D.—No. 4c.

FURTHER PAPERS

RELATING TO

WATER SUPPLY UPON THE GOLD FIELDS.

I.—AUCKLAND.
II.—OTAGO.

PRESENTED TO BOTH HOUSES OF THE GENERAL ASSEMBLY, BY COMMAND OF HIS EXCELLENCY.

WELLINGTON.

1872.

FURTHER PAPERS RELATING TO WATER SUPPLY UPON THE GOLD FIELDS.

AUCKLAND.

No. 1.

THAMES WATER SUPPLY.

Mr. H. P. HIGGINSON to Mr. CARRUTHERS.

SIR,— Auckland, 4th July, 1872.

On the 24th ultimo I went with Mr. J. O'Neill to the Thames and examined the route for proposed Water Race to within four miles of the head; the River Kauwaeranga being so swollen from heavy rain, I found it impossible to go far up the valley. I however saw and examined the greater part of the line, which has enabled me to form an opinion as to the practicability of the scheme, and report on the estimate previously made for its construction.

Commencing from Moanataiari Creek, the first two miles contour round the spurs of the hills, which are very steep—too much so to render ditching possible. As the soil is very treacherous and liable to slip, this would have to be boxed. Of the next two miles up to the first mile on the section, ditching is possible throughout, except where creeks and hollows are crossed.

The soil consists of a stiff yellow clay, which resists well the action of the water, and is not inclined to slip when the surface slopes moderately—say not quicker than 8 to 1.

The next mile (up to mile two) is very irregular, the line crossing a series of spurs; but were the line modified, a certain portion may be ditched. From there to mile three, two-thirds could be made in cutting, and the rest, where crossing creeks, would have to be flumed. Up to the fourth mile, there is but a very small space where a ditch could be cut, the line running for nearly the whole distance on very side-lying ground, in many places nearly perpendicular. The same description applies up to the fifth mile; and from there to the head of the race, at eight and a half miles, not more than half a mile of ground will admit of ditching.

At the head of the race it is evident that a considerable modification is needed, as the line has been run up the bed of the river under a nearly perpendicular bank, and consequently for some distance would be under flood level.

By shortening the race a quarter, and raising the water about five feet by a rough stone dam, the bed of the river can be diverged from at once, and the race kept away from the action of floods. As no plan exists of the river at the head of the race, I have asked Mr. O'Neill to get one made, with cross sections, showing the highest flood levels, so soon as the weather permits. Until this is done, there is no possibility of a plan of head works being laid down. It will, however, be a matter of no great expense to construct, as material for constructing a dry stone dam is there in profusion.

With regard to the construction of the boxing, I append three estimates. No. 1 is for a wooden trough, as previously designed, except where ditching is substituted; but I should recommend that it be constructed of a pattern approaching a semicircle, except where passing through the outskirts of Shortland. A square trough will best suit that portion, as it will be cheaper to cover in, if necessary.

There is no difference in the cost of the two patterns.

I have added to the estimate a sum of £2,000 to cover the cost of head works, and £800 for short flumes to act as feeders from the different creeks passed over to make up for loss of leakage.

Estimate No. 2 differs from the previous in only one respect—namely, substituting a sheet-iron trough for a wooden one. Its cost would be one quarter more, but it would have the advantage of being permanent if kept well painted outside, and would entirely prevent loss from leakage, which will be a serious matter in a wooden flume of such a length during the dry weather when water will be scarce, even at the head. The pattern I recommend is semicircular in form, supported in a wooden frame at intervals, constructed of sheet-iron ⅛ inch in thickness.

In this form it could be carried across the creeks considerably easier than if of wood, and much cheaper, as the supports would be further apart. In many places, if trussed or suspended by wire rope, supports could be done away with to a great extent.

For instance, by placing timber on each side to stiffen it, and rivetting a cross-tie at intervals, I estimate half the supports needed for a timber trough would only be required, and have framed my estimate accordingly.

Estimate No. 3 is for a similar mode of construction as the last, except that I propose using galvanized sheet iron, No. 16 Birmingham wire gauge, or one-sixteenth of an inch thick. The description of iron not corrugated but in continuous rolls would be the best, as it would entail less rivetting. The supports of this would be as frequent as for a wooden trough; it would, however, require no painting, the joints only being laid with white-lead.

The line as at present laid out will suit very well; but on obtaining possession of the land, a deviation of at least 100 feet on each side ought to be allowed, if necessary. For instance, where cutting is possible, the line must be moved up the hill in order to bring the whole ditch in cutting; in such places more careful contouring will be required, which can be done as the work proceeds.

The timber boxing, though much cheaper than iron, will be far from efficient, as the least shrinking of the timber will entail serious loss of water until caulked.

The repairs will be a heavy annual expense even during the first three or four years, after which the planks will gradually require renewal.

I beg to enclose the estimates referred to above, and one drawing.

I need hardly mention that the discharge of the channel will be the same as before fixed upon—forty heads.

I have, &c.,
H. P. Higginson.

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

Estimate No. 1.

Excavation and forming, 31,000 cubic yards at 1s. per yard	£1,550
Tunnelling, with timber, &c., 5 chains, at £70 per chain	350
Wood boxing and supports, 669 chains, at £33 per chain	22,077
Trestle work to 5 feet high 102 chains, at £3 per chain	306
" " " 10 " " 134 chains, at £10 per chain	1,340
" " " 20 " " 82 chains, at £25 per chain	2,050
" " " 30 " " 26 chains, at £40 per chain	1,040
" " " 40 " " 7 chains, at £60 per chain	420
" " " 50 " " 2 chains, at £80 per chain	160
Forming footpath	669
Clearing bush	67
Branch flumes, as feeders	800
Dam and Head works	2,000
	£32,829
Contingencies, at 12½ per cent.	4,103
	£36,932

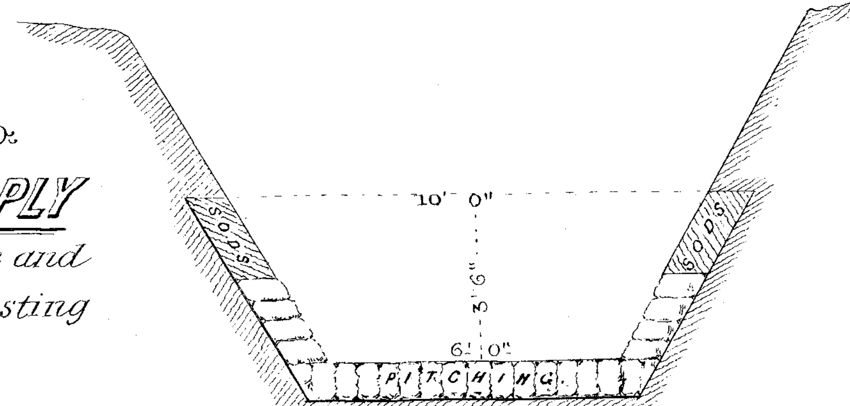
Estimate No. 2.

Excavation and forming 31,000 cubic yards, at 1s. per yard	£1,550
Tunnelling, timber, &c., 5 chains, at £70 per chain	350
⅛ sheet-iron channel, 669 chains, at £42 per chain	28,098
Wooden supports for above, 316 chains, at £5 per chain	1,580
Trestle work and supports to 5 feet high, 102 chains, at £8 per chain ...	816
" " " " " 10 " " 134 chains, at £15 per chain ...	2,010
" " " " " 20 " " 82 chains, at £20 per chain ...	1,640
" " " " " 30 " " 26 chains, at £30 per chain ...	780
" " " " " 40 " " 7 chains, at £40 per chain ...	280
" " " " " 50 " " 2 chains, at £45 per chain ...	90
Painting, 2 coats, 669 chains, at £1 15s.	1,170
Forming footpaths	669
Clearing bush	67
Branch flumes, as feeders	800
Dam and Head works	2,000
	£41,900
Contingencies, at 12½ per cent.	5,238
	£47,138

Estimate No. 3.

Excavation and forming 31,000 cubic yards, at 1s. per yard	£1,550
Tunnelling with timber, &c., 5 chains, at £70 per chain	350
$\frac{1}{16}$ inch, or No. 16 galvanized iron trough, 669 chains, at £37 per chain ...	24,753
Wooden supports for above, 669 chains, at £5 per chain	3,345
Trestle work to 5 feet high, 102 chains, at £3 per chain	306
" " " 10 " " 134 chains, at £10 per chain	1,340
" " " 20 " " 82 chains, at £25 per chain	2,050
" " " 30 " " 26 chains, at £40 per chain	1,040
" " " 40 " " 7 chains, at £60 per chain	420
" " " 50 " " 2 chains, at £80 per chain	160
Forming footpath	669
Clearing bush	67
Branch flumes	800
Dam and Head works	2,000
	£38,850
Contingencies, at 12½ per cent.	4,856
	£43,706

PROPOSED CROSS SECTION OF CHANNEL.



SKETCH PLAN OF THE MOUNT IDA WATER SUPPLY

Shewing course of proposed Flush Race and direction of Sludge Channel, with existing Water Rights, emanating from Little Kyeburn and its Tributaries.

Note. The Figures indicate the heights above Sea level.

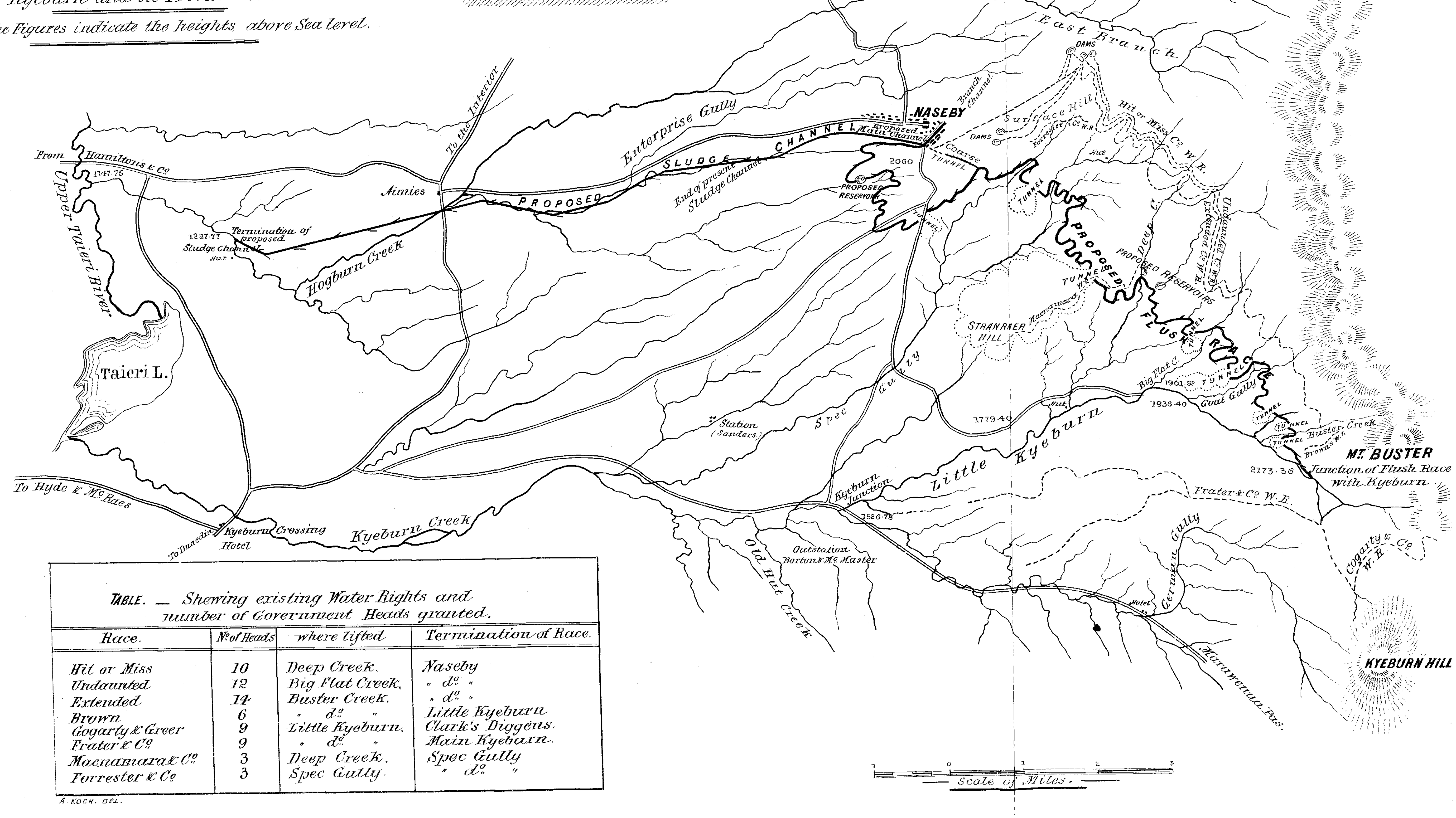


TABLE. — Shewing existing Water Rights and number of Government Heads granted.

Race.	No. of Heads	where lifted	Termination of Race.
Hit or Miss	10	Deep Creek.	Naseby
Undaunted	12	Big Flat Creek.	" do. "
Extended	14	Buster Creek.	" do. "
Brown	6	" do. "	Little Kyeburn
Gogarty & Greer	9	Little Kyeburn.	Clark's Diggens.
Frater & Co.	9	" do. "	Main Kyeburn.
Macnamara & Co.	3	Deep Creek.	Spec Gully
Forrester & Co.	3	Spec Gully.	" do. "

A. KOCH. DEL.

OTAGO.

No. 2.

MOUNT IDA WATER SUPPLY.

Mr. D. L. Simpson to Mr. J. Blackett.

Sir,— Dunedin, 22nd July, 1872.

I have the honor to report upon the proposed scheme of water supply for the Mount Ida District, in so far as it relates to the sludge channel for drainage of tailings, and supply of water for flushing purposes, from the Kyeburn watershed.

My examination of the district, and surveys instituted hitherto, have been mainly confined to this section of the whole scheme, the result of which is contained in the drawings prepared and forwarded, comprising plan and section of sludge channel, longitudinal section of flush race, and sketch plan showing relative position and direction of channel and race, and giving other information, which I considered would better elucidate the subject under consideration.

I may premise by stating that the weather was extremely unfavourable during the concluding half of my survey operations, and in a great measure prevented me from acquiring information of a supplementary character useful to the scheme, such as the mode of operation of the St. Bathans channel and the general inclination of tail races; but I believe that the merits of the contemplated works in so far as the sludge channel is concerned, will be apparent from a glance at the longitudinal section, assuming fall to be the most important requisite.

The present channel for discharge of tailings was opened by the Extended Company some time ago, and, as originally constructed, was in length a little over three miles, the discharging point being at 2 miles 65 chains; but in consequence of the absence of a proper discharge area, the tailings accumulate to such an extent as to interfere with its proper working at the lower end, and although efforts have, and are now being made to keep this part of the channel open, it is evident that they must eventually prove abortive.

At the present discharge point, viz. at 2 miles 40 chains, the bed of the channel is considerably elevated above the original level of the ground, to the extent of four or five feet, and this will go on increasing as the tailings accumulate.

The proposed line of sludge channel, as shown by the red line on the plan, was determined upon as being the most direct, consistent with economy in construction; and with a view to the channel being made available for the drainage of tailings from the prospective workings along the bed of the gully, the bed level is closely approximated to the depth required.

I have shown the channel to terminate at a point ten miles distant from Naseby, it being, in my opinion, the only part where there is an efficient discharging area, and where it may reasonably be expected that its proximity to the Taieri River will not cause any accumulation to be so formidable as to interfere with the satisfactory working of the channel.

The branch channel follows more or less the line of the bed of a small gully, now filled with tailings to the extent of 10 or 15 feet above the original level. It is necessary for the drainage of the contiguous workings that a communication should be opened with the main channel. It is more expedient that this should be done when it is understood that the present level of the tailings at peg No. 2 is 3 feet above the street at the intersection of Earn and Seven Streets, and this height may go on increasing, to the detriment of the township, unless the branch is opened.

The branch channel will have a fall of 190 feet per mile.

The main channel commences with an inclination of 1 in 44, terminating at the rate of 1 in 125, or 120 feet and 42·2 feet per mile respectively.

The existing channel has an average fall from peg O to termination, at 2 miles 40 chains of 88 feet per mile. The sectional area, when workings are in full operation, is 5 square feet; the mean velocity, 492 feet per minute, and consequently discharge about 2,500 cubic feet per minute, equal to twenty-seven Government heads.

According to the proposed form of new channel (see cross section) the sectional area is 28 square feet, and hydraulic mean depth 2 feet.

Taking the full sectional area as representing the flow in floods, the mean velocity will be at the discharging point, 715 feet per minute; and discharge, 20,020 cubic feet per minute.

Again, assuming that the ordinary flow will be 100 Government heads to 9,200 cubic feet per minute, the depth of section at the point of discharge will be represented by about 26 inches; the sectional area will therefore be 15·7 square feet, and hydraulic mean depth 1·4 feet, and accordingly the mean velocity will be close upon 600 feet per minute, equal to 10 feet per second, as against 8·2 feet per second, the present velocity of discharge of existing channel. The present channel has the following defects:—

1. It is irregular in cross sections, thereby increasing the friction and reducing the mean velocity.
2. The supply of water in the shape of tailings is intermittent, causing the gravel and sand to cake, which is afterwards difficult to remove, and consequently leaves the bed irregular in fall.
3. There is no proper area to receive the tailings; hence the velocity of discharge is lessened, and the tailings deposited in bed of channel.

Notwithstanding the two first defects, repeated observations have proved that the channel acts its part well for the first mile and a half.

In the appended estimated cost of the work I have provided for the channel being pitched on the bed and partly up the sides. This plan, I think, should be adopted, in order that a smooth and uniform surface should be presented to the tail water in its course. The extra expense of construction would be more than counterbalanced by the saving in maintenance in a few years.

In my remarks upon the proposed sludge channel I have assumed that there will be a constant flow of at least 100 Government heads, and I think this may fairly be looked upon as the minimum quantity, if the channel is to perform its functions and be useful in the further development of the district as a medium for the discharge of tailings.

I have gradiented a course for a flush race, commencing at the level of peg O and following the contour of the hill slopes to the Little Kyeburn. The section shows the fall for the first two and three-quarter miles to be at the rate of 11·2 feet per mile, and for the remaining distance at the rate of 8·8 feet per mile, with a break in level at the crossing of the Stranraer Hill range of 61·17 feet, this height being equal to what I considered would be absorbed in following the contour line shown by red dotted line.

The difference in level between the junction at Kyeburn and peg O at Naseby is 276 feet, the terminating peg $\frac{26}{22}$, on west bank of Kyeburn, being 28 feet above creek.

The line, as laid off, is very circuitous, the distance in a straight line not exceeding seven miles, which gives a proportion of 1 to $3\frac{3}{4}$; but this proportion is considerably less than would have been the case had tunnels not been adopted. The actual contour would have resulted in a total distance of forty-five miles, and the difference in level increased to 90 feet.

The ground is all good, and favourable for construction, with the exception of about one mile, part of which distance is in the approach to and from Deep Creek, and part in close proximity to the junction with Little Kyeburn. The tunnelling, from external appearances, will be through cement-gravel, and will not be a very expensive operation.

The dotted lines on sketch plan show the course the race would have taken had tunnelling not been resorted to. Between Milkman's Gully and the Kyeburn Creek I have shown an alternative course, which would involve a tunnel half a mile long, but would otherwise be of considerable advantage in reducing the total distance, and consequently the loss from absorption.

The difference in cost would be trifling, and on that account the alternative course can be open without employing any additional outlay should it subsequently be adopted.

I find that on gauging the various streams met with in the course, only four, leaving out the Little Kyeburn, afford a constant supply, viz., Deep Creek, north branch of same, Big Flat Creek, and Buster Creek, the aggregate supply from which would not exceed in ordinary seasons six Government heads of the Little Kyeburn. At the time of my last visit, and from periodical examination previously, I find that not more than five Government heads could be relied upon, nearly all of which consisting of tail water from Clarke's Diggings at Mount Buster.

Relative to the races now in existence, and which derive their supplies from the tributaries of the Little Kyeburn, the combined supply they are entitled to would be, according to tabulated statement on sketch plan, sixty-six Government heads, but the races, as cut, have only a carrying capacity of about eighteen heads, hence the remaining number granted, I am reliably informed, can be declared forfeited. The greatest portion of the supply from the Little Kyeburn tributaries is used in sluicing at Surface Hill, the tailings from which flow into the present Sludge Channel, so that nothing would be gained by the purchase of the existing right.

The only course to be pursued would be to store up the flood waters of Deep Creek and the other creeks in the line of the proposed race; so that a constant supply of something like twelve to fifteen Government heads could be available when required for flushing. It is not necessary that there should be a constant flow of flush water into the channel. Its useful effects would be when the flow of tail water was at a minimum, and this may be considered at from 6 p.m. until 8 in the following morning.

The reservoir I propose, at two and three-quarter miles of flush race section, is capable of storing 600,000 cubic feet. This quantity, with the constant supply from feeding race, would admit of a considerable body of water being brought to bear upon the channel at any time.

In the estimated cost of providing water for flushing purposes, I take it for granted that the only permanent source of supply from the Kyeburn watershed will be by supplementing that obtained from the creeks; and this can only be accomplished by constructing dams at Deep and other Creeks having a combined capacity of say 10,000,000 cubic feet; but although giving an estimate of the cost of the works necessary in accordance with the views above enumerated, I do not wish to be understood as thoroughly approving of the Kyeburn flush-water scheme, not so much on account of the uncertainty of supply, as the heavy cost the carrying out of the works will necessarily entail.

It might probably be judicious to postpone consideration of the Kyeburn watershed supply until the survey is completed of country between Naseby and the head waters of the Manuherikia (instruction to undertake which I received from the Honorable the Resident Minister some time ago), as it is very possible that a good and constant supply might be obtained from that source at a cost not much in excess of that from the Kyeburn.

The conclusions that I have arrived at are these: the channel scheme is perfectly feasible, and if carried out will be a work of considerable utility, and cannot fail to be the means of advancing the interests of the district and extending its resources.

The scheme of water supply from the Kyeburn is practicable but expensive, and I would therefore suggest deferring further consideration of it until the Manuherikia watershed has been examined and reported upon.

I have, &c.,
D. L. Simpson,
Civil Engineer.

John Blackett, Esq., Assistant Engineer-in-Chief.

Estimated Cost of Constructing a Flush Race from Little Kyeburn, including Dams.

	£ s. d.	£ s. d.
Tunnelling (sectional area 16 square feet), 1,561 lineal yards, at 20s. per yard	1,551 0 0	
Steep siding, with timber protection where required, 80 chains, at 80s. per chain	320 0 0	
Easy siding, 1951½ chains, at 25s. per chain	2,439 7 6	
Reservoir, at 2 miles 60 chains, capable of storing 600,000 cubic feet	400 0 0	
Dam at Deep Creek, storage capacity 4,000,000 cubic feet	1,200 0 0	
Dam at North Branch of Deep Creek, storage capacity 3,000,000 cubic feet	1,000 0 0	
Other Dams and Creeks, capable of storing say 1,000,000 cubic feet ...	750 0 0	
Storage and purifying Dam at Kyeburn, capacity 2,000,000 cubic feet	2,000 0 0	
		£9,660 7 6

Estimated Cost of Construction of Main and Branch Sludge Channel.

	£ s. d.	£ s. d.
Main Channel.		
Excavation, 141,200 cubic yards, at 1s. per yard	7,060 0 0	
Pitching, 17,600 cubic yards, at 15s. per yard	13,200 0 0	
Sod walling, 5,000 cubic yards, at 5s. per yard	1,250 0 0	
		£21,510 0 0
Branch Channel.		
Excavation, 7,200 cubic yards, at 1s. per yard	360 0 0	
Pitching, 420 cubic yards, at 15s. per yard	315 0 0	
Sod walling, 120 cubic yards, at 5s. per yard	30 0 0	
		705 0 0
		£22,215 0 0