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PARLIAMENT OF TASMANIA.

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**IRRIGATION:**

REPORT AND ESTIMATES BY MAJOR COTTON.

*Return to Order, Legislative Council, October 6, 1886. (Mr. Fysh.)*

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Laid upon the Table by Dr. Agnew, and ordered by the Legislative Council to be printed, October 20, 1886.



## REPORT, WITH ESTIMATES, ON IRRIGATION.

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*Longford, 13th July, 1844.*

SIR,

IN compliance with the instructions conveyed to me in your letter of the 19th ultimo, I have the honour to forward the Plans, as far as they are yet completed, of the Irrigation project in which I am employed.

In explanation of the Plans, and of the progress of the survey, it may be desirable that I should here refer to my original instructions, and the measures I have taken to carry them out.

The extensive plains of the Macquarie, Elizabeth, and Lake Rivers, and the facilities supposed to exist for forming reservoirs of water in the upper parts of those rivers, offering a fine field for laying out a great combined project, I suggested that the three rivers should be explored and surveyed, and the lands examined, with the view of forming one great project for the Irrigation of the whole country commanded by the three rivers, on the principle that the more comprehensive the plan, the greater would be the effect produced from the same outlay of capital, or the same amount of labour employed,—the more sure the supply of water for the whole,—and the more uniform and general the benefit obtained. These suggestions were offered in my letter of the 31st July, 1843, supported by a copy of a Lecture on the subject of Irrigation generally, which I had given at the Mechanics' Institution a short time previous; and I then received orders to propose a plan for commencing Irrigation. The plan I proposed was approved by His Excellency; and instructions were given, under date 20th November, 1843, for the formation of a small establishment for the examination of the rivers and country referred to.

I commenced this examination in December; and on the 29th of that month I reported on the heads of the Elizabeth and Macquarie Rivers, giving a detailed account of the work undertaken by private enterprise and funds, with Government labour, for reserving water in the Long Marsh, and the dam formed by private hands under the authority of Government at Tooms' Lake.

In January I received more full instructions for the conduct of the survey, and from that time to the close of the season I have been employed in carrying it on; and the Plans now submitted exhibit the extent to which the operations have proceeded.

As far as I have yet gone in the planning of the reservoirs and channels, with all the masonry works, as dams, aqueducts, sluices, &c. for this portion, I have kept in view the formation of a great combined project for all the plain country commanded by the Macquarie, Elizabeth, and Lake Rivers, including Norfolk Plains,—a vast tract of the finest arable land in the colony.

A first or partial undertaking might be carried on to the extent already surveyed and estimated, as explained in the Appendix to this report; but the capacity and the number of the reservoirs can be increased, and the main channels widened, according to the extent of land found available as the survey proceeds.

A. The "General Plan" is a map of the country between the Elizabeth and the Macquarie Rivers, and between the Macquarie and Blackman, in the County of Somerset, exhibiting the two reservoirs at the heads of the Macquarie; viz.—the Long Marsh and Tooms' Lake, and the proposed channels of distribution.

Tooms' Lake is an extensive shallow reservoir formed by a low embankment, retaining, when full, about fourteen million cubic yards of water. It is complete, having been formed with the assistance of Government by the efforts of a body of settlers possessing property on the banks of the river below. The Long Marsh is also an extensive flat, receiving the drainage of a far greater tract of country than Tooms' Lake; and may, by means of a short but high embankment, be made to retain fifty or sixty million cubic yards of water. This work was undertaken, and carried on to a certain extent by Government labour, conjointly with private subscription, but has been discontinued.

The first work to be done is the completion of this embankment; and I give it in my plan a base sufficient for its being raised to the height of eighty feet, when I calculate that it will retain all the water flowing into the marsh in one season: but the present Estimate allows only for the retention of thirty feet of water.

The water retained in these two reservoirs will be delivered into the natural bed of the river by means of sluices through their embankments; and, following its course while confined within precipitous banks, it will be arrested by a low dam six miles below the junction of the two heads. This dam forms the head of the two main channels north and south of the river, commencing in the Parishes of Peel on the north and Durham on the south side. These two main channels, coloured pink in the "General Plan," and their branches are allowed a fall of one and a half feet in a mile, and will, with the capacity given to them, carry water to twelve different properties, irrigating about 18,000 acres, besides the Townships of Tunbridge, Ross, and Campbell Town, in which about 2000 acres of crown land will be watered.

B & C. The plans of the Peel and Durham channels are drawn on a large scale to show more distinctly their course, and the lands to be watered by them, and the proposed sites for mills. The survey of the Peel channels is incomplete, having been interrupted by the winter weather: that of the Durham channels is complete as far as the Blackman River.

D. Plans of the masonry and other works in detail:—

No. 1. The dam at the Long Marsh in elevation and section, the sluices (showing the arrangement for opening them), and the guage-chambers by means of which the quantity of water delivered will be regulated. The elevation of the dam shows its height when completed, as well as the height I have allowed for in the accompanying Estimate.

No. 2. Is the Peel and Durham dam across the river at the heads of the two main channels. Its object is not to retain any body of water, but to raise its level, and give an elevation of fifteen feet to the surface, in order that the channel heads may be raised above the river floods. The river, in its floods, will pass freely over the escape in this dam, and pursue its natural course; there being at the head of each main channel a regulating sluice, to limit the body of water admitted into each, or exclude it entirely when necessary.

Nos. 3, 4, & 5 are the details of cuttings and masonry works for the channels. The whole water will by means of these be under perfect control, to be dispensed or retained as required.

E. Is a scale showing the quantity of water required to flow in each main and branch channel, the capacity of channel due to the required supply, and data for estimating all the different works.

F. The Estimate, amounting to £40,000. It includes the completion of the Long Marsh Reservoir, the Peel and Durham Dam, the Durham Channels, and all the works connected with them, with a *rough* calculation of the expense of the Peel Channels; they being not yet fully planned.

All my computations are for free labour; but it is palpable that in the present state of the Colony free labour cannot be obtained to the amount required to complete the work in one or two years: indeed, as my last instructions are to carry on the survey for the full project, my present Estimate has in it no object but to elucidate my plans, and give a view of what I expect to be the cost and effect of such projects in the Colony; and I append for the same purpose my estimation of the value of water, and a scheme for paying for it. (*Vide Appendix.*)

An extended project will be much less expensive in proportion to the benefit derived; and therefore the present computation of £2 per acre is above what will prove an average outlay for the whole country to be irrigated by the three rivers: particularly as the extensive plain which the Lake River commands will, from its extent and other advantages which it possesses, be done with far less labour.

At the rate of £2 per acre for the first outlay for the Government works, the water is brought within the reach of each proprietor for all his land fit for Irrigation.

I estimate the lowest *annual* value of water on the acre at £5; and I set the payment at a tithe of this, or 10s. per acre, after the fifth year, giving it three years gratis, the fourth year at 2s. 6d.,

and the fifth year at 5s. : under which scale I should expect the proprietor will obtain from the water itself ample means for preparing his land at first, and paying for the water after the fifth year at a price which will just remunerate the Government.

The sale of Crown Land in the townships will be a further return to the Government, and make up for the delay in receiving payment from the land proprietors. In the three townships of Ross, Campbell Town, and Tunbridge, 2000 acres of crown land will be watered; and would undoubtedly sell at an average price of at least £15 per acre, or £30,000, which amounts to three-fourths of the total amount.

I mention these particulars (and they are more fully detailed in the Appendix) to show that the project as at present planned would be a profitable outlay of money if paid for at the cost of free labour, though the return would be at a distant period; and therefore that the Government would be warranted in undertaking it for the benefit of the country, if it could bear the present outlay, and the delay of repayment.

The extended project would yield a greater proportionate direct return; and the advantages to the community, spreading over a wider space, would be more equable, and conduce more to general prosperity.

I may in conclusion therefore repeat, that the present partial project might be undertaken independently, and rest on its own recommendations, or it may be considered as a commencement of the full project, and be extended at a future period.

I would beg leave to add, that the North and South Esk Rivers offer great facilities for extending the Irrigation of the country to Launceston, and would afford water-power and canal communication to the town and its vicinity, as well as induce the sale of some highly valuable crown land.

In the south, although no very extensive fields for Irrigation exist, and the system to be pursued would be of a different character, yet I have no doubt that most important works might be carried on in that part of the country, combining all the advantages of water communication, water power, and Irrigation.

I have the honour to be,  
Sir,

Your most obedient Servant,  
H. C. COTTON.

J. E. BICHENO, *Esq.*,  
*Colonial Secretary,*  
*&c. &c. &c.*



## APPENDIX.

## VALUE OF WATER, AND SCHEME OF PAYMENT.

The quantity of water to be allowed per acre is 2500 cubic yards per annum, to be drawn uniformly in the course of 5 months, or at any other rate to suit the crops, mills, &c. This quantity is sufficient for grass land, and is the maximum for any crop,—1000 cubic yards drawn in the course of 2 months is sufficient for grain; but cut green as a previous crop for hay, the grain would require water for a longer period, and pasture may be obtained after the crop is off by continuing the water, so that the full quantity of 2500 cubic yards would generally be used. Potatoes watered twice a month during the dry months will make a very great return, especially in this part of the country where frosts prevail; the expenditure of water being comparatively very small. Lucerne irrigated is a highly productive crop; it requires the full supply of water. The grain crop is the least valuable. The increase of produce on any land will be at least 20 bushels per acre, which, at the low rate of 5s. per bushel, gives £5 as the value of the water per acre, when 1000 cubic yards only of water is used: and I set this as the lowest return for the use of water upon an acre of land. Green crops, potatoes, and all garden produce will yield up to £30 per acre; and Irrigation makes all crops sure as well as productive.

The total estimate of the first part of the Government project,—viz. the Peel and Durham Channels, with their supplying reservoirs,—amounts to £40,000, calculated at the cost of free labour. About 20,000 acres will be irrigated; so that the first expense is £2 per acre.

Tooms' Lake, one of the supplying reservoirs, has been completed by a body of subscribers, who have laid out on that, and the commencement of the Long Marsh, about £1200. I have therefore supposed that 600 acres belonging to the subscribers might be watered gratis for ever in consideration of their outlay; and, to mark the exertions of the founders of the Macquarie Irrigation, Crown Lands in the Townships of Tunbridge, Ross, and Campbell Town, to the amount of 2000 acres, may be sold at from £8 to £30 or £40, yielding at an average of £15, £30,000, or three-fourths of the amount of the first outlay.

Setting the value of the water at its lowest rate of £5 per acre, and fixing the water rate at a tithe of this, or 10s. per acre per annum, the computation gives 25 per cent. on the total outlay when all the land is cultivated; and deducting 2½ per cent. for repairs and superintendence, the receipts will amount to 22½ per cent.— (£9000).

In addition to this annual return, and receipts for Crown Land sold, water-power will be a further source of Revenue. There will be several mill-sites on the irrigating channels where water will be paid for, as it were, twice, where the water will not be withdrawn from the land by its being applied to drive mills; and there is also water to spare for some other mills, all of which will pay: but the number of them will depend on the population and wants of the neighbourhood—every principal proprietor will have water-power for threshing, winnowing, grinding, cutting turnips, &c. &c.

The whole of the works are so planned as that they may be enlarged for the purpose of extending the operations below; and the project, besides being complete in itself, is the foundation of a second project for the plains lower down the Macquarie, and will tend to diminish the expense of all the irrigation downwards to the sea.

With reference to what is stated above, I will suppose, 1st. That 600 acres belonging to the founders is watered gratis. 2nd That the following rates shall be fixed for all other land; viz.—

1st, 2nd, and 3rd year to allow for preparation of the land—Gratis.	s.	d.
4th year, at per acre .....	2	6
5th year, ditto.....	5	0
6th and sequent years.....	10	0
Or at per 1000 cubic yards—		
1st, 2nd, and 3rd year.....	Gratis	
4th year .....	1s.	
5th year .....	2s.	
6th year .....	4s.	

3rd. That mills shall pay for water at the full rate of 4s. per 1000 cubic yards.

## Statement of expected Returns from Lands for 20 Years.

Year.	Acres under preparation, Gratis.	Acres paid for at 2s. 6d.	Acres paid for at 5s.	Acres paid for at 10s.	Founders' Acres, Gratis.	Annual Receipts.			Amount to be expended on the Works.		
						£	s.	d.	£	s.	d.
1	500	..	..	..	600	..	..	..	15,000	0	
2	1000	..	..	..	600	..	..	..	7000		
3	1500	..	..	..	600	..	..	..			
4	1500	500	..	..	600	62	10	0	6000	0	0
5	1500	1000	500	..	600	250	0	0			
6	1500	1500	1000	500	600	687	10	0			
7	1500	1500	1500	1000	600	1062	10	0	6000	0	0
8	1500	1500	1500	1500	600	1312	10	0			
9	1500	1500	1500	3000	600	2062	10	0			
10	1500	1500	1500	4500	600	2812	10	0	6000	0	0
11	1500	1500	1500	6000	600	3562	10	0			
12	1500	1500	1500	7500	600	4312	10	0			
13	2000	1500	1500	9000	600	5062	10	0	6000	0	0
14	2000	1500	1500	10500	600	5812	10	0			
15	1000	1500	1500	12000	600	6562	10	0			
16	..	2000	1500	13500	600	7375	0	0			
17	..	2000	2000	15000	600	8000	0	0			
18	..	1000	2000	17000	600	8500	0	0			
19	..	..	1000	19000	600	9125	0	0			
20	..	..	..	20000	600	10000	0	0			

Total of Estimate at the Cost of Free Labour.....40,000 0 0

Amount of receipts when all the land is cultivated .....	£10,000
Deduct for repairs and superintendence, at 2½ per cent. on £40,000 .....	1000
Remaining clear receipts, 22½ per cent. on £40,000 .....	<u>£9000</u>

The interest on the Capital sunk is not taken into the account. If taken at 5 per cent. it will exceed the clear receipts for the first seven years, after which the receipts will increase from 5 to 22½ per cent: this is on the irrigation of land only. The sale of Crown Lands, and the return derived from water for mills, will at once commence paying off the Capital.

H. C. COTTON.

## ESTIMATES.

## No. 1.

## ESTIMATE FOR DAM, &amp;c. AT LONG MARSH.

## FREE LABOUR.

36,566 cubic yards of earth to be got, and shot, calculated at 5 yards per day.

7870 cubic yards of puddle to be got, tempered, and placed, calculated at two yards per day.

67,200 cubic feet of rough facing stone to be got, rough dressed, and built, calculated at 40 feet per day.

10,450 cubic feet of rubble masonry in culverts, calculated at 15 feet per day.

	£	s.	d.
11,248 days for labour, at 2s.....	1124	16	0
2093 ditto mechanic, at 4s.....	418	12	0
418 bushels of lime, at 1s. 6d.....	31	7	0
Centering, tools, repairs of ditto.....	50	0	0
2 framed stages, complete .....	42	0	0
2 guages, iron work and valves .....	15	0	0
2 sluices, including cut masonry, in which they are to be set .....	40	0	0
2 crab winches, chains and fixing .....	36	0	0
Cottage for Dam-keeper.....	50	0	0
<i>Supervision.</i>			
	£		
1 Superintendent, 1 year.....	150		
1 Overseer, ditto .....	60		
1 Messenger, ditto .....	35		
		245	0 0
TOTAL.....	£2052	15	0

## No. 2.

## ESTIMATE FOR THE DAM ON THE MACQUARIE RIVER.

## FREE LABOUR.

2710 cubic yards of earth to be got and shot, calculated at 4 yards per day.

995 cubic yards of puddle to be got, tempered, and placed, calculated at 1½ yards per day.

7320 cubic feet of paving to top and slopes of escape, to be got, rough dressed, and laid, calculated at 20 feet per day.

12,744 cubic feet of rough facing to top and slopes of dam, calculated at 30 feet per day.

6899 cubic feet of rubble masonry in walls and culverts, to be got, dressed, and built, calculated at 12 feet per day.

*Labour.*

	£	s.	d.
1340 days at 2s.....	134	0	0
1365 ditto, mechanic, at 4s.....	273	0	0
250 bushels of lime at 10d.....	10	8	4
Centering, tools, implements, repairs of ditto, wear and tear .....	10	0	0
6 freestone caps for pins, at 25s.....	7	10	0
195 feet freestone coping, saddle back, tooled and throated, at 2s. 6d.....	24	7	6
2 double sluices, fixed.....	25	0	0
1 single ditto, ditto .....	15	0	0
Cottage for Dam-keeper.....	50	0	0
TOTAL.....	£549	5	10

*Supervision.*

See No. 7, Estimate of Sundries.

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No. 3.

ESTIMATE FOR EMBANKMENT AND AQUEDUCT ACROSS KITTY'S RIVULET,  
DURHAM CHANNEL.

FREE LABOUR.

2790 cubic yards of earth to be got, and shot, calculated at 3 yards per day.  
4327 cubic feet of masonry, calculated at 12 feet per day.

	£	s.	d.
<i>Labour.</i>			
930 days, at 2s.....	93	0	0
360 ditto, mechanic, at 4s.....	72	0	0
20 ditto, digging foundations, at 2s.....	2	0	0
180 bushels of lime, at 1s.....	9	0	0
Scaffolding, centering, tools, repairs, &c.....	10	0	0
132 feet run of freestone coping, saddle-back, tooled and throated, fixed with cramps, at 2s. 6d.....	16	10	0
4 freestone caps, fixed, at 25s.....	5	0	0
TOTAL.....	£207	10	0

*Supervision.*

See No. 7, Estimate of Sundries.

No. 4.

ESTIMATE OF EMBANKMENT AND CULVERT ON THE DURHAM MAIN CHANNEL,  
BETWEEN BRANCHES Nos. 5 & 6.

FREE LABOUR.

25,206 cubic yards of earth to be got and shot, calculated at 3½ yards per day.  
875 cubic feet masonry in culvert, calculated at 15 feet per day.

	£	s.	d.
<i>Labour.</i>			
7201 days, at 2s.....	720	2	0
58 ditto, mechanic, at 4s.....	11	12	0
35 bushels of lime, at 1s.....	1	15	0
Water for ditto .....	0	17	6
Centering, tools, implements, and repairs of ditto .....	30	0	0
Tamping .....	20	0	0
TOTAL.....	£784	6	6

*Supervision.*

See No. 7, Estimate of Sundries.

No. 5.

ESTIMATE FOR EMBANKMENT AND BRIDGE AQUEDUCT ON THE MAIN  
CHANNEL ACROSS YORK RIVULET.

FREE LABOUR.

705 cubic yards of earth to be got and shot, calculated at 3½ yards per day.  
2050 cubic feet of masonry in aqueduct, calculated at 12 feet per day.

	£	s.	d.
<i>Labour.</i>			
171 days, mechanic, at 4s.....	34	4	0
201 ditto labour, at 2s.....	20	2	0
10 ditto, foundations, at 2s.....	1	0	0
122 bushels of lime, at 1s.....	6	2	0
Centering, scaffolding, tools, repairs.....	10	0	0
132 feet of coping, saddle-back of freestone, tooled and throated, and fixed with bead and cramps, at 2s. 6d.....	16	10	0
4 freestone caps for pins, at 25s.....	5	0	0
TOTAL.....	£92	18	0

*Supervision.*

See No. 7, Estimate of Sundries.



## No. 6.

ESTIMATE FOR THE CHANNELS, BACK DRAINS, & CUTTINGS CAUSED BY  
INEQUALITIES OF GROUND, &c.

## FREE LABOUR.

*For Quantities see Tabular Abstract.*

	£	s.	d.
54,994 days labour, at 2s.....	5499	8	0
Tools, and repairs of ditto, for the above, estimating 300 days to the year, at 30s. per man .....	276	0	0
14,536 days; mechanic, at 4s.....	2907	4	0
Tools, and repairs of ditto.....	72	0	0
Centering, moulds, running planks .....	50	0	0
1500 bushels of lime, at 1s.....	75	0	0
Water for ditto .....	50	0	0
40 occupation bridges, at 5l.....	200	0	0
12 sluices (6 head sluices to the branches, and 6 dispensing ditto), at 8l... Fencing the various channels on both sides, when necessary, 36 miles, at 40l.....	96	0	0
	1440	0	0
TOTAL.....	£10,665	12	0

*Supervision.*

See No. 7, Estimate of Sundries.

## No. 7.

## ESTIMATE OF SUNDRIES.

Purchase of 148 acres of land for channels, at £3 per acre.....	444	0	0
Ditto of 2 acres of land for cottage for dam and sluice keepers .....	10	0	0
Compensation for damage done to lands by works.....	100	0	0
Building 3 stations for the accommodation of men, at £150 .....	450	0	0
Wood and water, 18 months, for stations:—			
Water, 40 hhds. per week, 40×78, at 1s.....	156	0	0
Wood, 20 tons ditto, 20×78, at 2s.....	156	0	0
Stores and implements for 3 stations, cooking utensils, &c. at £25.....	75	0	0
Surveyor, men, and allowances .....	500	0	0
Superintendent.....	200	0	0
Six Overseers, at £50... ..	300	0	0
Three Messengers, at £30 .....	90	0	0
	£1090	0	0
Ditto ditto for 18 months.....	£1635	0	0
TOTAL .....	£3026	0	0

## No. 8.

## ABSTRACT ESTIMATE.

	£	s.	d.
No. 1. Dam at Long Marsh .....	2052	15	0
2. Dam on Macquarie River .....	549	5	10
3. Embankment and aqueduct across Kitty's Rivulet .....	207	10	0
4. Embankment and culvert between No. 5 & 6.....	784	6	6
5. Embankment and aqueduct across York Rivulet.....	92	18	0
6. Channels, &c.....	10,665	12	0
7. Estimate of Sundries.....	3026	0	0
	<hr/>		
	17,378	7	4
Contingencies 10 per cent.....	1737	16	9
	<hr/>		
TOTAL.....	£19,116	4	1

NOTE.—The Estimate supposes that the labourers and mechanics will be hutted, and provided with wood and water, at the expense of the Government; and that the Government will supply them at contract prices with provisions.

	£	s.	d.
Total of Reservoirs and Durham Channels.....	19,116	4	1
Estimated expense of Peel Channels .....	20,883	15	11
	<hr/>		
TOTAL.....	£40,000	0	0

H. C. COTTON.

[For other Papers on the subject of Irrigation, *vide* Paper, Legislative Council, 1860, No. 9; 1861, No. 25; 1879, No. 61: House of Assembly, 1879, No. 69; 1883, No. 143.]