however, that the Company would sell for that price.

The altitude of the Mikonui Race above Ross Flat is about 480 feet, and that of the Company's race about half that height. The effect of raising the water would be that about 2 heads at the higher elevation would do the drainage for which 4 heads would be required at lower elevation; and, as these quantities represent approximately what would probably be required for purpose at present, the monetary value will be, say, the capital price of 2 heads of water released for sluicing purposes, or, say £2,000 on same basis as former computations of value herein.

It is not likely that more than twice the power above provided for would be required at any one time in the future, so the utmost money value that could be placed on the higher elevation from the "power" point of view, would not exceed £4,000. Of course, however, the higher elevation would enable the water to command more ground, and the greater pressure would add largely to its efficiency in sluicing operations, and so cheapen them and render them more profitable.

F. W. MARTIN,
Resident Engineer.

Greymouth, 15th March, 1882.

Enclosures.

A.—Map.

B.—Copy Regulations Westland County Council *re* subsidies to head water-races.

C.—Copy Messrs. Brogden's application for protection.

D.—Copy Report C. Y. O'Connor to the Engineer-in-Chief, dated 1st August, 1872.

B.—*Regulations of the County Council, under which Head Water Races Companies may receive Guarantees from the Council.*

[Adopted by the County Council, 22nd February, 1869.]

1. That in such cases as those alluded to in these Regulations, one-half the necessary capital should be guaranteed by the Council for the construction of head water-races.

2. The other half of the necessary capital shall be subscribed for, and at least one-fourth of the subscribed capital paid up by *bonâ fide* shareholders, such money to be paid into a separate account, in the names of the company and some person to be appointed by the County Chairman, and not to be withdrawn, except by cheques signed by the manager of the company and the person appointed by the County Chairman, as above.

3. All money received by the company, from whatever source, shall be paid into the account of the company alluded to in Regulation 2, and be subject to the restrictions contained in that section until the capital of the company be fully paid.

4. The company, applying for aid to the Council, shall be composed of at least twenty persons.

5. Each race, to be constructed under these regulations, shall carry not less than thirty Government heads of water.

6. Each company applying for a guarantee shall be registered, or be, in the course of registration, under "The Mining Companies Limited Liability Act, 1865."

7. Each race, which shall be constructed under these regulations, shall be constructed and maintained under the supervision and subject to the approval of the Government Engineer and Mining Surveyor of the District.

8. The capital of each race company, applying to the Council for a guarantee, shall be not less than £10,000.

9. No company shall be guaranteed unless the race to be constructed by it shall be first approved by a Board, to be appointed by the Council, consisting of two of its members (not including the Chairman), the County Engineer, and another Engineer not employed by the Government.

10. The water brought in by any company, obtaining the guarantee of the Council, shall be sold to the miners at rates to be fixed by the Council in each case.

11. No company shall receive a guarantee except on a vote of the Council.

12. In case the Council be called upon to pay any guarantee made under, or by virtue of, these Regulations, and have to pay the same, the property held by the company, for whom the said guarantee shall be paid as aforesaid, shall become the property of the County Council and inhabitants of the County of Westland in the same degree and to the same extent as the said property was held by the said company at the time of the forfeiture of the said guarantee.

C.—*Extract from "County of Westland Gazette," No. 10, of 16th April, 1872, page 56.*

APPLICATION FOR A WATER RIGHT LICENCE.

To the Warden of the Totara District.—Sir,—We herewith deposit the sum of twenty pounds (£20), as required by the Water Race License Regulations, and we agree, if our application (the particulars of which are hereunder set forth) be investigated, that such sum shall, in all respects, be held subject to the terms of such Regulations, so far as they are not at variance with the proposals undermentioned.

We are, &c.,

JOHN BROGDEN & SONS,
(by their Agent, Geo. H. Tribe).

Name and Address of Applicants.—Messrs. John Brogden & Sons, (care of Mr. George H. Tribe, Ross).

Style under which it is intended to conduct the Business of this Race.—The Mikonui Water Company.

Number of Heads of Water.—Forty heads from source, together with all drainage and streams on the line subject to existing rights.

Length of Race.—Twenty-one miles.

Capital proposed to be expended.—Forty thousand pounds (£40,000).

Term for which License is required.—Fifty years.

Precise Locality.—Commencing at the Mikonui River, above the second gorge, and cut along the Mikonui slopes of the Greenland Range to crest of range at Sailors' Gully.

Further Conditions.—We require a space of ten chains wide, being five chains on each side of the race, conveyed to us for the term of the lease, for the protection of the race and supply of timber, and a special claim for mining purposes, five chains wide, the whole length of the race, along the lower side of the protected belt.

Ross, 9th April, 1872.

D.

Sir,—

District Engineer's Office, Hokitika, 1st August, 1872.

I have the honor to forward herewith, by "Wallace," the plans and specifications of Mikonui Water Race.

With a few exceptions, which are figured on section, the pegs have been driven to regular gradients, so that the size of race being finally determined on, the depth of cutting suitable can be readily stated for each gradient. Along the fifth, fourth, and part of third divisions, where a 10-head race was contemplated, the depth is already figured for that quantity, and the sizes and heights of boxing and fluming entered in tabulations.

At the commencement of tunnels of considerable extent, the formation level has been dropped 2 feet for the purpose of taking the whole height of tunnel into conduit, and so saving in the width of the drive.

The total length of race line as now surveyed, is 20 miles and 12 chains, and at the prices given in original estimate, a race to carry 40 heads throughout would cost £37,500. For a race to carry 10 heads (commencing far enough back to secure the quantity, and carried to termination of recent survey, viz., 10 miles 44 chains), the cost on same basis would be £11,100; but I think it possible that tenders, if called for here now, would be found 20 per cent. over both of these estimates, as the rate of wages, when they were made, was 10s. per day, while now it is 12s.

The chief advantages which this race possesses are: First,—The large extent of ground which it commands, making it almost a certainty that the water will be disposed of somewhere, even if not saleable at the places on which reliance is at present placed. Second,—The permanent character of the supply from which it takes its source; and Third—Its great height over the deep workings on Ross Flat, rendering it available for hydraulic-pumping engines.*

Its disadvantages are, first—The costliness of the works involved as compared with other races; and second—The difficulty of access to the upper portion of the line, which would prevent its being very expeditiously carried out.

I believe that it must ultimately prove a remunerative undertaking; but it is quite possible that it would be several years in existence before it became so.

As far as it is safe to estimate from the data to hand, the receipts would probably balance the expenditure at the end of the 12th year as follows:—

	£	s.	d.		£	s.	d.
Cost of construction, say ..	45,000	0	0	Sales of water for 1st year ..	1,500	0	0
Interest for 12 years, at 7 per cent.				" " 2nd " ..	3,500	0	0
per annum, on absolute outlay,				" " 3rd " ..	5,000	0	0
say	30,000	0	0	" " 9 following years..	95,000	0	0
Maintenance and Superintendence							
for 12 years, say	30,000	0	0				
Total	£105,000	0	0	Total as before ..	£105,000	0	0

I have, &c.,

C. Y. O'CONNOR,

District Engineer.

J. Carruthers, Esq., Engineer-in-Chief.

Copy of Addendum to above, written in Wellington, on Mr. BROGDEN'S copy.

At the end of the 12th year the receipts would amount, as above shown, to £10,550 per annum, or at the rate of about 23 per cent. on the capital originally invested, and, so far as it is possible for any one to estimate them at the present time, they would probably remain at that rate for 20 or 30 years.

The price of water in all the calculations has been taken at £5 per head, which is the lowest that it would be likely at any time to sell for. Were the present prices ruling for water to be obtained, viz., £8 per head, the race might be expected to recoup capital in 7½ years, and would thenceforward pay at the rate of 36 per cent. per annum.

C. Y. O'C.

* The available height above Ross Flat would be about 450 feet.

No. 3.

NELSON CREEK WATER-RACE.

MEMORANDUM for the Hon. the MINISTER FOR MINES.

Questions as to future Maintenance and Extensions.

SIR,—

Public Works Office, Wellington, 6th June, 1882.

In accordance with your instructions when in Dunedin at end of January last, an investigation has been made into the above-mentioned subject, and I have the honor to forward herewith a memorandum from Mr. Martin thereon, covering a report with map prepared by Mr. Gordon.

As evidenced by copy telegrams of 5th instant, attached hereto, I was at first inclined rather to disagree with some of the conclusions arrived at by Messrs. Martin and Gordon, but on getting the further information asked for, it seems to fully bear out their views on the subject, in which I therefore now concur.

One other point, however, it may be desirable to draw attention to—namely, the immense difference between the estimated value of the gold which the race extension might enable the miners to obtain, and the estimated amount which they would pay for the water; the value of probable gold-yield in the case of one of the proposed extensions being estimated to be £956,000, while the total payments for water are estimated at only £125,000. Taking such low rates for water as the Government are usually obliged to adopt, there is very little hope that any more than £125,000 could be realised by sales of water only; but this fact points all the more to the desirability of reserving auriferous lands, to be afterwards leased to miners by auction, so that the rentals thus derived might aid the water rates in recouping the Government for the cost of construction.

C. Y. O'CONNOR,

Inspecting Engineer, Middle Island,
(for Engineer-in-Charge.)

Enclosures.

(Telegram.)

Government Buildings, 5th June, 1882.

Re Nelson Creek Race. Your memorandum 58-31, of 26th ultimo, Gordon's report (page 18). Why 70 men for 35 years? Why not 350 men for seven years? Would not available water supply be sufficient to keep 350 men going? Less quantity of water keeps that number of men going at Kumara and Waimea. If result to be anticipated were 350 men for seven years, or anything like that, it would materially alter the figures as to cost of maintenance and consequent interest, and it might also alter time at which deviation would become most desirable in view of getting the best practical results from expenditure to date and proposed.

F. W. Martin, Greymouth.

C. Y. O'CONNOR.

(Telegram.)

Greymouth, 5th June, 1882.

In reply *re Nelson Creek Race extension to Ahaura.* A different system of working is in use at Waimea and Kumara, and at former place water can be economised more, owing to greater facilities for storing it; while at latter the ratio of men employed to head of water is becoming reduced since system of sluicing in place of paddocking is coming into use. The least remote comparison is with Nelson Creek itself, which was adopted for that reason, and the race employs seventy (70) men there. Perhaps it might employ a few more at Ahaura, but not many. The report was drawn up in view of the tolerably certain probabilities, but the probabilities of the case are immense. I should look rather to a high price for water than to its employing a large number of men for financial success. Of course the number of men mentioned means miners directly employed in claims worked by race.

C. Y. O'Connor, Wellington.

F. W. MARTIN.

MEMORANDUM for C. Y. O'CONNOR, Esq., Wellington.

Public Works Office, Greymouth, 26th May, 1882.

By direction of Mr. Blair, I send you herewith report on the question of what should be done with this work when the bridges decay. This report has been very carefully compiled by Mr. Gordon after making full enquiries, and considering the matter from all the apparent aspects which it presents. I fully concur in the report.

I also enclose a copy of your memorandum No. 14/196, as you may require it in order to see exactly what were the questions asked, and may not have a copy with you in Wellington to refer to.

If the recommendations are approved immediate steps should be taken to reserve the land required for race and by-washes which is at present quite clear of prior rights, but will not likely remain so unless protected.

I have meantime mentioned the matter to the Warden, who will protect the land so far as he can, but cannot protect it against miners pegging out claims under miners' rights.

F. W. MARTIN,

Resident Engineer.

MEMORANDUM for Mr. MARTIN.

Public Works Department, Head Office, Middle Island,
Dunedin, 2nd February, 1882.

Mr. MARTIN,—

Hon. Mr. Rolleston has asked the following questions with regard to the above race:—(1.) How long will bridges last, and what is proposed to be done when they decay? (2.) Would maintenance for long period be costly, and what character of works would it involve?

In order to enable these questions to be answered from here, it will be necessary to get from you a good deal of information, as follows :—

A.—A list of the bridges in question, showing their locality, the probable original cost of each, the probable cost of re-erecting same of local timber similar to what is in them at present, the probable cost of re-erecting of durable timber, the approximate quantity of timber (C.B.M.) in each bridge, and the probable duration of each bridge, as existing on the assumption that they receive ordinary attention only, and not wholesale additions or renewals. Large high fluming can be put into list with the bridges.

B. If maintenance for long period be determined on, would it be possible, in the case of any or all the bridges or large flumes to head the gullies and carry race, in ditching or tunnelling, along sides of same, with flume across creek at crossing, much less costly than original flume or bridge, and, if so, what would be the cost of such diversion in each case.

C. The probable cost of maintenance each year, for, say, next ten years, including ordinary light repairs to bridges and large flumes, but exclusive of probable cost of reconstructing same, or of making diversions to avoid them.

D. The probable gross revenue from race each year, during, say, next ten years, and the probable number of men whom it would keep at work mining for same period.

E. The probable length of time which the ground, immediately commanded by race, and available for gold mining, will hold out, with the number of men who could conveniently work upon it each year.

F. The possible prospects of the race in the future, as regards carrying it on to ground not immediately commanded by it at present. The cost of so carrying it on. The revenue which would thus be derived from it, and for how long, and how many men would be benefited annually. Also, in event of its being so extended by some private company, rather than by the Government, the price which said company could afford to pay for water where taking it from existing race.

G. The probable increase of revenue, if any, which might be derived from buying out the riparian rights (and other rights liable to be interfered with) of leaseholders along Nelson Creek, and the probable cost of purchasing said rights. Also the extra number of men who could thus be kept at mining work, and for how long.

H. The object, so far as I understand it, which the Minister for Mines had in view, when asking the questions above cited, was to obtain sufficient information to enable him to decide upon the most judicious course of action for the Government to pursue with respect to this race in the future, and, especially, as regards the question of maintenance, whether the prospects are such as to warrant the reconstruction of the large bridges, from time to time, as they decay, or whether the whole of the works should not merely be maintained temporarily, and to only the capacity actually requisite, with the view of abandoning them at such period as they would seem likely to become unremunerative, either directly or indirectly.

C. Y. O'CONNOR.

The RESIDENT ENGINEER, Westland,—

Greymouth, 25th May, 1882.

In reply to the queries in Mr. O'Connor's memorandum, 14/196, referred to me for report, I have the honor to enclose herewith a tracing showing the extent of country that could be commanded by the Nelson Creek Water Race; and table, as requested in memorandum above quoted, showing a list of the bridges and flumes on the present line of race, with estimate for reconstructing the same, and the probable term that the present structures will last with ordinary maintenance, and report upon the various questions as follows :—

A. The table attached contains a list of the bridges and flumes on the main line of race, but does not include the branch races, as the present structures on branch races will probably work out all the ground that they command. In the columns headed "cost of ordinary timber," and "cost of all heart timber," former means that ordinary timber is whatever is to be found in the locality of the structures that are to be reconstructed, and to be of say $\frac{3}{4}$ heart wood. "All heart timber" means that nothing but the inner heart of the timber is to be used, and wherever practicable to use either black birch, rata, totara, or kawhaka. The rates estimated for timber per C.B.M. may appear at first sight to be high, but when the nature of the country, the difficulty of access, and the means of transit are taken into consideration, the rates estimated are only reasonable, and not more than what the timber is likely to cost.

The total amount of materials for reconstructing bridges and flumes is as follows :—

Timber, C.B.M.	...	...	...	...	...	...	...	...	9,228
Iron Work, lbs.	...	...	...	...	...	...	...	...	55,231

The total cost of reconstruction will be, viz. :—

							£	s.	d.
If ordinary timber is used	...	...	...	...	...	...	28,446	0	0
If all heart wood timber	...	...	...	...	...	...	28,060	0	0
Difference in cost	...	...	...	...	...	...	<u>£4,614</u>	<u>0</u>	<u>0</u>

In addition to either of these amounts, there will be £325 for puddle at ends of flumes, and, say 5 per cent. for supervision, contingencies, &c., which would make the first amount, say, in round numbers, £25,000, and the latter £30,000. The original cost of bridges and flumes was something like the present estimate.

B.—The term for which the present bridges and flumes will last with ordinary maintenance may be set down at from four to six years. A longer period could not be calculated on without wholesale repairs; but I think the principal structures will last from five to six years. Short deviations could

not be made to avoid bridges and large flumes, inasmuch as there is not sufficient fall in the vicinity of them to allow a tunnel to head the gullies, or nearly so; but a large deviation could be made from Wilson's Creek to avoid all expensive bridges and flumes between that point and the end of the race.

C.—The probable cost of maintenance, including ordinary repairs to bridges and flumes for the next six years, will be as follows:—First year, £1,750; second year, £1,800; third year, £1,800; fourth year, £2,000; fifth year, £2,200; and sixth year, £2,500.

D.—The probable gross revenue from sales of water during the next six years, and the number of men employed, would be as follows:—First year, £2,400; 68 men employed. Second year, £2,400; 68 men employed. Third year, £2,400; 68 men employed. Fourth year, £2,300; 66 men employed. Fifth year, £2,200; 62 men employed. Sixth year, £1,900; 54 men employed. From the above computation, the sixth year does not pay for maintenance.

E.—From what is known of the auriferous ground commanded by the present line of race, it will take probably from ten to twelve years to work out; but from four to six years will work out the principal portion of it.

F.—With regard to the future prospects of the race, a reconnaissance survey has been made from the end of the flume at Wilson's Creek peg, 6 miles 46 chains to the end of the race, *via* Callaghan's Creek, which shows that a deviation could be made to avoid all expensive bridges and flumes, by tunnelling from gully to gully, and crossing each creek or gully with a low flume from 6 feet to 8 feet in height. The total distance from Wilson's Creek to present end of race by this route is about 4 miles 60 chains, and the cost of constructing the same would be about £10,600. In addition to this there are four water rights which would require to be purchased, which would probably amount to £1,000, making the total estimate for this route £11,600.

The water rights referred to, are small water races brought along flat terraces, and lock up a considerable extent of auriferous ground that would be worked if water were available at a higher level.

With regard to the extent of auriferous ground that is said to be payable in the vicinity of Callaghan's Creek and its tributaries, there exists a great difference of opinion among the miners who reside in this locality, and it is only from observations of the auriferous indication of the country, the depth of alluvial deposits, the fall there is for working the ground, and from the information obtained concerning the gold workings that has been done that any estimate can be formed of the amount of ground that is likely to be worked if water were brought on to it.

The general nature of the country greatly resembles that through which the Nelson Creek Water Race is constructed, the creeks and gullies are very precipitous on the sides, but much narrower than those on the Nelson Creek side. There is no wash on the side of the range at the level that the race would be on. The auriferous ground is on terraces along the bank of Callaghan's Creek, and its tributaries, and on a large flat, between what is termed Callaghan's Creek Township and O'Rourke's Creek. A good portion of the latter ground has very little fall, and it is on this account very questionable if it could be ground sluiced; or, if not, whether it is sufficiently rich to be worked by any other method.

The total extent of new auriferous ground that the race would command, by adopting the route *via* Callaghan's Creek, would be about 400 acres, but probably one-half of this could not be worked. Assuming that 150 acres could be worked, and the average depth of the ground to be 16 feet, it would give employment to seventy men for eleven years.

A reconnaissance survey has likewise been made from peg, 6 miles 46 chains, on the Nelson Creek Water-Race, to command the country, on the Ahaura water shed, between Irishman's and Sullivan's Creeks.

The extent of auriferous country that could be commanded by the race in this locality is fully 1,000 acres. With regard to the payable nature of this country, the miners in the locality are unanimous in their opinion on the subject. They say the whole of the terraces would pay for working if water was available, and that it would give good returns. The appearance of the country, and the depth of alluvial deposits, with a large amount of fall for working, bears out what the miners say about it. The country is very broken, with deep, wide gorges, the depth of wash can be easily seen, in some places it is 80 feet deep, and I think the average depth may safely be taken from 15 to 20 feet over the whole area of the 1,000 acres. It is, however, impossible to arrive at a correct estimate of the amount of payable ground* without having the country thoroughly prospected, and it is only the information of the miners residing in the locality, together with the appearance of the alluvial deposit, and the richness of all the gullies running back from the river, that the estimate of the quantity of auriferous ground is based on.

The proposed line from Nelson's Creek at peg, 6 miles 46 chains, to the Ahaura River, is by tunnelling from gully to gully, crossing first to Callaghan's Creek, thence crossing it with a flume, where it is only about 30 feet wide, thence by tunnel to head of Black Sand Creek, thence tunnelling from gully to gully to Sullivan's Creek in one direction, and from Black Sand Creek to Irishman's Creek in the opposite direction, allowing the water from the race to flow down Sullivan's and Irishman's Creeks to the Ahaura River. The broken nature of the country will not admit of the race being carried round on a contour line, unless at a very great expense. Tunnelling will be far cheaper than ditching, in the first instance, on account of the length that it will cut off, and will also cost less for maintenance afterwards. The miners would have to make branch races from the openings in the several gullies, which they would not consider any hardship in this locality.

The length of race required to command this ground will be about 5 miles 30 chains, and the cost of constructing same £12,200.

In estimating the cost of both these routes—*viz.*, *via* Callaghan's and to Ahaura River, a liberal allowance has been made for surveys, supervision, &c., so that the total estimate given will cover all contingencies.

* Eighty feet of wash in some places. Average, over 1,000 acres, 15 to 20 feet.—C.Y.O.C.

G.—With regard to this question it is probable that by purchasing some of the riparian rights along Nelson Creek that it would increase the extent of ground that could be worked by the race, but I hardly think the increased revenue would justify the purchase. The rights that would in any way effect the increased revenue would be as follows:—

NAMES.	No. OF ACRES.	AMOUNT.	TITLE.	REMARKS.
Drennan Bros.	50	£2,500	Freehold	The estimate is at £50 per acre, but no doubt it could be purchased privately for a much less sum.
Do.	100	5,000	Leasehold	
J. Kennedy	50	2,500	„	
H. Mitchell	30	1,500	„	
Total	230	£11,500	—	—

If the whole of these rights were purchased, it would increase the area of ground that the race commands to the extent of about 100 acres, but it is questionable if much of this increased area would pay for working.

Having now gone into details on the several schemes, viz. :—

- 1st. The reconstruction of bridges.
- 2nd. The deviation *via* Callaghan's Creek.
- 3rd. The deviation to Ahaura River.

They can be summarised as follows :—

First.—The reconstruction of bridges and flumes from the head works to peg, 6 miles 46 chains at Wilson's Creek, will cost, say, taking the mean of ordinary and heartwood timber, £8,600; and from Wilson's Creek to the end of the race, £18,900. This shows in any case it would not be advisable to rebuild the bridges and flumes below Wilson's Creek, as a deviation *via* Callaghan's to the end of race could be constructed for £11,600, and be made of a permanent character.

Second.—The deviation, *via* Callaghan's Creek, will cost £20,200, including the reconstruction of bridges and flumes from the head works to Wilson's Creek.

With regard to this deviation, the ground now commanded by the race and the ground in the vicinity of Callaghan's Creek has to be taken conjointly; but at the same time the principal portion of the ground that the race at present commands, will be worked before it will be necessary to reconstruct the bridges, and, therefore, it would be only the remaining portion that would require to be added on to the extent of ground in Callaghan's, which may be set down at about 25 acres. This would increase the total area of probable ground that would be worked by deviation, *via* Callaghan's, to 175 acres, which would employ about 70 men for 13 years. The gross revenue from sales of water sufficient to work this area of ground would be about £44,000, and the maintenance for 13 years would be about £22,000: this leaves £22,000 against the £20,200 that it takes to construct. The amount of gold that probably would be produced by working this area, would be about 87,500 ounces, representing a value of £334,687.

Third.—The deviation to Ahaura River will cost £20,800, including rebuilding the bridges and flumes from the head works to Wilson's Creek, and to take the quantity of ground at one-half what is estimated, viz., 500 acres, it would employ 70 men for 35 years. The gross revenue from sales of water for working this area of ground would be about £125,000, and the expenditure on maintenance during the period about £70,000, which would leave £55,000, or reimbursement of capital with 5 per cent. interest. The probable yield of gold from this area would be about 250,000 ounces, representing a value of £956,250.

I would, therefore, recommend that the bridges and flumes be upheld as long as possible by ordinary maintenance, which will work out the principal portion of the ground that the race commands about Nelson Creek, and, say in two years' time, to commence to construct the race from Wilson's Creek to Ahaura River. This would allow two years to construct the race and sufficient time to open up the ground, so as to be in full working order before a total collapse of the present bridges and flumes took place.

In conclusion, it may be well to add, that the nature of the ground through which the tunnels in both routes would have to be constructed in, is of soft sandstone and soft old-man reef, of sufficiently hard a nature to stand without timber.

HENRY A. GORDON,
Assistant Engineer.

P.S.—There is at present a population of about sixteen men on Callaghan's Creek, and thirty-five men on the Ahaura Watershed that the race will command, who are reported to be making at the latter place from £5 to £10 per week per man; but the present water supply is very poor, being available only during rain, and for a short time after rain.

H. A. G.

NELSON CREEK WATER RACE.

ESTIMATE OF RECONSTRUCTING BRIDGES, FLUMING, AND BOXING.

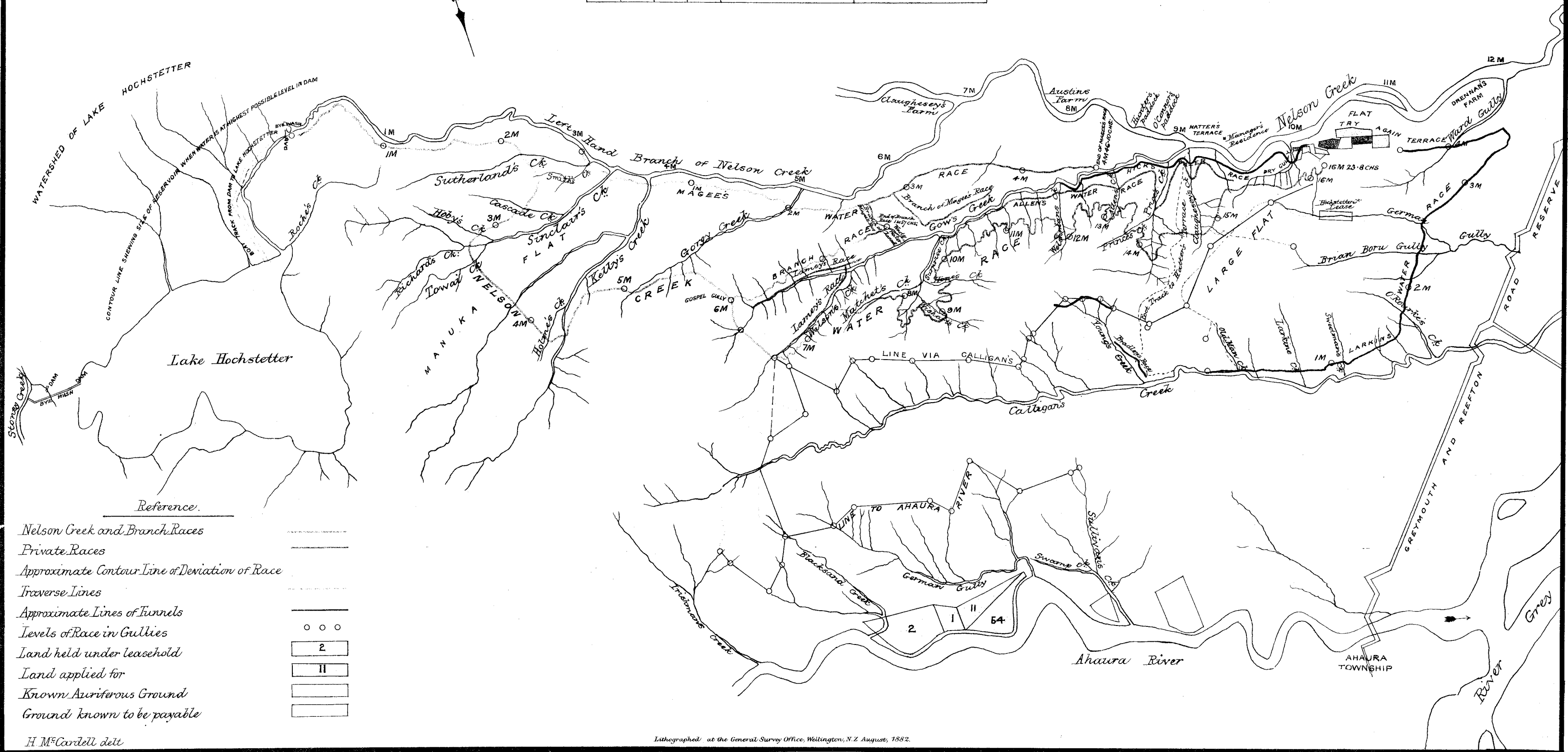
No.	Name of Creek.	Mileage.	QUESTION A.						Time that Bridges and Fluming will probably last. Years.
			Timber. C.B.M.	Iron estimated at ls. per lb.	Rate of Timber. C.B.M.	Cost if ordinary Timber is used.	Rate of Timber. C.B.M.	Cost if All-heart Timber is used.	
			M. C.	lbs.	£ s.	£ s. d.	£ s.	£ s. d.	
1	..	1 13	33	21	2 0	70 11 0	2 10	87 1 0	6
2	..	1 14	33	91	2 0	70 11 0	2 10	87 1 0	6
3	Sutherland's ..	2 15	294	1,500	2 0	663 0 0	2 10	810 0 0	4
4	Hobby's ..	3 10	31	75	2 0	65 15 0	2 10	81 5 0	6
5	Sinclair's ..	3 19	161	691	2 0	356 11 0	2 10	437 1 0	6
6	Towai ..	3 29	79	211	2 0	168 11 0	2 10	209 1 0	6
7	Evans' ..	3 65	182	830	2 0	405 10 0	2 10	496 10 0	6
8	Holmes' ..	4 15	69	388	2 0	157 8 0	2 10	191 18 0	6
9	Kelly's ..	4 25	219	1,428	2 0	509 8 0	2 10	618 18 0	4
	Do. Bridge portion	..	140	1,600	2 10	430 0 0	3 0	500 0 0	6
10	..	4 50	33	91	2 0	70 11 0	2 10	87 1 0	6
11	Gorgy ..	5 4	120	474	2 0	263 14 0	2 10	323 14 0	4
12	Bruce (Bridge) ..	5 32	222	1,600	2 10	635 0 0	3 0	746 0 0	6
13	Tasso's ..	5 42	86	600	2 10	245 0 0	3 0	288 0 0	6
14	Dorley's ..	5 50	86	600	2 10	245 0 0	3 0	288 0 0	6
15	Gospel ..	5 78	194	1,153	2 0	445 13 0	2 10	542 13 0	6
16	Gow's ..	6 19	197	1,044	2 0	446 4 0	2 10	544 14 0	5
	Do. Bridge portion	..	298	2,917	2 10	890 17 0	3 0	1,039 17 0	6
17	Wilson's ..	6 45	579	2,093	2 0	1,262 13 0	2 10	1,552 3 0	4
18	Nicolson's ..	6 54	115	585	2 0	259 5 0	2 10	316 15 0	5
19	Benjamin's ..	6 55	104	545	2 0	235 5 0	2 10	287 5 0	5
20	..	7 5	41	151	2 0	89 11 0	2 10	110 1 0	6
21	..	7 15	41	151	2 0	89 11 0	2 10	110 1 0	6
22	..	7 20	41	151	2 0	89 11 0	2 10	110 1 0	6
23	..	7 27	36	128	2 0	78 8 0	2 10	96 8 0	6
24	Matchett's (Bridge)	7 39	131	700	2 10	362 10 0	3 0	428 0 0	6
25	..	7 44	25	68	2 0	53 8 0	2 10	65 18 0	6
26	..	7 50	23	64	2 0	49 4 0	2 10	60 14 0	5
27	..	7 56	41	151	2 0	89 11 0	2 10	110 1 0	5
28	..	7 65	45	137	2 0	96 17 0	2 10	119 7 0	5
29	..	8 11	38	98	2 0	80 18 0	2 10	99 18 0	5
30	..	8 17	51	226	2 0	113 6 0	2 10	138 16 0	5
31	Surprise ..	8 27	69	326	2 0	154 6 0	2 10	188 16 0	6
	Do., Bridge portion	..	654	3,395	2 10	1,804 5 0	3 0	2,131 15 0	4
32	..	8 36	26	73	2 0	55 13 0	2 10	68 13 0	5
33	..	8 56	62	295	2 0	138 15 0	2 10	169 15 0	5
34	Wishart's ..	8 72	83	437	2 0	187 17 0	2 10	229 7 0	4
	Do., Bridge portion	..	178	1,600	2 10	525 0 0	3 0	614 0 0	4
35	..	9 17	53	241	2 0	118 1 0	2 10	144 11 0	6
36	Dando Bridge ..	9 22	189	1,200	2 10	532 10 0	3 0	627 0 0	6
37	Hope's ..	9 44	30	116	2 0	65 16 0	2 10	80 16 0	4
	Do., Bridge portion	..	118	600	2 10	325 0 0	3 0	384 0 0	4
38	Lundon's ..	10 30	53	247	2 0	118 7 0	2 10	144 17 0	6
	Do., Bridge portion	..	290	2,926	2 10	871 6 0	3 0	1,016 6 0	6
39	Garven's Bridge ..	10 57	199	1,600	2 10	577 10 0	3 0	677 0 0	4
40	Gray's Bridge ..	10 79	130	600	2 10	355 0 0	3 0	420 0 0	5
41	Palmer's Bridge ..	11 29	200	1,550	2 10	577 10 0	3 0	677 10 0	3
42	..	11 32	39	177	2 0	86 17 0	2 10	106 7 0	5
43	Haub's ..	11 44	55	277	2 0	123 17 0	2 10	151 7 0	5
44	..	11 59	38	163	2 0	84 3 0	2 10	103 3 0	5
45	..	11 69	43	186	2 0	95 6 0	2 10	116 16 0	5
46	Welshman's ..	11 77	107	545	2 0	241 5 0	2 10	294 15 0	6
	Do., Bridge portion	..	299	2,917	2 10	893 7 0	3 0	1,042 17 0	6
47	..	12 8	48	215	2 0	106 15 0	2 10	130 15 0	4
48	..	12 17	39	177	2 0	86 17 0	2 10	106 7 0	4
49	Craig's ..	12 46	45	206	2 0	100 6 0	2 10	122 16 0	4
50	Allen's ..	13 1	53	247	2 0	118 7 0	2 10	144 17 0	6
	Do., Bridge portion	..	118	600	2 10	325 0 0	3 0	384 0 0	6
51	..	13 5	51	271	2 0	115 11 0	2 10	141 1 0	6
52	..	13 17	31	139	2 0	68 19 0	2 10	84 9 0	5
53	..	13 38	37	157	2 0	81 17 0	2 10	100 7 0	4
54	Prince's ..	13 55	34	164	2 0	76 4 0	2 10	93 4 0	4
	Do., Bridge portion	..	118	600	2 10	325 0 0	3 0	384 0 0	4
55	Coles' ..	13 76	77	394	2 0	173 14 0	2 10	212 4 0	5
56	Sykes' ..	14 2	12	68	2 0	27 8 0	2 10	33 8 0	4
	Do., Bridge portion	..	86	600	2 10	245 0 0	3 0	288 0 0	4
57	Price's ..	14 16	189	1,043	2 0	430 3 0	2 10	524 13 0	6
	Do., Bridge portion	..	379	3,447	2 10	1,119 17 0	3 0	1,390 7 0	6
58	..	14 31	104	545	2 0	235 5 0	2 10	287 5 0	4
59	..	14 48	60	295	2 0	134 15 0	2 10	164 15 0	4
60	Claughesey's Bridge	14 65	536	3,476	2 0	1,513 16 0	3 0	1,781 16 0	6
61	..	14 72	33	91	2 0	70 11 0	2 10	87 1 0	6
62	..	14 77	38	131	2 0	82 11 0	2 10	101 11 0	6
63	Dry Gully ..	15 36	131	710	2 0	297 10 0	2 10	363 0 0	5
64	..	16 0	268	1,337	2 0	602 17 0	2 10	736 17 0	6
65	..	16 7	38	215	2 0	86 15 0	2 10	105 15 0	5
	..	..	9,228	55,231	..	23,446 1 0	..	28,060 1 0	..

TOPOGRAPHICAL MAP

SHEWING COUNTRY THAT CAN BE COMMANDED BY

NELSON CREEK WATER RACE

Scale. 40 Chains = 1 Inch



Reference.

- Nelson Creek and Branch Races
- Private Races
- Approximate Contour Line of Deviation of Race
- Transverse Lines
- Approximate Lines of Tunnels
- Levels of Race in Gullies ○ ○ ○
- Land held under leasehold 2
- Land applied for II
- Known Auriferous Ground
- Ground known to be payable

H. M. Cardell delt

