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Government of Madras.

Public Works DEPARTMENT.

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No. 232. Note by the Chief Engineer for Irrigation, dated 30th November 1870, No. 246 :—

THE Superintending Engineer of the 4th Division has, with his letter No. 3,513, of the 23rd instant, submitted revised estimates for the enlargement of the Chembrumbaukum tank, which, as the Government are aware, have been for a long time past under preparation. As the project has been the subject of much discussion, it may be useful to give a short summary of its history from the time it was brought before Government in Mr. Fraser's Report of the 17th April 1867, No. 14.

2. Mr. Fraser at that time submitted estimates, amounting to Rupees 3,55,435, for enlarging the tank, so as to enable it to hold an additional depth of 4 yards of water above the former highest level (top of dam stones), or 5 yards above the more usual full level, the crest of the waste weirs. By the arrangements proposed the capacity of the tank was to be increased from 55·605 millions of cubic yards at the weir crest level, or 77·797 millions at the top of the dam stones, to 196·874 millions. The estimates contained no provision for improving the supply of the tank, though Mr. Fraser mentioned in his report the nature of the improvements required. It appears at that time to have been thought that the supply from the natural drainage basin of the tank, irrespective of that derived from the Cooum by the channel called the new Bungairoo, which has its head at the Koratur anicut, would suffice to fill the enlarged tank, or that at any rate moderate improvements to the means of conducting the river water to the tank would meet all requirements. It was shown that the area of the tract of country draining ultimately into the tank is about 400 square miles, or 1,239 millions of square yards, and that, although there are about 320 irrigation tanks within the limits of this area which would absorb a considerable quantity of the drainage, nevertheless, as a drainage of 4 inches in depth over the catchment basin would suffice to provide the 141 millions of cubic yards of water required to fill the tank above the level of the old calingulah crests, this quantity being only one-tenth to one-twelfth of the annual rain-fall, it might be anticipated that the supply would be forthcoming. Mr. Fraser's argument appears to me, with reference to the data at his disposal, to be fair enough. He took pains to ascertain from rain-fall and revenue records what the facts were, and though his deductions have not been borne out by subsequent experience, his data were given in detail, and no better were then to be had. Mr. Fraser's records of rain-fall were those of the Madras Observatory, and I believe that the average therefrom obtained is very considerably in excess of that of the tract of country draining towards the tank. At any rate, during the two years prior to 1870, considerable falls of rain have occurred at Madras without the tank getting anything more than a nominal amount of water, and this season is the first, since the works for the enlargement of the tank were undertaken, in which more than about one-fourth of the quantity required to fill the tank to the crest of the old escapes has been received. Now, where the drainage basin of a tank is to a great extent occupied, though only by small tanks, in seasons of moderate rain-fall the drainage finding its way to the lower part of the basin is very limited, and the character of the season, even when the total rain-fall comes up to the average, is of so much moment that, independently of the risk of failure of supply, where this depends upon local

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rain fall, occurring, for the most part, during the north-east monsoon, it is unsafe to rely upon any large proportion of the depth of rain falling finding its way into a reservoir. The sufficiency of the supply, however, having been apparently demonstrated, it was shown that out of a total ayacut area of 8,601 cawnies, or 11,000 acres, under the tank, the average extent of cultivation in the fourteen years prior to the preparation of the project was only 1,317 cawnies, or 5,715 acres, or in other words but little more than one half the available area was actually cultivated. Here indeed there was a warning regarding the real value of the water supply. The tank, if filled to the escape crest level, would have held 55·605 millions, or sufficient for 6,180 cawnies, taking 9,000 cubic yards per cawny as the quantity required, and this is at any rate a fairly liberal allowance. On the other hand, if the tank had filled to the tops of the dam stones the contents would have been 77·797 millions, and the area capable of irrigation by it 8,644 cawnies, or a little more than the full ayacut. These figures serve to indicate that the first requirement of the tank and of the cultivation under it was an improved supply, rather than an enlarged capacity for its retention.

3. The project, as thus submitted, was approved* by Government, and received the sanction of the Government of India on the 25th October 1867, No. 162-I., subject to its being ascertained what the additional outlay would be for making the several supplying channels efficient, and that these additions would not, when added to cost of establishments for construction, and taking into account cost of maintenance, etc., thereafter, reduce the estimate of returns below 9 per cent. on the 6, instead of 3½, lacs of Rupees, which outlay it was thought the complete project would involve. The requisite information for completing the estimates in this sense was ordered† to be collected; and, on examining the levels for improving the new Bungairoo, the channel by which the supply from the Koratur anicut on the Cooum is brought to the tank, it was discovered that a serious mistake had been made in the contour of the proposed full level of the lake, and that this, instead of reaching only up to, or but little beyond, the point where the trunk road crosses the new Bungairoo, really passed through the depression at this point and then spread out so as to submerge 2,130 acres of land, of which 1,770 were reported to be valuable lands under the Namum tank, the cost of purchasing which was considered to be under-estimated at 200 Rupees an acre. This item alone would, therefore, have occasioned an outlay of Rupees 3,51,000, or more than the total amount of Mr. Fraser's estimate. The Assistant Engineer in charge of the works then suggested an alternative arrangement for the supply of the tank from the Cooum, involving a new anicut on and channel from this river, the latter to be led through the Namum tank, and thence into the Chembrumbaukum tank. The rough estimate for this arrangement amounted to Rupees 1,20,000, and thereupon orders were given for the preparation of the necessary plans and estimates in detail. The investigations, which were at once made, showed the feasibility of confining the water spread of the enlarged tank, and of providing for its supply, via the Namum tank, and the late Chief Engineer having satisfied himself on these points, the alterations of the tank bund,

* G. O., No. 2,797, 11th September 1867.

† G. O., No. 3,808, 7th December 1867.

G. O., 21st April 1868, No. 1,205.
Do., 27th " " " 1,275.

Namum tank, the cost of purchasing which was considered to be under-estimated at 200 Rupees an acre. This item alone would, therefore, have occasioned an outlay of Rupees 3,51,000, or more than the total amount of Mr. Fraser's estimate. The Assistant Engineer in charge of the works then suggested an alternative arrangement for the supply of the tank from the Cooum, involving a new anicut on and channel from this river, the latter to be led through the Namum tank, and thence into the Chembrumbaukum tank. The rough estimate for this arrangement amounted to Rupees 1,20,000, and thereupon orders were given for the preparation of the necessary plans and estimates in detail. The investigations, which were at once made, showed the feasibility of confining the water spread of the enlarged tank, and of providing for its supply, via the Namum tank, and the late Chief Engineer having satisfied himself on these points, the alterations of the tank bund,

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so as to fit it for retaining the additional 4 or 5 yards of water, were allowed to be proceeded with.

4. In November 1869, the Acting Superintending Engineer of the Division submitted to this office estimates amounting to Rs. 7,41,000 for the re-arranged project; the total thus arrived at took into account deductions for certain parts of the works which it was considered should be debited to other works, such as the road along the top of the bund, a portion of the cost of improving the old Bungairoo, sale proceeds of submerged lands to be disposed of, etc. The increase was shown to be due—

Firstly, to excess on the tank itself, amounting to Rupees 1,64,250, or nearly 50 per cent. on Mr. Fraser's estimate, which, it will be remembered, provided only for the requirements of the tank. The excess was due partly to the insufficiency of the rates allowed in the original estimate, and this circumstance was brought to the notice of Government in the correspondence printed in G. O., 21st April 1868, No. 1,205, the extra cost on this account being then roughly estimated at Rupees 80,000. The rest was made up of additional quantities of work, and of a large excess in the cost of sluices and waste weirs, the former of which had been found for the most part to require entire re-construction.

Secondly, to items connected with the supply of the tank—	RS.
1. A new anicut with head sluices on the Cooum ...	38,757
2. A new head to Tinnanore supply channel, in lieu of old head rendered useless by anicut....	6,500
3. Supply channel to Namum tank ...	47,751
4. Enlargement of Namum tank ...	48,138
5. Channel from Namum tank to Chembrumbaukum tank ...	62,380
6. Drainage channel ...	17,295
	<u>2,20,821</u>

Thirdly, to increase of the item for the alteration and raising of the trunk road from Rupees 15,768 in the original, to Rupees 43,117 in the revised estimate, also to branch roads Rupees 21,458, etc.

5. These estimates were examined by me, and, after discussing the several items with the Assistant Engineer who had framed them, I went over the ground with him, and came to the conclusion that, while retaining the site selected for a new anicut on the Cooum, it would be better to lead the channel therefrom above the Namum tank rather than into it; for although under the latter plan it was required site to make the tank capable of holding a largely increased supply, practically the effect would have been to raise the water level only for a few days; and, on the other hand, the passing through this tank of the large supply required for Chembrumbaukum would have rapidly diminished its capacity for its own irrigation.

6. Instructions on this and other points were given to Mr. Lowry, and the revision of the estimates was proceeded with. In the meantime, however, grave doubts were felt as to whether the water supply could be considered sufficient to make it probable that the tank would fill, were its capacity, enlarged to the extent

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contemplated by Mr. Fraser, and provided for in the sanctioned estimate, and, His Excellency the Governor having visited the tank, it was decided that an alternative project should be estimated for, which should so far increase the capacity as might be practicable without submerging the Namum lands, and which should enable the supply from the Cooum to be obtained from the existing anicut and channel.

7. The estimates which have now been prepared show the cost of what may, for brevity, be termed the 15 and 6 feet projects, respectively, and their amounts are Rupees 9,07,573 for the larger scheme, and Rupees 4,48,000 for the smaller. In the abstract estimate for the former the following deductions are made, thereby reducing the estimate to Rupees 8,38,000:—

	RS.
Part of cost of improvements to the old Bungairoo ...	6,000
Branch road over bund	18,573
Resale of submerged lands, the compensation for which is put at 63,000	45,000
	<u>69,573</u>

but no similar allowances are made in the latter estimate. The first deduction is equally applicable to both, and might, I think, be properly increased to Rupees 10,000, and be debited to repairs for the benefit of the 19 channels taken off from the old Bungairoo and Cooum, between the Kesavaram and the Koratur anicuts, as these channels will benefit largely by the clearances and repairs provided for. The smaller project is equally entitled to the second deduction to the extent of the expenditure, Rupees 6,672, already incurred; but I do not think that a road along the bund is so necessary as to make it advisable to complete it by the diversion of funds from other district roads which would be more useful, and I propose, therefore, to debit both projects alike with the 6,672 Rupees which have been spent. The estimates for the 6 feet project contain no entry for the completion of the road. The last deduction is for compensation. I do not know upon what data five-sevenths of the amount put down as required to be paid are expected to be recovered by the resale of the land, but unless upon the supposition that a good deal of the ground would, in the larger project, never be submerged at all, the deduction appears to me to be too high. I would therefore, for purposes of comparison, estimate the amount to be recovered as one-third of that to be paid. With these modifications the deductions from the three estimates would be as follows:—

Mr. Fraser's one-third of Rupees 58,851 for compensation, or 19,615

Mr. Lowry's 15-feet project—

1. Part of old Bungairoo Estimate	10,000
2. Difference between Road Estimate Rupees 22,812 and Rupees 6,672 expended	16,140
3. One-third of Rupees 63,000 for land	21,000
	<u>47,140</u>
	10,000
	<u>4,859</u>
	<u>14,859</u>

The 6 feet project—

1. As above

2. One-third of land compensation

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8. No useful purpose would be served by anything more than a very short comparison of the estimates, as prepared by Mr. Fraser and Mr. Lowry respectively. The principal items are shown in the following statement:—

1	TANK.									11	12	13	14	15
	Earthwork.	Revetment.	Gravel back- ing.	Puddling.	Turfing.	Sundry works.	Sluices.	Waste weirs.	Total.					
Mr. Fraser's 15-feet Pro- ject ...	69,520	1,10,813	8,707	45,603	5,495	4,148	8,517	13,889	2,66,692		15,768	39,236	14,124	8,35,820
Mr. Lowry's 15 feet Pro- ject ...	1,25,499	1,56,073	19,487	47,721	7,593	12,903	72,243	25,630	4,67,152	2,60,847	49,789	42,000	40,644	8,60,433
Do. 6-feet do.	71,552	56,764	6,139	23,471	5,341	20,803	66,001	20,047	2,70,118	83,199	47,403	9,720	22,701	4,83,141

The earthworks of Mr. Fraser's and Mr. Lowry's 15-feet projects show, it will be seen, a great difference. The former quantity is 556,157 cubic yards, and one

16,428	Cubic yards at 1 Anna.
109,643½	" at 2 Annas.
36,920	" at 3½ "
73,677	" at 2½ "
65,296	" at 3½ "
97,244	" at 4 "
80,233	" at 3½ "
82,318	" at 2½ "
73,496	" at 2½ "
85,180	" at 1½ "
81,070	" at 1½ "
21,180½	" at 2 "
822,686½	

average rate of 2 Annas was allowed. Mr. Lowry's quantity is 822,686½, and the average rate of the estimate is 2 Annas 7½ Pies, subject, however, to a deduction which reduces the average, on the charge of earthworks, to 2½ Annas. This increase of rate is not, I think, greater than was shown to be probably necessary at the beginning of 1868. As regards the increase of quantity, it was considered that the margin

of 6 feet above escape crest level was insufficient for a reservoir of such large capacity, and the estimate accordingly provides for a bund one yard higher than was intended originally. The entries in the detailed estimate show that cubic yards 143,237 are due to this cause, and 21,180 more to the bund across the old supply channel. The rest of the difference is not so clearly accounted for, and the whole difference should have been explained* in detail. The difference in revetment is upwards of 50 per cent.

* Vide correspondence, Appendix A.

The original estimate provided	58,397 cubic yards at Rs. 1-12-0 new stone.
	17,236 " at " 0-8-0 old stone.
	<u>75,633</u>
The revised estimate shows ...	97,382 " at " 1-8-0 new stone.
	20,000 " at " 0-8-0 old stone.
	<u>117,382</u>

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of the excess 14,278 cubic yards are due to the increased height of the bund, and 3,973 cubic yards are allowed for the bund across the old supplying channel. The remaining 30 per cent. of increase on the original quantity has not been explained in the papers accompanying the estimates.

Vide Appendix A.

The difference in quantity of gravel is (53,973—16,439) about one-sixth, and is all put down to the increased height of the bund. The rate for new gravel has been 8 Annas instead of 4, and the former is probably not much, if at all, higher than was necessary.

The sundry works in the two estimates include the same items, except that in the revised estimate Rupees 2,812 for channels of communication between the new sluices and the old sluice channels have been properly provided.

The item for sluices has been raised from Rupees 8,517 to Rupees 72,243. Mr. Fraser's estimate allowed for altering the heads of the eleven existing sluices, and for building two new sluices, the allowance for the former averaged 143 Rupees each per sluice, and for the latter Rupees 1,824 each sluice. Mr. Fraser was not aware of the necessity for the alterations, as it was not until they were examined, that the necessity for the alterations was discovered. The alterations were of a more extensive nature than was anticipated, and the cost of the alterations was found to be more costly than was anticipated. The difference between the two estimates is Rupees 63,726. The difference is due to the fact that the original estimate was based on the assumption that the alterations would be of a minor nature, and that the cost of the alterations would be less than was actually found to be the case. The revised estimate is based on the actual cost of the alterations, and is therefore more accurate.

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Rupees 76,000, to which I should add 30,000 Rupees for the sluices, for the designs would not have involved so heavy an expenditure had they been intended for a comparatively small, instead of a great, depth of water. The fair value of the work involved in the 6-foot project would then have been Rupees 3,22,000. It may be noticed here that there is some error* in the amount provided for sluices in the estimate for this project, and the Superintending Engineer's attention has been called thereto. Apparently nearly 16,000 Rupees have been included in both past and future expenditure.

Deduct—	4,33,141
76,000	
30,000	
5,141	
	1,11,141
	3,22,000

* *Vide correspondence, Appendix A.*

Of the eleven sluices which the tank formerly possessed, three have been or will be closed, three will be remodelled, and five entirely re-constructed, and most of the work has been already done. Particulars of the arrangements, which are, I consider, satisfactory, will be found in paragraphs 19 to 25 of the Assistant Engineer's report. The arrangements for the escape of surplus water differ materially in the two projects. In the larger scheme all the old calingulabs must be closed, and superseded by one new weir 1,000 feet in length. In the reduced scheme it is proposed to retain four out of the six weirs, to join Nos. 1 and 2 by removing the bank between them, and to raise the crests, wings, etc. In this way 624 feet of water-way, or 62½ feet more than the tank has before possessed, will be obtained at a cost of Rupees 13,216, or about 21 Rupees a foot; in nineteen years out of twenty this will suffice. At the south end of the tank there is a ridge of hard ground, which is for the most part about 1 foot above the proposed full tank level, and this, at an outlay of Rupees 709 only on the spot, and of Rupees 5,693 in making a conducting channel for the surplus water, will supplement the regular escapes amply and effectually. I would, however, mention one point in connection with these escapes which should be further inquired into before they are converted. In paragraph 14 of the General Specification, Mr. Lowry refers to the work to be done somewhat vaguely, and it should be understood, I think, that, if an entirely new weir, 1,000 feet in length, can be built at the south end of the tank at the required level for a less sum than 20,000 Rupees, or for a less amount than may be found to be required when the ground is opened for a short length in front of each of the present weirs, then it will be better to substitute the one new work for the several small ones, which with every care will be inferior to a weir on high ground, as they have the disadvantage of a heavy over-fall, which will make them expensive to maintain.

10. The information regarding the revenue aspect of the project is, I am sorry to say, not as complete as might be wished, owing principally to the absence of particulars of the changes of assessment which appear to have taken place since the commencement of the period referred to in Mr. Fraser's report. That officer states the

Ayacut area in the 58 villages under the tank to be cawnics	8,604,
or acres	11,374
Do.	Assessment
do.	do.
do.	Rs. 63,842

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favourable aspect than that presented above; but as I believe that under no circumstances can the water-supply be made equal to the requirements of the tank if enlarged, as provided for in the 15-feet project, I do not feel any hesitation in recommending that the reduced scheme be adopted. The Budget for 1871-72 being under preparation, and the time required for the collection of the additional information, which I have mentioned as being desirable, have induced me to submit the estimates with this note, in preference to waiting until a complete report could be laid before Government, added to which my time, until the beginning of February, will necessarily be occupied with the works of the districts which I am now in the course of visiting.

30th November 1870.

(Signed) J. MULLINS, Major, R.E.,
Chief Engineer for Irrigation.

No. 25.

Supplemental Note by the Chief Engineer for Irrigation.

THE information given in the correspondence and statement printed in Appendix A. explains a considerable part of the difference between Mr. Fraser's and Mr. Lowry's estimates for earthworks, but intending Engineer should see to this.

Nearly all the difference in revetments is accounted for in the statement. 2. The Assistant Engineer's letter in the same appendix shows that Rupees 17,405 were erroneously shown as past expenditure on, and at the same time included in the amount required to complete, the sluices.

The amount of the estimate for the Chembrumbaukum Reservoir on the smaller scale will therefore be—

Amount as submitted by Superintending Engineer	RS. 4,48,000
Deduct part of old Bungairoo estimate	10,000
One-third of the amount entered for land compensation	1,858
Error in sluice estimate	17,405
Sundries	1,736
Revised amount of estimate	34,000
Information as to the water received into the supply channel at the Koratur anicut, and as to the quantity discharged this season at the waste weirs of the tank, was called for, and statements were submitted through the Superintending Engineer, but they manifestly required revision and they have been returned for that purpose.	4,14,000

3rd February 1871.

(Signed) J. MULLINS, Major, R.E.,
Chief Engineer for Irrigation.

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From the Superintending Engineer, 4th Division, to the Chief Engineer for Irrigation, dated Madras, 23rd November 1870, No. 3,513.

I HAVE the honour to forward, for your approval and eventual submission to Government for sanction, two* sets plans and estimates for the improvement to the Chembrumbaukum tank and its sources of water-supply.

- * 15-feet Scheme, plans and estimates.
- 6-feet Scheme, plans and estimates.

Enclosures.

- 1 Portfolio of plans.
- 1 Estimate of 6-feet project.
- 1 Specification Report.
- 2 General Reports.
- 1 Estimate of 15-feet project.
- 1 Portfolio of plans.
- 1 Specification.

2. One set of plans and estimates, amounting to Rupees 8,38,000, include the whole of the original project as worked out by Mr. Fraser with certain alterations and improvements suggested at different times after inspections by the Chief Engineer for Irrigation and Lieutenant-Colonel Bean, duly recorded in the several orders on the subject, this project may be designated as the 15-feet project, as the escape weirs are proposed to be raised to that height above the present ones.

3. The other plans and estimates, amounting to Rupees 4,48,000, is the revised project recommended by Major Mullins, this project may be designated as the 6-feet project, as the waste weirs are only to be placed 6 feet above the present calingulals.

4. It will be needless to recapitulate the whole design which has been so frequently before the Chief Engineer and the Government, both in Mr. Fraser's reports and in letter from the Superintending Engineer, under date 30th June 1869. In preparing these projects the several points ordered in the several memorandums and orders of the Chief Engineer, including those of 7th February and 4th May 1870, and the Government Orders 21st April 1870, 24th May 1870, No. 1,329, have been duly attended to.

5. The only remark that seems called for is that the waste weir for the escape of surplus water seems ample, being 63 feet more than in the original, and when the fact of there being a head sluice to the old Bungairoo channel, so as to regulate the supply, is taken into consideration, this seems ample. Should there be any fear there is a ridge on the southern side, if the 6-feet scheme is adopted, that will answer the purpose of a natural waste weir averaging one foot above the escapes.

6. Colonel Bean, in submitting the 15-feet project on the 30th November 1869, showed that after all deductions the profit on the expenditure should be 7½ per cent., but the cost was only estimated at Rupees 7,41,000 and profits at Rupees 55,000, but now the revised estimate has come up to Rupees 8,38,000, which would reduce this per-centage to 6.55 with the same profit of Rupees 55,000.

7. In the new or 6-feet scheme Mr. Lowry estimates the clear gain to Government at 11 per cent., but I should think that his calculations were faulty, and that we could hardly reckon on more than that the full yearly ayacut would be obtained, the difference being that formerly the collections were always a good deal below the revenue, about Rupees 47,462, averaging only 27,000 for the last five years, while now with these improvements a good and certain feeding channel, that the full cultivation would be a certainty except in years of exceptional drought. There will be, however, water enough in excess of the old supply to irrigate some 4,500

* Report, dated April 1867, Paragraph 32.
† 4,347, in Statement.

He likewise shows* that the average area irrigated during the last 14 years was cawnies 4,345,† or acres 5,745, on which Rs. 38,975

the assessment or collections were...	Rs. 38,975
but he mentions that the present rate of assessment on the same area would be only	„ 21,725
Now the assessment per acre on the whole circar ayacut averages	Rs. 5.45
Do. Inam do. do.	„ 6.63
Do. area of cultivation of the 14 years	„ 6.78
While the assessment per acre deduced from the reduced sum of Rupees 21,725 would be	„ 3.78

On the other hand, Colonel Bean in his letter of the 30th November 1869, No. 4,437, states the average cultivation for five years to have been 6,378 cawnies, or acres 8,432, yielding a revenue of Rupees 47,462, or on the average Rupees 5.63 nearly. Colonel Bean does not say to what five years he refers. Again, Mr. Lowry, in paragraph 40 of the report on the 6-feet project, names the average revenue of the last five years as Rupees 27,394, but nothing is said regarding the acreage cultivated. If Mr. Fraser's account of the reduced rates of assessment be correct the area would be 7,869 acres. On the other hand, appended to paragraph 52 of the report on the 15-feet project is a statement showing the quantity of water received by the tank in each year of a series of twenty-one, and for the five years referred to the average supply was just under seven-twelfths of a full tank, and taking the tank as capable of cultivating, when full, the whole ayacut of 11,374 acres, and this it could certainly do at the level of the top of the dam stones, 6,635 acres would be the average cultivation of the five years as deduced from the quantity of water stated to have been available. I cannot reconcile all these differing figures, and I would suggest that—

- 1st.—The period referred to in the statement given in paragraph 31 of Mr. Fraser's report should be stated.
- 2nd.—A statement for the 58 villages under the tank for each year since that period should be prepared, and a column should be added showing the water-supply received by the tank in each year.
- 3rd.—The period to which the statement of the 28 villages given in paragraph 53 of Mr. Fraser's report refers should be stated.
- 4th.—A supplemental statement for the subsequent years in the same form should be given, but this may be for the average of this additional period and not for each year separately, as these villages are not included in the present ayacut of the tank.
- 5th.—It should be clearly shown when the changes of assessment occurred, and what was the former average rate per acre for each set of villages (the 58 and 28) and what that which now is in force.
- 6th.—It should be shown, if such be the case, how it has occurred that in some instances the collections, divided among the area stated to have been cultivated, give a higher average rate per acre than the total ayacut assessment divided by the ayacut area. This may be due to highly assessed lands having been cultivated, and inferior

lands left waste; but it may also be due to second crop cultivation, and if so, the area and assessment of the second crop lands should be stated, as these would affect the comparison between the cultivation and the water-supply.

11. The probable extent of the water-supply is the point which will determine which project should be carried out. It seems quite certain that, with all the improvements which can be made in ensuring the available supply reaching the tank, there would have been no chance of its sufficing to fill the tank with a capacity of 196,874 millions cubic yards in any recent season prior to the present one, in which latter the rain-fall has been much above the average. It is stated by Mr. Lowry, but on what data has not been reported, that the Cooum may be expected to be in considerable fresh for only about eight days during the season of cultivation. The old Bungairoo, by which the Cooum obtains from the southern branch of the Cortelliar, its principal supply will, when improved, be capable of carrying about 531,000 cubic yards an hour. Similarly the new Bungairoo, by which whatever river water may reach the tank will come, will, when enlarged, with a maximum depth of 6 feet, carry about 350,000 cubic yards an hour, or, with a depth of 6½ feet, which can, without any alteration of arrangements be fixed as the maximum, nearly 395,000 yards an hour. The difference between the capacities of the old and new Bungairoo is probably not more than must be allowed to provide for other channels between the Kesavaram and Koratur anicuts. In the eight days referred to the supply which would reach the tank from the Cooum would be 75.84 millions, and probably the most that can be calculated upon from land drainage would be in ordinary years 40 millions, or, say, 15½ millions less than the tank held up to the crest of the old calingulahs. If these data be at all reliable, it would manifestly be in only very good years that there would be any chance of the larger tank filling; while, so far as

I can judge, the tank, if enlarged only to the extent of the 6-feet project, would not fill* every year, though perhaps it might be safe to calculate upon its filling in nine years out of twenty-one, and of its receiving in the other twelve years the 77.80 millions, which it occasionally obtained in very good seasons under the old arrangements. If so the results would be that on the average the tank would receive 88.56 millions, and allowing 9,000 cubic yards per cawny, or 6,750 cubic yards per acre, the area of cultivation or irrigation would be 13,120 acres. The average of past years is not at present accurately known, but it would seem to have been not more than 7,500 acres, and the difference would then be 5,620 acres. I do not know how to assess this, but it may be supposed that not less than 5 Rupees an acre will ultimately be obtained, and the gross increase of revenue would then be 28,100 or about 6.5 per cent. on Rupees 4,33,141, the amount of the estimate for the smaller project (*vide* column 15, paragraph 8 above). The conservancy would cost perhaps 5,620 Rupees annually in addition to the former average outlay on repairs, and the net return on the cost of the project, exclusive of establishments, would be 4.87 per cent.

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12. I much regret that I am unable to advise the Government on better data; it is possible that when additional revenue information has been obtained, and the water registers of the Cooum are examined, the smaller project may bear a more

acres, while the waste land is considerably more than that; but still I doubt if more land will be taken up, though I must write subject to correction, as I am not acquainted with the locality, and judge only from my experience of similar projects. Suppose we take the difference between the ayacut revenue, Rupees 47,462, and the average on the last five years, Rupees 27,391, it will give a certain permanent increase of Rupees 20,068 yearly, and this will, on an expenditure of Rupees 1,18,000, give on per-centage of $4\frac{1}{2}$ per cent. which, in my opinion, is about as much as can be depended upon.

8. I have not said anything regarding the designs of the sluices or other subsidiary works, as they were completed long before I came to the Division, I believe chiefly under the personal orders of the Chief Engineer for Irrigation.

9. Whichever scheme is adopted the amount already expended and that now being carried out will have to be deducted from the estimate.

10. The amount expended in former years Rupees 1,91,961—up to 31st October 1870, 27,882—sanctioned this year 37,739. Total 2,32,703.

Report on the alternative scheme for enlarging the Chembrambaukum Tank by raising the Waste Weirs six feet.

With this Report are forwarded sheets of plans.

1. *Sheet No. 1, Index Map*, showing the position of the Kesavaram dam across the Cortelliar, the old Bungairoo channel, thence to the Cooum river; the latter as far as the Koratur dam and head sluice, and the new Bungairoo channel from this dam to the Chembrambaukum tank. The contoured map of this tank, as well as the Namum tank, is shown on the Index Map; the blue-shaded line on the former shows the present water-spread of the tank, and the pink-shaded line, marked No. 3, shows the height to which it is proposed to raise the water, by what I will call for the sake of distinction the 6-feet scheme.

2. *The Streepermattur tank surplus channel*, which is one of the feeders of this tank, is also shown on this map, as well as the surplus channel from the Chembrambaukum tank flowing into the Adyar river, in the bed of what was once the Pummel tank.

3. There are also laid down on this map, the channels, etc., required for the scheme for raising the escapes 15 feet, which, as they are not portions of this project, need not be further noticed here.

4. *Sheet No. 2, Longitudinal and Cross Sections of the tank bund*, showing the present state of the bund, the portions coloured brown, is what has been added in carrying out the 15-feet project; and that coloured red, is what is required to complete the earthwork of the bund for the present (6-feet) scheme.

5. *Sheets Nos. 3, 4, 5, 6, 7, and 8* are plans of the irrigation sluices of the tank; *Sheet No. 3* gives the plans for two new sluices to supersede old No. 2, or Cavanore sluice, and old No. 9, or Poonamallee sluice; *Sheet No. 4* shows how it is proposed to construct a new sluice to replace old sluice No. 1, or Koonnathoor sluice; *Sheet No. 5* is the plan and sections of a sluice to replace No. 7, or Chetty sluice; *Sheet No. 6* contains plan and sections of a sluice to replace No. 10, or Mapoor sluice.

6. The plans, *Sheet No. 7*, show how it is proposed to deal with old sluices Nos. 1, 5, and 6, to make them safe and to suit them for the 6 feet additional height of water; *Sheet No. 8* shows how it is proposed to block up and secure from leakage old sluices Nos. 3, 8, and 11, the lands under which will be served by the new sluices.

7. *Sheet No. 9* shows the existing waste weirs of the tank, and how it is proposed to deal with them. It will be seen that it is intended to unite No. I., or Vettumadday calingulah, and No. II., or Rasambig calingulah, forming one escape of 264 in length, to close up escape No. 4, as has already been done with No. 6 at the northern end of the bund, and to raise all the remaining calingulahs 6 feet.

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10. *Sheet No. 12-25, Longitudinal and Cross Sections of the old Bungairoo channel and the longitudinal sections of the river as far as Koratur dam*. The sections of the former are intended to show how it is proposed to raise and strengthen the bank which separates the channel at its head from the Cortelliar, and raise the escape that exists in this bank by which the water, after it attains a depth of less than 3 feet in the channel, is allowed to flow back into the Cortelliar. The sections also show what is required to correct the gradients and strengthen the banks of this channel.

11. *Sheet No. 13-24 shows Longitudinal and Cross Sections of the Streepermattur tank surplus channel*, showing how it is proposed to strengthen the banks, and, where necessary, remove obstructions from the bed of the channel; this sheet also gives plans and sections of a waste weir and sluice situated in the banks of this channel, which require to be slightly altered and repaired.

12. *Sheet No. 14 shows Longitudinal Sections of the ridge*, 1,000 feet in length, which is available at the south end of the tank, as a natural escape, and of the line on which a surplus channel from it may be cut.

13. The line of the ridge requires little work to fit it for a waste weir. It is on the average 1 foot above the level of the other escapes. There are a few places where the natural formation is a few inches too high, which will require to be cut down, those are coloured yellow; and there are also few places that will require raising a few inches. This will be done by building a body wall along such low places, of which a section is shown on the plan.

14. The surplus channel, if thought necessary, can be excavated along the slope of the ridge half in cutting and half in bank; the fall is 13 feet per mile, so that a channel, with a comparatively small section, will suffice to discharge all the water that may at any time pass over the escape.

15. It is proposed to cut this channel so as to connect it with the line of the old surplus channel of the tank, a section of it is shown on the *Sheet No. 14*.

16. It may here be necessary to say why it is now proposed to abandon Mr. Fraser's proposal to raise the escapes of the tank 15 feet above former high tank level; I will endeavour, as briefly as possible, to do this.

17. Mr. Fraser, when contouring the tank, failed to discover that the new Bungairoo supply channel, where it crosses the Great Western Road (which is carried over it by what is called the Chunam Kal bridge), is lower by 5 feet than the present calingulah crest, and if the level of the latter were raised 15 feet, the whole of the valley under the Namum tank, marked by a light brown-shaded line on the Index Map, would be submerged, with five villages that may be seen within this line. It would take at least Rupees 8,00,000 to compensate the owners of this land and these villages, and hence it was necessary to completely revise Mr. Fraser's scheme, and the result is that, instead of the project costing only Rupees 3,55,000, as estimated by him, it could not be carried out for less than Rupees 8,38,000, as the estimate for the revised scheme, forwarded together with this Report, will show; so that even if Mr. Fraser's estimate of the amount of increased revenue to be derived from the enlargement of the tank, could be realized, the project would pay only 9 percent., instead of $20\frac{1}{2}$ per cent., as calculated on by Mr. Fraser.

18. But unfortunately it is now known that a sufficient supply to fill the enlarged tank cannot be relied upon in ordinary years, and it is even doubtful if the tank, when enlarged as at

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18. But unfortunately it is now known that a sufficient supply to fill the enlarged tank cannot be relied upon in ordinary years, and it is even doubtful if the tank, when enlarged as at

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first proposed, would fill in any but years of extraordinary rain-fall. The Government having taken these facts into consideration have been pleased to order that plans and an estimate for the present reduced scheme should be submitted.

19. Sheet Nos. 3 to 8 show plans of the irrigation sluices of the tank, and of the way it is proposed to deal with them. Eight of the eleven old sluices on being opened up and examined have been found utterly unsound and untrustworthy; five of those, namely, No. 2, or Cavanore sluice, No. 4, or Koonnathoor sluice, No. 7, or Chetty sluice, No. 9, or Poonamallee sluice, and No. 10, or Maypoor sluice, will be re-built, all with the exception of No. 7, or Chetty sluice, being now under construction; three, namely, No. 3, or Thiroomooodevaukum sluice, No. 8, or Malayambaukum sluice, and No. 11, or Agrarum sluice, are shut up; the channels which they supplied being served by the new sluices as follows:—No. 3, or Thiroomooodevaukum sluice, will receive water from both the Cavanore and Koonnathoor sluices, the channel of the latter being placed on the same level as the shut-up sluice, in order that the lands formerly supplied by it may have the same advantages which they before possessed, of drawing the last drop of water from the tank. The dimensions of the culverts of the two new sluices are as follows:—

	Square feet.
Cavanore 6 feet 6 inches × 3 feet = 19½	
Koonnathoor 6 feet 6 inches × 3 feet = 19½	
Total sectional area of culverts ..	39

While the dimensions of the culverts of the three old sluices were—

	Square feet.
Cavanore 2½ feet × 4 feet = 10 0	
Thiroomooodevaukam 2 feet × 3 feet—3 feet = 6 6	
Koonnathoor 2 feet 9 inches × 6 feet = 15 6	
Total sectional area of culverts of old sluice...	22 0

20. An inspection of the plans, Sheet Nos. 3 and 4, will show that the area of the sluice openings have been more than doubled, by giving each step five plug holes instead of two, or as most three, which was the old number, and the diameter of those openings has been increased from 6 inches at bottom to 10 inches, and from 10 inches at the top to 13 inches, the holes being conical to avoid as much as possible the *vena contracta*.

21. The new Poonamallee sluice and new Chetty sluice will supply Malayembaukum sluice, which has been closed, and the new Maypoor sluice will serve the Agrarum lands as well as those directly under it, which, as the sluice culvert will be equal in sectional area to both the old sluices, it will be quite capable of doing.

22. It will be seen by the following calculation that any two of the new sluices are equal to the discharge of more water than would be required to irrigate the area supplied by three old sluices:—

Take Thiroomooodevaukam, Cavanore, and Koonnathoor sluices; the number of plug holes is five of 10 inches bottom diameter and 13 inches upper diameter each and, as where a tube is conical to a length equal to half its larger diameter, having the issuing diameter less than the entering diameter in the proportion of 26 to 33, the stream does not become contracted, each of the plug holes would discharge 9.5 cubic feet per second, or the five 2,850 cubic yards per hour, or 142,500 per day, the two sluices together discharging 285,000 cubic yards daily, (and if more water was required, it would be easy to open one or more additional plug holes;) this would be sufficient for 2,850 cawnies, at 100 cubic yards per cawny daily. The Cavanore, Thiroomooodevaukam, and Koonnathoor sluices have up to this time had a total ayacut under them of 2,164 cawnies. I hope enough has been said to show that three of the old sluices can be dispensed with, without inconvenience or loss accruing to the ryots holding the lands under them. To rebuild those three sluices would cost Rupees 20,000, and as a sluice is decidedly the weak place in even the best constructed tank, there will be three weak places the less in this tank in consequence of those three sluices being closed.

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23. The plans, Sheet No. 7, will show how it has been found necessary to treat the three old sluices found sufficiently sound to be allowed to stand. It will be seen that there are really only two, No. 1, or Palanthundalam sluice, and No. 5, or Mangadoo sluice, that have been found without flaw or leak. The Manapaukum sluice, constructed by Colonel D'Haviland, after the breach which occurred through a former sluice having given way in the year 1818, was apparently built on the site of the former one in the month of October of the same year. It has been found unsound for a distance of ten feet from the retaining wall. The unsound portions have been removed and replaced by rebuilding the side walls and turning a new arch over them in the way shown in the plan. The cause of this portion of the sluice having given way is that, immediately under the plug holes in the step above, there is a stone platform placed at such an angle as to throw the water falling in it with great force against the intrados of the arch of the culvert. This platform will now be made into a gridiron arrangement by the removal of every other stone, and will then serve to break the falling water while letting it through, and prevent its being dashed against the masonry of the culvert.

24. It will be seen by the plans, sheet No. 7, that the earth has been removed from behind the retaining walls and around the culverts of the three last named sluices, and that a puddle wall will occupy the place of the earth. This puddle will be carried out on each side of the sluice and connected with the puddle wall behind the revetment.

25. Before concluding with the sluices I cannot help remarking that it is fortunate that the enlargement of the tank had been proposed, if for no other reason than that it has led to a thorough examination of the sluices, as there can be no doubt that matters would have otherwise gone on in the usual way until, on the occurrence of a flood, when, the tank being full to overflowing, one or more of these rickety structures would give way, and dire would probably be the loss of life and property.

26. Sheet No. 9 shows the present state of the waste weirs of the tank, and how it is proposed to raise and alter them. It will be seen that No. 4, or Nalleeammen calingulah, is to be closed, which has been already done in the case of No. 6, or Vattoomaday calingulahs. Nos. 1 and 2 will be thrown into one by removing the short length of bund between them, and forming the whole into one escape 264 feet in length. There will then be a total length of escape as follows:—

No. I.	264
„ II.	130
„ III.	230
Total length...	624

which, as the dam stones will be dispensed with, will be 63 feet more than the tank has formerly had. In addition to this there is a ridge at the southern end of the bund, marked in yellow on the longitudinal section, which being 1,000 feet in length and averaging 1 foot above the proposed level of the escapes, can with very little cost be made to answer advantageously as a waste weir. This done there will be no risk of the water ever rising to a dangerous height in the tank.

27. Sheet No. 10.—Plans and sections of Koratur dam and head sluice will show how it is proposed to raise the dam, the crest of which is at present but 2.82 above the floor of the head sluice. The banks of the Coom being low, will not admit of more than 1.5 being added to the height of the dam, which will leave the crest 4.32 above the floor of the sluice.

28. The northern land sluice will be closed, and the width of the rough stone apron increased by 10 feet. The existing head sluice has nine openings of 5 feet each, or 45 feet lateral, this with a depth of 2.82 would only discharge about 80,000 cubic yards per hour, or 1,920,000 cubic yards in twenty-four hours, which would require fifty-two days to fill the tank, which at 2.82 above present tank level, will contain some 102 millions of cubic yards. This contracted head sluice the Chief Engineer for Irrigation has ordered to be removed, and one, on the plan shown on this sheet, of twenty-one openings of 7 feet each to be substituted for it. This with a depth over floor of sluice of 3.32 and a head of 1 foot will give a discharge of 355,000 cubic yards per hour, or 8½

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millions of cubic yards per day. This would, if discharging at this rate, take twelve days to fill the tank, and, as we cannot calculate on the Coom being in flood on the average more than about eight days annually, it will be allowed that the head sluice and supply channel should be made of such capacity as to discharge all the water that in ordinary floods reaches the Koratur dam.

29. Sheet No. 11 contains longitudinal and cross sections of the new Bungairoo supply channel. This is called the new Bungairoo channel in contradistinction to the old Bungairoo channel. It is not, as the name would indicate, a new work, having been cut in the time of Collector Mr. Lionel Place, about the year 1798.

30. This channel, as will be seen by the Index Map, carries the Coom water from the Koratur dam to the Chembrumbaukum tank. The longitudinal and cross sections show how it is proposed to improve the bed and increase the capacity of this channel, which, having a gradient of $4\frac{1}{2}$ feet per mile, a breadth on the sole of — feet and a depth of 6 feet, giving a hydraulic mean depth of $5\frac{1}{2}$, will discharge about 360,000 cubic yards per hour.

31. Sheet No. A-11.—*The Vellaudu Bridge*.—This bridge carries Trunk Road No. 13 over the new Bungairoo channel at the village of that name, and, as will be seen by the plan Sheet No. A-11, is not of sufficient capacity to pass the increased volume of water which the enlarged head sluice will allow to pass down this channel. It is proposed, as will be seen by the plan, to add one more to the three openings of 20 feet each which now exist. This will give a sectional area something greater than that of the channel, and will be sufficient to prevent scour.

32. Sheet No. 11, *Longitudinal and Cross Sections* of the old Bungairoo channel, and longitudinal section of the Coom from its junction with the old Bungairoo channel to the Koratur dam. The bank is fairly strong which separates this channel from the Cortelliar, from which river it is taken off by the Kesavaram dam; but to prevent the chance of its being breached by a flood an escape has been placed in it 427 yards distant from the head of the channel. The crest of this escape is 2.5 feet above the bed of the channel, so that when the water rises above this level it flows back into the Cortelliar, and is, of course, lost to the tanks below. This, in my opinion, is not a wise arrangement, and I therefore purpose (if I am allowed) to raise this escape to 6 feet above the channel bed, which is the level of full supply, strengthen the head between the Cortelliar and the channel, and rectify the levels, which are very faulty, for the first three miles from the head.

33. It will be seen that the banks in many places require to be raised and strengthened, *vide* longitudinal and cross sections. When taking the levels for those sections, the ryots holding land near the channel informed me that whenever a fresh of even 2 or 3 feet in depth comes down the channel, the banks are breached in a number of places, and the waters flow to waste to the destruction of their cultivation.

34. I consider that a portion of the cost of the improvement of this channel should be charged to the nineteen tanks, which, being situated higher up the Coom, receive a supply before any water can reach the Chembrumbaukum tank; but this is a question for the decision of my superiors.

35. Sheet No. 11, *Longitudinal and Cross Sections* of the Streepermattur tank surplus channel. This is one of the principal feeders of the tank. It is for the whole of its length of $10\frac{1}{2}$ miles a great catch-water drain, which receives and discharges into the tank all the water that falls on the ridge above it to the north and north-west, over a surface of about 28 square miles, and as it also receives the surplus of the Streepermattur and Pellapaukum tanks, this channel must, when rains are heavy and continuous, discharge a large body of water into the tank.

36. It will be seen by the longitudinal and cross sections on Sheet No. 11, how it is proposed to improve this channel, which only requires the section enlarged and deepened in a few places and the right bank to be raised and strengthened throughout its length. The ground below this bank or bund is everywhere low, and it is essential to the effectiveness of this feeder that it should not be overtopped by floods and thus breached, which I learn has been a common occurrence in past years.

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37. There is a small calingulah that requires raising and strengthening, and a sluice that ought to be lengthened, plans of both of which may be seen on the Section Sheet No. 11.

38. Sheet No. 15 is a survey and sections of the land that it will be necessary to take up within the limits of the village of Koratur, in order that the river Coom may be widened above the head sluice, so that the approach to the latter may be without obstruction. The plan shows that it will be necessary to remove a portion of a tope, a few huts, and two better kind of houses; a fair value has been put upon this property, and will be found inserted in the estimate.

39. Sheet No. 16 contains longitudinal and cross sections of the communication channels under the bund, between the new sluices and the channels of the closed sluices. Those should be cut with a breadth of 5 feet on the sole, a slope of $1\frac{1}{2}$ to 1 on the sides, leaving 10 feet as berm between the spoil banks and the edge of the channel.

40. *Value of the project*.—The water now stored in the tank, when it is at the level of the top of the dam stones, is about $77\frac{1}{2}$ millions of cubic yards, and if at the level at which it is proposed to raise the escapes the quantity would be 103 millions, leaving $25\frac{1}{2}$ millions as the extra quantity that can be stored. This would irrigate about 3,643 acres, taking 7,000 cubic yards as the quantity required to irrigate one acre; this area at Rupees 5 would give Rupees 18,200 additional revenue, this sum added to the former assessment makes the total assessment about Rupees 80,000 and as the annual average revenue for the last five years is Rupees 27,394.

If the tank fills yearly so as to cultivate the whole ayacut the actual increase of revenue would be 52,606 Rupees, or about 11 per cent. on an outlay of Rupees 4,48,000, and I hope when the alterations and improvements in the supply channels, etc., contemplated by this project are made, that the tank will fill in all but years of extraordinary drought.

(Signed) R. J. LOWRY,
Assistant Engineer.

Abstract Estimate of the Chembrumbaukum Tank Irrigation Project 6-feet Scheme.

Number of Items in Estimate.	Description of Works.	Amount of each work.	Total.
		RS.	RS.
A. ...	Improvement of the Chembrumbaukum Tank	1,31,701	
B. ...	Raising ancient and extending the head sluice at Koratur	21,492	
C. ...	Improvement of the new Bungairoo supply channel, from Koratur ancient to Chembrumbaukum tank	15,793	
D. ...	Improvement of the old Bungairoo channel, from Kesavaram ancient down to its junction with the Coom river	45,200	
E. ...	Improvement of Soudrycal or supply channel from Streepermattur tank	7,714	
F. ...	Channel of communication between new sluice and irrigation channels of old sluice	1,273	
G. ...	Sundries at about 5 per cent. on the estimated sum	12,285	
H. ...	Compensation for lands and houses that shall become submerged by raising the crest of the waste weirs 6 feet above its present level	11,000	
I. ...	Add expenditure on the work up to 1869-70	1,98,542	
	Total Estimate...	...	4,48,000

(Signed) R. J. LOWRY,
Assist. Engr. in charge of No. 7 Range.

17th October 1870.

*Proceedings of the Madras Government, Public Works Department,
9th March 1871.*

*Statement showing the details of expenditure on Chembrumbaukum Tank works up to
March 1870.*

Sub-heads.	Amount.			Proportion that ought to be charged to 6-feet Project.			Remarks.
<i>Tank work.</i>	RS.	A.	P.	RS.	A.	P.	
Earth-work	62,447	15	4	31,723	15	8	One-half.
Turfing	127	0	6	127	0	6	Total.
Removing old revetment	2,136	15	8	2,136	15	8	Do.
Do. loose earth, etc.	3,483	3	6	3,483	3	6	Do.
Puddle Trench	2,508	14	6	2,508	14	6	Do.
Puddling	12,223	5	8	12,223	5	8	Do.
Gravelling	1,155	13	5	1,155	13	5	Do.
Re-building old revetment	7,610	4	6	7,610	4	6	Do.
Constructing new do.	16,215	8	10	16,215	8	10	Do.
New Calingulah	429	0	9				None.
Drainage channels	8,906	3	6				Do.
Constructing No. II. or Cavanore Sluice ...	7,609	3	0	7,609	3	0	Total.
Do. „ 7 or Poonamallee do. ...	8,388	0	4	8,388	0	4	Do.
Do. „ 8 or Maypoor do. ...	1,200	0	0	1,200	0	0	Do.
Do. „ 5 or Manapaukum do. ...	24	12	9	24	12	9	Do.
Do. „ 3 or Koonnatores do. ...	182	10	9	182	10	9	Do.
Removing trees from tank bund	2,496	2	6				None.
Quarry road and road over do.	2,103	8	7	2,103	8	7	Total.
Engineer's Bungalow	2,100	0	0	2,100	0	0	Do.
Road from tank bund to Trunk Road No. 3.	4,568	3	3				None.
Alteration in the 20th mile of Trunk Road No. I.	40,730	10	2	13,573	8	8	One-third.
Superintendence	5,037	8	5	5,544	8	0	Two-thirds.
Sundries including office, brick sheds, etc., etc.	3,279	3	7				
Compensation for lands	3,578	10	3	3,578	10	3	Total.
Total...	1,98,542	15	10	1,20,490	0	7	

25th November 1870.

(Signed) R. J. LOWRY,
Asst. Engr. in charge of No. 7 Range.

**REPORT ON THE REVISED PLANS FOR THE ENLARGEMENT OF THE CHEM-
BRUMBAUKUM TANK.**

With this Report thirty Sheets of Plans are forwarded as follows :—

Sheet No. 1.—Index Map, showing the several portions of the revised project from the Kesavaram anicut on the north to the Strcepermatores tank to the south, including the old Bungairoo channel and Cooum river, and the site of the proposed anicut across the latter; the supply channel thence to the Chembrumbaukum tank via the Chunam Kal; the contour plan of the Namum tank on which the blue shaded contour line shows the form and extent of the basin at the level of the present calingulah, and the pink shaded contour line would be the water spread, when enlarged, as was proposed, by raising the calingulah 6 feet.

2. The contour plan of the Chembrumbaukum tank is also shown on this map; only four contour lines are drawn upon it—the red line is the crest level of the present calingulah; the blue shaded one the wet boundary at the level of the top of the dam-stones; the pink line 6 feet above calingulah crest; and the red shaded line what it would be were the calingulah raised to the proposed height of 15 feet above its present crest level. I may mention that this map is common to both this and the 6-feet scheme.

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9th March 1871.*

3. The site of the proposed bund across the old supply channel is also indicated on this plan, as well as the proposed drainage channel from above this bund to the Manapaukum irrigation channel into which it will discharge.

4. *The Surplus Channel* from Strcepermatores tank, which is one of the feeders of the Chembrumbaukum tank, is also laid down on this map on the south.

5. The red contour line above Trunk Road No. 3, shaded in brown, shows the extent of land and the villages under the Namum tank that would have been submerged had the original scheme been carried out, and the red line on the east between the points A. and B. is where a bund 8 feet in average height and 10,000 feet long would have been then required to prevent the water flowing away towards Poonamallee.

6. *Sheet No. 2.—Longitudinal Section* of the top of the bund of Chembrumbaukum tank, and of the bund along the foot of the slope inside and outside the tank. On this sheet are also drawn Cross Sections, showing the present height and slope of the bund, and, coloured red, how it is proposed to enlarge it. There are also shown on this sheet Longitudinal and Cross Sections of the proposed bund for blocking up the old supply channel with the sluices proposed to be placed in it.

7. The blue line drawn on the Longitudinal Section shows the level of the crest of the present calingulah, and the red lines show, respectively, the height of proposed calingulah and top of proposed parapet. The datum line drawn on the section is 50 feet above mean sea level at Madras.

8. *Sheet Nos. 3, 4, and 5* are Plans proposed for five new Sluices, which will replace the old Sluices Nos. 2, 4, 7, 9, and 10, which were in a very dangerous state. No. 8 Sluice it is intended to place at the north end of the old bund; this sluice will supply water for the irrigation of a considerable tract of land not before under the influence of this tank. Sluices Nos. 2 and 3 will give water to the channels of old Sluices Nos. 2, 3, and 4; and Sluice No. 7 will supply the channels of old Sluices Nos. 8 and 9; and Sluice No. 8 will irrigate the land under old Sluices Nos. 10 and 11. There will be channels outside the bund to communicate between the new sluices and the extra channels they supply. This arrangement will enable me to dispense with three of the old sluices which were found in an untrustworthy state, and have been shut up.

9. *Sheets Nos. 6 to 8* show how it is proposed to alter the three old sluices which are retained.

10. *Sheet No. 9.—Plans* of proposed Calingulah, and also plans of masonry falls for regulating the gradient of supply channels.

11. *Sheet No. 10.—Plans* of an Anicut and Head-sluice which it is proposed to place across the Cooum river at the 23rd mile from Madras; on the north side of the anicut are shown plans of a head-sluice for the Tinnanore tank.

12. *Sheet No. 11 shows details of Sluice-gates* and

13. *Apparatus* for lifting the same, and also details of Sluices and Self-acting gates for the proposed bund across old supply channel.

14. *Sheet No. 12.—Longitudinal and Cross Sections* of the proposed Supply channel from the anicut across Cooum river to the Chunam Kal, and thence by that stream to where the channel leaves it, and is carried above the Namum tank through the dividing ridge into the Chembrumbaukum tank, with Cross Sections showing the excavation that will be required.

15. *Sheet No. 13.—Plans of Embankment, etc.,* to carry 20th mile of Trunk Road No. 1 over the western end of the tank.

16. *Sheet No. 14.—Plans of a Masonry Bridge of three Arches* to span Supply channel from the Cooum river in the embankment on the 20th mile of Great Western Road.

17. *Sheet No. 15.—Longitudinal and Cross Sections of Drainage Channel* from the bridge over the old supply channel at the 17th mile of Trunk Road No. 3, to the Manapaukum channel near the centre sluice of the tank.

18. *Sheet No. 16.—Plans of Aqueducts and Inverted Syphon* to pass irrigation water from the Chembrumbaukum tank sluices to the further side of the drainage channel.

19. *Sheet No. 17.—Plans of Bridge* to pass Trunk Road No. 3 over drainage channel on the 15th mile.

20. *Sheet No. 18.—Plans of Sluices* proposed to be placed in the bund across the old supply channel.

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21. *Sheet No. 19.—Plans of a Skew Masonry Bridge* over drainage channel to carry communication road from Trunk Road No. 3 to the tank.

22. *Sheet No. 20.—Plans of Culverts* for communication road.

23. *Sheet No. 21.—One small Bridge and twelve Culverts* on quarry road from the Madras Koonnattore road to the tank bund.

24. *Sheet No. 22.—Longitudinal and Cross Sections* of the proposed channel from anicut to Tinnanore tank.

25. *Sheet No. 23.—Plans of Head-sluiice* for drainage channel.

26. *Sheet No. 24.—Longitudinal and Cross Sections* of the supply channel from Streepermattore tank, on which, in red, are drawn the proposed alterations and improvements. This plan is common to both projects.

27. *Sheet No. 25.—Longitudinal and Cross Sections* of the Cooum river and old Bungairoo channel, showing the obstructions and how it is proposed to rectify the levels, block up the calingulah, and strengthen the bank between head of the channel and the Cortelliar river, and raise and strengthen the bank. This plan is common to both projects.

28. *Sheet No. 26.—Sections of Channels* to connect new sluices with the channels of old sluices which are to be shut up.

29. *Sheet No. 27.—Masonry Crossings* to allow water of drainage channel when in flood to pass into and out of Irrigation channels.

30. *Sheet No. 28* contains Plans and Sections of the dam proposed to be placed across the Chunnam Kal, where the supply channel leaves that stream; there are also figured on this sheet the details of the shutters for closing the gates of the dam, and the apparatus for lifting and lowering them.

31. *Sheet No. 29* gives sections of the ground at the site of the waste weir, showing what earth it will be necessary to remove to give a free approach to, and delivery from, the calingulah.

32. *Sheet No. 30* shows the plan pursued in closing old Sluices Nos. 3, 8, and 11.

33. In Mr. Fraser's report the history and description of the tank are so fully given that it would be waste of time and paper to attempt to say anything on either subject in this report. I would therefore refer any one wishing to know more than is contained herein on those subjects to the above-named document.

34. The Index Map Sheet No. 1 will, if carefully examined, give a clear idea of the position of the tank, how it is supplied, and of the water-spread at the different levels.

35. It would be giving the Collector unnecessary trouble to ask him for a fresh Statement of Ayacut and Revenue of the tank, I have consequently extracted those supplied to Mr. Fraser; and as I believe his (Mr. Fraser's) deductions, from the information thus obtained, are generally correct, I have adopted his statement of the probable additional revenue to be expected from the enlargement of the tank.

36. I have invariably acknowledged, by inverted commas, every line so quoted.

37. The principal supply which the tank received is from the Cooum river, across which there is a dam and head-sluiice at Koratur, the new Bungairoo channel conveying the supply thence to the Chembrumbaukum reservoir. The Cooum receives the water of the southern branch of the Cortelliar by the old Bungairoo channel, there being at the head of the latter at Kesavaram a dam across the Cortelliar for the purpose of throwing water into this channel. There are nineteen tanks that receive water from the Cooum, the supply channels of which are situated above the Koratur anicut.

38. Since the date of Mr. Fraser's report, head-sluiices have been built to a number of those channels; but I doubt if there be any proper system of control as yet established for regulating the quantity of water that each will receive when a fresh occurs in the river.

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The Supply Channels taken off the Cooum River are as follow:—

No.	Names of Channels.	TAKEN OFF		Remarks.
		North side.	South side.	
1	Condengerry Channel	...	...	Has a new Head-sluiice.
2	Pinjivakkum do.	...	...	Do. do.
3	Athigathore do.	...	...	Do. do.
4	Agamy do.	...	...	Do. do.
5	Casam Nullatore do.	...	...	Do. do.
6	Cadumbathore do.	...	...	Do. do.
7	Yagatore do.	...	...	Do. do.
8	Poongatore do.	...	...	Do. do.
9	Salay do.	...	...	Do. do.
10	Peryacoopum do.	...	...	Do. do.
11	Pooliyancoopum do.	...	...	Do. do.
12	Calacatore do.	...	...	Do. do.
13	Poothore do.	...	...	Do. do.
14	Thunneercolum do.	...	...	Do. do.
15	Tholoovoor do.	...	...	Do. do.
16	Aranvoyal do.	...	...	Do. do.
17	Goodapackum do.	...	...	Do. do.
18	Thiroovoor do.	...	...	Do. do.
19	Tinnanore do.	...	...	Old, broken.
Total Channels both on North and South...		...	...	

Supply Channels taken off the new Bungairoo Channel between Koratur Anicut and Chembrumbaukum Lake."

No.	Names of Channels.	TAKEN OFF		Remarks.
		East side.	West side.	
1	Nedoonjary Channel	...	...	Old Sluice.
2	Peroyembet do.	...	...	None.
3	Thiroomathishey do.	...	...	Old Sluice.
4	Manumbadoo do.	...	...	Do.
Total Channels		...	...	

"Table showing the Capacity and Area of the Basin in which Chembrumbaukum Tank is situated at each contour line on the Plan No. 2."

No. of cubic yards.	Area at each contour in square yards.	Average area of each pair of average cubic yards between each pair contour lines.	Total number of cubic yards at each contour.	Area in square miles.	Area in Acres.	Circumference in miles.	Remarks.
5	34,800,183	33,602,195	196,873,925	11,234	7,190,121	21,275	Level of proposed calingulah.
4	32,401,203	31,348,748	163,271,730	10,461	6,695,083	20,525	
3	30,293,288	29,012,144	131,022,984	9,779	6,258,943	19,375	
2	27,731,000	25,113,600	102,910,840	8,953	5,729,545	18,575	Level 6 feet above calingulah crest.
1	22,496,201	22,191,778	77,797,240	7,263	4,647,975	17,375	Level of top of dam stone.
0	21,887,356		55,605,464	6,715	4,298,035	16,093	Level of the three calingulahs at the south end of bund.

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39. "Calingulaks.—There are six Calingulaks to Chembrumbaukum tank, five of them being near the south end, and one near the north end of the bund as follows, counting from the south end :—

" No. 1.—Vettumaddy Calingulaks	...	...	...	...	58	23
" 2.—Rosanbeg do.	...	...	...	...	130	39
" 3.—Thattan do.	...	...	...	...	115½	36
" 4.—Nalliaman do.	...	...	...	...	46	18
" 5.—Poniaman do.	...	...	...	...	223	48
" 6.—Vettumaddy do.	...	...	...	...	61	80

"Total length in feet... 643½ 164

"Deduct the aggregate width of the dam-stones ... 82 ...

"Total clear length ... 561½ ...

40. "Of these calingulaks, Nos. 1, 2, and 3 are at the same level; 4 and 5 are 6 inches to 12 inches higher; and No. 6 is nearly 2 feet higher. They are all, with the exception of No. 6, very solidly built with dressed gneiss, and with the same exception they have all dam-stones 3 feet in height. As these calingulaks are all to be removed, plans of them are not sent up."

41. *Sluices*.—The present Sluices are eleven in number. Of these, I have found eight so very badly built and altogether so utterly insecure and dangerous that I have removed them, and am building five new sluices in their stead; the other three being shut up. These old sluices were apparently most massive and strong, while on examination they proved to be utterly rotten and undermined.

42. The following is a Statement of the dimensions, etc., of the old sluices, counting from the south end :—

Numbers from South end.	Names of Sluices.	Bottom of Culverts below present Calingulah.	Dimensions of Culverts.
1	Palanthundalum ...	14' 50	56' × 2' × 4'
2	Cavanore ...	14' 80	65½' × 2½' × 4'
3	Thirrumuddivakum ...	17' 50	54' × 2' × 3'-3"
4	Koonnatore ...	19' 0	59' × 2'-9" × 6'
5	Maungaud ...	16' 0	110'-6" × 2' × 4'-3"
6	Manapaukum ...	21' 75	81'-6" × 2' × 5'-6"
7	Chetty Sluice ...	13' 30	125'-3" × 2'-3" × 5'
8	Malayambaukum Mettu ...	9' 40	61'-9" × 2'-3" × 3'-3"
9	Poonamallee ...	8' 70	58'-9" × 3'-6" × 2'-6"
10	Maypoor ...	8' 30	53'-6" × 1'-6" × 2'-3"
11	Agaram ...	3' 75	52' × 1'-6" × 2'-3"

43. "Land now Irrigated.—Chembrumbaukum has always been highly valued as an Irrigation tank, as the cultivation of a large portion of the irrigated land lying on the west of Madras depends on it. It irrigates the whole or parts of fifty-eight villages, the Nunjah ayacut of which is 8,604 cawnies, assessed at 63,842 Rupees. This includes 1,163 cawnies of Inam land, assessed at 10,190 Rupees.

44. "Very seldom, however, has there been sufficient water to irrigate the whole ayacut. I have obtained from the Tahsildar's Cutcherry such information as has enabled me to give the following table, showing the numbers and names of the fifty-eight villages; the ayacut in each of the Circar and Inam lands; the average area irrigated during the last fourteen years; and the number of cawnies in each Circar village under dry cultivation, or of waste land or of both, which could be converted into wet cultivation if there was sufficient water."

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Statement of the Ayacut, Assessment, etc., of the fifty-eight villages irrigated from Chembrumbaukum Tank.

Registered number of Villages.	Names of Villages under the Tank.	CIRCAR LANDS.		INAM LANDS.		The average number of Cawnies under wet cultivation for the last 14 years.	The number of Cawnies of either dry cultivation or waste in each village that could be converted into wet cultivation.
		The Ayacut of each village.	The Assessment of each village.	Ayacut.	Assessment.		
1	2	3	4	5	6	7	8
156	Mangadoo ...	423	3,566	153 5	1,723 8	337 4	14
157	Matavalagam ...	37	261	10 11	86 12	29 6	2
158	Ragoonathapooram ...	40	326	13 8	104 14	34 7	2
159	Chikkaroyapooram ...	44	315	15 13	126 8	33 1	15
160	Olagamcathavelagam ...	34	227	5 14	28 4	27 15	1
161	Keolaperoomalpattayaram ...	13	114	8 0	73 11	9 4	...
162	Nalamcuttaly ...	41	255	9 11	55 7	32 0	4
163	Chinnappuchary ...	29	225	5 0	39 9	25 11	1
164	Malayambakum ...	812	2,429	44 9	402 5	129 9	266
165	Sathamallam ...	4	28	...	...	3 11	...
166	Kalacattochary ...	39	372	...	...	7 12	32
167	Malaperoomalpattagaram ...	38	311	2	43 14	29 9	8
168	Vellanthangal ...	25	181	17 9	127 9	13 11	1
169	Kolimanayrakkam ...	97	752	17 11	215 7	67 0	2
170	Syrianthangal ...	3	24	...	...	2 8	2
171	Cannampully ...	30	210	4 6	46 8	16 6	44
172	Catoopakkum ...	94	633	21 7	133 15	66 7	34
173	Poonparappay ...	39	282	5 11	39 4	24 1	2
174	Thiroovoonthavelagam ...	7	45	1 0	6 6	0 15	3
175	Streenvassapooram ...	74	582	11 14	107 1	47 14	3
176	Paranypothoor ...	69	642	18 0	152 5	53 8	19
177	Coonathoor ...	1,258	8,532	92 0	741 12	612 15	76
178	Vengatapooram ...	48	366	4 9	41 5	35 11	12
179	Thiroonacasaveram ...	31	239	3 9	32 5	19 10	11
180	Mananjary ...	79	678	9 11	115 8	59 4	4
181	Collacharry ...	49	361	4 6	43 9	30 5	13
182	Malayadycherry ...	12	91	3 12	42 6	8 2	11
183	Moonamcuttaly ...	66	500	6 8	69 1	49 12	57
184	Caroor ...	283	2,116	59 8	555 15	162 1	40
185	Poothavadoo ...	9	78	2 10	25 12	9 8	4
186	Poonparappay ...	22	151	1 13	13 9	10 10	30
187	Siroccalathoor ...	217	1,633	35 8	284 4	138 4	131
188	Cavanore ...	149	1,002	19 9	159 7	74 14	33
189	Palanthundalum ...	478	3,612	43 13	564 11	287 11	60
190	Thiroodivakkum ...	601	4,284	88 2	834 14	388 11	5
191	Nanthumbakkum ...	219	1,642	23 14	186 8	117 6	44
192	Mathanunthapooram ...	161	900	19 14	181 5	95 12	3
193	Iyappenthangal ...	134	930	24 15	153 10	85 14	34
194	Colathoovanjary ...	97	531	40 3	203 7	39 4	2
195	Mannapakkum ...	127	1,026	27 5	890 11	80 7	94
196	Ettivally ...	21	137	3 5	21 11	9 14	7
197	Mittanamilly ...	17	76	1 7	4 6	10 6	4
198	Poonnavadoo ...	28	155	9 10	51 3	10 15	131
199	Thundalum ...	141	154	9 13	105 11	89 15	2
200	Peryspannichary ...	69	528	14 5	125 14	55 6	4
201	Rendanttalay ...	110	769	20 8	195 2	86 0	44
202	Thoorapakkum ...	106	708	12 0	79 11	72 11	35
203	Poonamallee ...	324	2,930	66 6	873 10	174 15	87
204	Agaram ...	47	350	6 18	62 2	21 13	7
205	Mooppathoovetty ...	30	148	2 10	15 15	16 5	2
206	Maypoor ...	190	1,516	12 6	102 9	46 12	10
207	Agaram ...	60	498	9 3	106 8	32 9	15
208	Peroombady ...	32	220	7 4	36 7	14 1	6
209	Garcumbakum ...	371	2,578	93 14	508 8	235 2	40
210	Candagay ...	42	313	6 2	45 12	33 4	...
211	Chithathore ...	42	243	3 4	7 5	19 12	18
212	Mavoolivackum ...	102	207	16 11	80 8	27 15	20
213	Moogalivackum ...	177	960	20 0	105 14	86 4	...
Total Villages, 58...		7,441	53,652	1,163 0	10,189 14	4,345 10	1,534

45. "It will be seen from column 7 that the average area irrigated during the last fourteen years was only 4,345 cawnies, or little more than one-half of the ayacut, and even over this area there was generally but one crop obtained in the year.

46. "The average annual revenue received during these fourteen years was 38,975 Rupees, but this includes a period at which the assessment was much higher than it is now. If we take

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"the average number of cawnies cultivated at the present rate, the average annual revenue will be 21,725 Rupees.

47. "I have already shown that of the 8,604 cawnies of the ayacut only 4,347 have been cultivated on an average during the last fourteen years, leaving 4,257 cawnies uncultivated.

"The additional cultivation of the ayacut would stand thus:—

I.—First crop of 4,257 cawnies, at 5 Rupees per cawny ...	21,285
II.—Second crop of 8,604 do. at 3 „ do. ...	25,812

Total, additional Revenue of Chembrumbaukum Ayacut... 47,097

48. "Other Villages may be cultivated.—Between the Chembrumbaukum ayacut and Madras (or rather Nungumbaukum and Mylapoor tanks), and within the rivers Cooum and Adyar, there are twenty-eight villages, regarding which the following table is a statement similar to that given of Chembrumbaukum ayacut appended to paragraph 38, with the exception that the average cultivation is given for only five years."

Statement of the Ayacut, Assessment, etc., of twenty-eight villages lying between the Cooum, the Adyar, the fifty-eight villages of Chembrumbaukum and Mylapoor Tanks.

Number of Villages.	Names of Villages not under the Tank.	CIRCAR.		INAM.		CIRCAR.		The number of Cawnies of either cultivation or waste in each village that could be converted into wet cultivation.
		The Ayacut of each village, the whole.	The Assessment of the whole.	Ayacut.	Assessment.	The average number of Cawnies under wet cultivation for the last five years.	The average Revenue during the last five years.	
1	2	3	4	5	6	7	8	9
219	Tecumynoor	717	2,814	8	46	199	883	63
64	Colappackum	247	1,314	32	167	93	567	88
2	Senjary	56	119	2	8	18	59	3
3	Neesappackum	39	176	2	12	30	1,147	24
4	Agaram	31	125	2	8	10	40	15
5	Maravalegam	4	21	...	...	4	21	...
11	Arumbakum	105	910	26	132	35	168	28
233	Valasavarkum	85	402	94	276	67	812	205
234	Kulambakum	423	1,416	63	268	21	98	99
11	Valagranthum	294	946	15	64	21	931	41
1	Kumpoor	267	1,545	193	1,215	131	1,005	20
14	Vanagarum	217	1,212	167	968	130	162	23
17	Caranthakum	35	275	27	127	16	403	4
23	Charthackaram	20	223	12	95	12	102	9
18	Valayacharam	11	104	1	11	34	210	135
19	Sevacharam	37	267	4	16	83	348	9
20	Ramacharam	174	760	21	121	10	342	80
21	Thalayaragam	46	511	7	41	65	314	114
22	Thalayaragam	117	602	15	104	53	1,900	15
23	Thalayaragam	341	1,411	26	174	40	323	10
24	Thalayaragam	379	1,515	42	201	40	355	27
25	Thalayaragam	29	272	9	45	69	603	...
26	Thalayaragam	29	272	9	45	123	66	...
27	Thalayaragam	137	627	45	244	8	331	20
28	Thalayaragam	142	622	45	22	81	55	...
29	Thalayaragam	11	21	11	84	4	128	6
30	Thalayaragam	15	153	11	11	24	...	...
31	Thalayaragam	16	142	8	62	...	...	...
32	Thalayaragam	59	302	9	...	...	...	...
Total Villages, 28		3,815	20,912	601	4,861	2,201	11,181	1,317

49. "This Statement shows that of 4,615 cawnies only 2,201 have been under cultivation (and one crop only has been produced), leaving 2,414 cawnies uncultivated:—

I.—First crop of 2,414 cawnies, at 5 Rupees per cawny ...	12,070
II.—Second crop of 4,828 do. at 3 „ do. ...	13,813
Total, additional Revenue of the wet Ayacut of these 28 villages...	25,883

50. "These two cultivations show, if the figures are correct, that, if used in the complete cultivation of the wet ayacut of these eighty-six villages alone, the value of the water stored would be 73,012 Rupees, equal to 20½ per cent. on the estimated cost of the works.

51. "There would be one great advantage in applying the water to those lands which are already prepared for wet cultivation, that no expensive works of distribution would be necessary, as in most cases the water could be applied direct without delay and without additional cost."

52. I fear Mr. Fraser's very sanguine account of the large supply of water this tank receives from so many sources is not borne out by the facts of the case. I append a Statement which the Collector of Madras has been good enough to furnish me with, by which it will be seen that this tank has only filled nine times in the last twenty-one years. I am, however, of opinion that this supply can be very considerably increased in quantity by the improvement to the supply channels which is herein proposed.

Statement showing the quantity of water received by the Chembrumbaukum Tank in each year from 1848 to 1868.

Year.	Half Tank.	Full Tank.	Number of days water passed over Calingulah.	Number of times the Tank was full in a year.
	MONTHS.	MONTHS.	ABOUT DAYS.	
1848...	2	12	5	
1849...	3			
1850...		12	4	
1851...		12	4	
1852...	5			
1853...	3			
1854...	3			
1855...		12		
1856...		12		
1857...		12	4	
1858...		12	5	
1859...	5			
1860...	2			
1861...	3			
1862...	6		10	
1863...		12		
1864...	6		4	
1865...		12		
1866...	1½			
1867...	3			
1868...				

(Signed) G. FANE,
Collector.
POORNOVOIL,
16th February 1869.

53. Proposed Works.—I have already enumerated all the different portions of the revised project in describing the Index Map.

54. The object in view is to enlarge the tank by raising the level of the calingulah 15 feet; this will give 141 millions of cubic yards additional storage space for water; 15 feet is the highest point to which it would be possible to raise the water in the tank, as the ground on the south side is for three or four miles only a foot or two above this level, and in two places it is lower, and will require to be bunded, as will be seen by a reference to the Longitudinal Section Sheet No. 2. And further up the Streepmatore channel under Kattrambaukum village, it is only the raised bank of the channel that would prevent the water, if at this level, from flowing away into the Adyar river.

55. Bund.—It is proposed to raise the Bund to a height of 9 feet above the proposed calingulah level. The top width of the bund will be 9 feet.

56. *Road on top of Bund.*—The Bund almost connects the old and new Bangalore roads, and a road over the top of it would be of considerable public convenience; but I am of opinion it would be wrong to saddle the project with the cost of it. I have shown this road in the plans, and estimated for it as ordered.

57. The trees on the bund have already been removed at a cost of Rupees 3,375; there were 6,500 Palmirah trees. I put up 1,000 of the best of the trees to auction, and as they realized but Rupees 112, I thought it better to keep them for firewood sheds, etc.

58. The Cross Sections shown in Sheet No. 2 will make it clear how it is proposed to enlarge the bund; already 533,000 cubic yards of the earth-work have been executed, which completes the outer slope to a level of 2 feet above the top of the old bund; three-fourths of the additions to the length of the bund at each end have also been completed.

59. *Revetment.*—The proposed slope of the inner side of the bund is $1\frac{1}{2}$ to 1 which is revetted with large roughly squared blocks of gneiss and laterite stones, the former being placed in the lower courses, and the latter above; this is cheaper and equally as secure as would be the more expensive dressed laterite revetment before proposed. The saving effected by this change will be above a lac of Rupees. Already some 12,000 cubic yards of gneiss of the old revetment have been re-constructed, and 6,500 cubic yards of the new laterite revetment built.

60. *New Sluices.*—A comparison of Mr. Fraser's Sluice Plans with Sheets Nos. 6 to 8 will show how much the present design differs from that sent in by the Executive Engineer; the sluice shown in the plans is a slight modification of the old native step-system of openings, which although it seems a rude way of effecting the purpose for which it is intended, yet the plan has several material advantages in its favour, namely, simplicity, the almost impossibility of its being put out of order, and, lastly, the fact that it allows the water to escape from the tank without bringing pressure to bear on the culverts or sides of the sluices. Those qualities render it the best form of gate (if I may so call it) where natives are the sole custodians of a tank.

61. I have also designed a light frame work of iron over the plugs for the purpose of securing them from being accidentally knocked out of their places, and to serve as an apparatus for lifting them.

62. Of the existing sluices, eleven in number, only three have been found sound enough to be allowed to stand; those are old Nos. 1, 5, and 6. Five have been removed, and are being re-constructed; these are old Nos. 2, 4, 7, 9, and 10. Three, Nos. 3, 8, and 11, have been closed.

63. *The New Calingulah.*—It is proposed that the escape should be placed in the ridge at the south side of the tank where is situated one of the low places that escaped Mr. Fraser's Surveyors when contouring the tank; this spot is about 500 yards from the extreme south end of the bund, and $2\frac{1}{2}$ feet below the 15-foot contour line, and is admirably situated as a site for the calingulah, as it faces the valley of the Adyar and old Pammel tank, towards which the ground slopes very gradually.

64. The calingulah will be 1,000 feet in length as ordered by the Government of India.*

* Order of the Government of India, No. 162-I., dated 25th October 1867.
I cannot think it will be necessary to cut any surplus channel for conducting the water from the calingulah. I have carefully gone over and examined the land under the old calingulahs, and, although there never was any surplus channel from them, I see no where any indications of erosion or injury done; when the tank is enlarged there will be less chance of discharge over the calingulah, and the quantity of water will be less on the rare occasions when it does discharge, I therefore think we may safely leave the surplus channel uncut.

65. The length of the calingulah and its consequent great capacity renders it improbable that any other outlet will ever be required, as even, in the event of such a storm as that which is related to have occurred on the 24th of October 1818, when 48 millions of cubic yards of water are said to have entered the tank in eight hours, were the tank full up to the proposed level, as it would take 36 millions of cubic yards to raise it the next 3 feet, and the calingulah would have discharged some 12 millions of cubic yards in eight hours, taking an average of $1\frac{1}{2}$ millions per hour (with a 3 feet head its discharge would be over $2\frac{1}{2}$ millions), the whole 48 millions would be accounted for.

66. There is, however, a natural calingulah on the extreme south-west side of the tank, shown at that end of the Longitudinal Section of the tank (Sheet No. 2), which being nearly 1,000 feet in length, and from 6 inches to 18 inches above the proposed calingulah level can be left, so that, when the water rises, say 2 feet above the crest of the proposed calingulah, it will flow over here, which it may safely be allowed to do as the soil is of a hard gravelly nature.

67. I think it will be evident from the foregoing that the tank will be safe from the risk of the water rising to a dangerous height in it.

68. *Embankment* of 20th mile of Great Western Road, Trunk Road No. 3.

69. This part of the project is and has been since its commencement in the hands of the Officer in charge of No. 3 Range of this division who is responsible for the work, with the exception of the masonry bridge over the supply channel, which (channel) it will be seen by the Index Map enters the tank on the upper or western side of this embankment.

70. The works described above are those which composed the project as sent up by Mr. Fraser. Those about to be the subject of report are the additional works which I have found to be necessary to complete this irrigation work successfully.

71. *The proposed new Anicut and Head-sluice on the Coovum River.*—The Anicut and Head-sluice are rendered necessary by the fact of the site of the old anicut being situated at too low a level to allow of a channel being carried either above or through the Namum tank, which is the only way by which the low valley, through which the old supply channel flows, could be avoided: it will be seen by the red contour line tinged with yellow, drawn on the Index Map under the Namum tank, that some 2,000 acres of land (which is very valuable irrigated land worth some Rupees 300 per acre), and four villages would have been submerged in this valley had the project, as designed by Mr. Fraser, been carried out.

72. The anicut and head-sluice are proposed to be placed about $2\frac{1}{2}$ miles above the old anicut where the ground is very favourable for the construction of the dam, and for the excavation of the channel to the Chunam Kal, the cutting being light and the distance short.

73. The bed of the Coovum being sandy, both the anicut and head-sluice are planned to be founded on wells; the anicut has a total length of 450 feet, and is placed on three lines of wells.

74. There will be two sets of sand-sluices of 30 feet opening each in the body wall of the dam nearly in line with the face of the head-sluices as will be seen by the plans.

75. The head-sluice, which is also a bridge to carry the Trivalore road (Trunk Road No. 13), over the supply channel, has eighteen arched openings of 8 feet $\times$ 5 feet, giving a section of 720 feet.

76. I have adopted the old mamool plan of sluice-boards for closing these openings, as they are simple and effective enough.

77. It will be perceived that the road will require to be diverted for some 280 yards to allow of its passing over the head-sluice and bridge. The bridge shown in the first part of the road so diverted is the head-sluice of the Godapaukum channel, which it will not be necessary to interfere with; the expense of a new head-sluice will thus be saved.

78. The head-sluice shown at the other end of the anicut is that proposed for Tinnanore tank, which now receives its supply through an old head-sluice half a mile down-stream. The proposed anicut and channel would to a great extent have cut off this supply. The Tinnanore Zemindar perceiving this had petitioned Government for a channel from the anicut, and the justice of his demand was allowed. This structure is also founded on wells with four-arched openings of 5 feet $\times$ 5 feet each.

79. It will be evident from the Plans, Sheet No. 13, how these several works are proposed to be constructed; I will therefore not lengthen out this report by going into a more detailed description of them.

80. *Supply Channel from the Anicut to the Chembrunbaukum Tank.*—Sheet No.—This was originally designed to pass into and down the Chunam Kal jungle stream from the junction of the channel with that stream until it entered the Namum tank; but as this arrangement necessitated raising and strengthening the banks of this tank at a considerable cost, the present line was selected as being the least expensive at the suggestion of the Chief Engineer for Irrigation. The Longitudinal and Cross Sections, Sheet No. 12, show the length and depth of the cutting required;

the latter is necessarily heavy as it passes through the dividing ridge between the valley of the Namum tank and that in which is situated the Chembrumbaukum tank. Its length is 41,093 feet and breadth of sole 80 feet, the sides having a slope of $1\frac{1}{2}$ feet to 1 foot. Pits have been sunk along its length to the level proposed for its bed, and the soil found particularly favourable both as affording facilities for excavation and for standing the attrition of flowing water. This channel will be capable of discharging 388,000 cubic yards per hour.

81. As the fall is considerable (18 feet per mile) between the summit of the ridge and where the channel would pass through the embankment on the 20th mile of the Great Western Road, where the latter passes over the western end of the tank, three masonry falls, 6 feet in height each, are proposed for regulating the gradient. The plans for those falls will be found in Sheet No. 9. The plans in Sheet No. 28 are for a dam proposed to be placed across the Chunam Kal where the channel leaves it. The design of this dam was suggested by Major Mullins. I hope I have understood his instructions, and that his idea is carried out in this drawing.

82. The lower sluices in this dam are intended to allow the ordinary supply to pass down the Chunam Kal to the Namum tank, in order that those holding lands under that Irrigation work may have no cause of complaint. The sills of those under-sluices are at a level $2\frac{1}{2}$ feet below that of the head of the channel; thus when there is only a small supply in the Chunam Kal, and none coming from the anicut, all the water will flow into the Namum tank to which it of right belongs.

83. The upper openings in the dam are for the purpose of shutting off or admitting, as the case may be, the flood-waters of the Chunam Kal. As in case the Namum tank happened to be full on the occurrence of a flood, the upper and lower gates would be shut, and all the water be forced down the channel which would safely convey any flood to be expected in this stream, if the supply from the anicut were shut off at the head-sluice.

84. The head of the channel, it will be seen by the plans on this sheet, is to be protected by a body-wall across the floor, and by wing-walls at each side, with 100 feet in length of revetment below the latter.

85. *Bund across old Supply Channel.*—It will be seen by the Longitudinal and Cross Sections of this work on Sheet No. 2 that it is so placed that it will fill up the cuttings through the ridge which was either a natural fissure or made originally to pass the old supply channel through into the tank. The four sluices, Sheet No. 18, to be built into it (the bund), having openings of 6 feet 6 inches $\times$ 5 feet, will admit the surplus water from Namum fields and the drainage of the valley, until the water rises to the height of the present calingulah crest; when the self-acting gates, of which details are shown in Sheet No. 11, will close and prevent the return of the water from the tank as it rises higher. The construction of the bund is so similar to that of the bund round the other portions of the tank that it would be needless to say any more on the subject. The construction is shown in the Cross Sections.

86. *The Drainage Channel from the old Supply Channel to the Manapankum Sluice.*—When the sluices in the bund across the old supply channel shall be closed, this channel will then be opened to receive the drainage of the Namum fields and valley. It discharges into one of the largest of the irrigation channels, and will, on the occasion of extraordinary floods, flow into three others, provision being made for its doing so. It is 20 feet wide at bottom with sides sloped to $1\frac{1}{2}$ feet to 1 foot, and a gradient of 2 feet per mile. I have had it laid out for more than half its length within 80 yards of the outer slope of the bund, and thus have been able to use the earth excavated from it for raising and strengthening the bund, which has effected a saving of some Rupees 8,000—See Sheet No. 15.

87. *The Aqueducts and Inverted Syphons*, plans of which are shown in Sheet No. 16, are intended for passing the water from irrigation sluices over or under (as the case may be) the drainage channel. One of the inverted syphons is intended to pass the water of the Arruvoyal Courn tank over the supply channel.

88. *The Skew Bridge*, shown on Sheet No. 19, will carry the communication road from the Great Western Road to the tank bund over this drainage channel. I may mention that this road is finished for a distance of 1 mile 798 yards, and there remains only this bridge and about 200 yards of the road near the tank to complete it.

89. *A Quarry Road*, one mile and 605 yards in length, opening communication between the old Bangalore road and the tank bund, has also been completed, so that the tank is now accessible for carriages from both the old and new Bangalore roads; there was formerly no means of getting to it except on foot across the paddy fields.

90. *The improvement of the Streepermatore Supply Channel.*—This is one of the principal feeders of the tank. It is, for the whole of its length of $10\frac{1}{2}$ miles, a great catch-water drain which receives and discharges into the tank all the water that falls on the ridge above it to the north and north-west over a surface of about 28 square miles; and as it also receives the surplus of the Streepermatore and Pillapaukum tanks, this channel must, when rains are heavy and continuous, discharge a large quantity of water into the tank. It will be seen, by the Longitudinal and Cross Sections on Sheet No. 24, how it is proposed to improve this channel, which only requires the section enlarged and deepened in a few places, and the right bank to be raised and strengthened throughout its length. The ground below the bank or bund is everywhere low, and it is essential to the effectiveness of this feeder that it should not be over-topped by floods and thus breached, which I fear has been a common occurrence in past years. There is a small calingulah that requires raising and strengthening, and a sluice that ought to be lengthened, plans of both of which may be seen on the Section Sheet No. 24.

91. *The improvement of the old Bungairoo Channel.*—The bank is fairly strong which separates this channel from the Cortelliaur, from which river this channel is taken off by the Kesavaram dam; but to prevent the chance of its being breached by floods, an escape has been placed in it 427 yards distant from the head of the channel. The crest of this escape is 2-53 feet above the bed of the channel, so that when the water rises above this level, it flows back into the Cortelliaur, and is, of course, lost to the tanks below; this, in my opinion, is not a wise arrangement, and I therefore purpose (if I am allowed) to raise this escape 6 feet, strengthen the head between the Cortelliaur and the channel, and rectify the levels which are very faulty for the first three miles from the head of the channel.

92. It will be seen that the banks in many places require to be raised and strengthened—vide the Longitudinal and Cross Sections, Sheet No. 25. When taking the levels for those sections, the ryots, holding land near the channel, informed me that whenever a fresh comes down, the banks are breached in a number of places, and the waters flow to waste to the destruction of their cultivation.

93. I consider that a portion of the cost of the improvement of this channel should be charged to the nineteen tanks that are supplied from it before any water can reach the Chembrumbaukum tank.

94. *Channels of Communication.*—Between the new sluices and the channels of the old sluices that are to be shut up, other channels will be excavated, and regulating sluices placed upon them, one at the head of each irrigation channel—seven in all. Three over-falls will also be necessary for regulating the gradient of the beds of those channels—See Sheet No. 26.

95. *The Masonry Crossings*, No. 27, are intended for passing the water of the drainage channel in floods over the Malliambaukum Chetty and Manapaukum Sluices, in order that it may have room to expand itself in the large channels of the centre sluice.

96. The following abstract of the detailed estimate will show the cost of the works proposed in the revised project. A comparison of this with Mr. Fraser's estimate will show a large additional amount against the scheme now submitted. This is principally owing to the number of additional expensive works which have been found necessary to the very existence of the project, but in part also to the rates having been in the first estimate much too low, the advance of some 10 or 12 per cent. that has taken place in the cost of work in the last three years, and the quantities of earth-work in the bund of the tank and of stone in the revetment being much larger in this than in Mr. Fraser's estimate. A Comparative Statement showing the difference is appended.

97. In conclusion, I would point out that although there is now no probability of Mr. Fraser's high estimate of profit from the tank being realized, yet, if the estimate, Rupees 75,000, here given of the additional revenue to be derived from the enlargement of the tank be correct, the work will pay 9 per cent., which is as much as the Government of India, in the order as per margin, calculated on its doing.

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98. Colonel Anderson says in paragraph 21 of his report on the irrigation works of this Presidency, dated the 27th January 1869, "that the remunerative effect of irrigation works is not the only aspect under which they are to be regarded, and that if Government derive an exceptionally high rate of profit from one system of works like those in the deltas, they ought to be prepared to make a corresponding sacrifice to bring up works less favourably situated to the highest standard of efficiency."

99. Every one must allow this to be a statesmanlike and fair view of a great question. It would be difficult to find a work with higher claims to be exceptionally considered than has the Chembrumbaukam tank. If even it must be completed at a sacrifice in a revenue point of view (which I do not think need be the case), still the benefits this great reservoir will confer on the country to the south and west of Madras are worth some sacrifice.

CHEMBRUMBAUKAM,
17th October 1870.

(Signed) R. J. LOWRY,
Asst. Engr. in charge of No. 7 Range.

Abstract Estimate of the Chembrumbaukam Tank Irrigation Project, 15-foot Scheme.

No. of Items in Estimate.	Description of Works.	Amount of each work.	Total.
		RS.	RS.
A	Improvement of the Chembrumbaukam tank ...	4,78,690	
B	Anicut and two head-sluiques ...	12,293	
C	Supply channel to Tinnalore tank ...	6,674	
D	Supply channel from the new anicut to Chunam Kal and thence to Chembrumbaukam tank, cross dam, masonry falls, syphon sluice, and bridge, etc. ...	1,39,150	
E	Drainage channel ...	20,438	
F	Streepermatore Supply channel ...	7,713	
G	Improvement of the old Bungairoo channel from Nesavaram anicut up to its junction with Cooum river ...	45,200	
H	Channels of communications between new sluices and irrigation channels of old sluices ...	2,842	
I	Road connecting the new and old Bangalore roads carried over the bund of Chembrumbaukam tank ...	22,812	
J	Alteration of the 20th mile of Trunk Road No. III. ...	43,117	
K	Add sundries about 5 per cent. ...	40,614	
L	Compensation for lands. { Chembrumbaukam tank ... 58,000 Land for the Supply channel ... 5,000	63,000	
M	Proposed savings to be deducted from the Estimate, namely:— I.—Portion of cost of repairs to old Bungairoo channel, including sundry charges ... 6,000 II.—Branch road over bund connecting the old and new Bangalore road with sundry charges ... 13,573 III.—By re-sale of lands to become submerged in the tank for which compensation is charged ... 45,000	69,573	
	Total Estimate.	8,38,000	8,38,000

No. 7 RANGE OFFICE,
17th October 1870.

(Signed) R. J. LOWRY,
Assistant Engineer in charge No. 7 Range,
Chembrumbaukam Tank Project.

(Signed) C. V. WILKIESON, Colonel, R.E.,
Superintending Engineer, 4th Division.

*Proceedings of the Madras Government, Public Works Department,
9th March 1871.*

APPENDIX A.

Memorandum from the Chief Engineer for Irrigation, to the Superintending Engineer, 4th Division, dated Fort Saint George, 30th November 1870, No. 245.

With reference to the letter, No. 3,513, dated 23rd instant, forwarding revised estimates for the Chembrumbaukam tank, the undersigned has the honour to point out that the entries in the 6-foot project for sluices require explanation. Mr. Lowry not having given any details of the amount already expended, he was asked demi-officially to send a statement in order that the Chief Engineer might get it before leaving Madras, and it will be seen that some error has occurred.

Sluices.	15-foot Project Estimate.	6-FOOT PROJECT.			Remarks.
		Past expenditure.	In estimate.	Total.	
	RS.	RS.	RS.	RS.	
No. 1. or Pallanthandalum ...	5,032		1,429	1,429	Called Coona-thore in statement.
" 2. or Cavanore ...	10,483	7,609	8,909	16,518	
" 3. or Pillathunna ...	12,819	183	8,057	8,250	
" 4. or Mangauloo ...	5,032		1,308	1,308	
" 5. or Manapaukum ...	5,262	25	2,668	2,693	
" 6. or Chetty ...	13,591		8,433	8,433	
" 7. or Poonamallee ...	12,732	8,388	11,339	19,727	
" 8. or Maypoor ...	5,450	1,200	4,604	5,804	
Closing three sluices ...	1,842		1,839	1,839	
Total...	72,243			66,001	

For instance, Sluices Nos. 2 and 7 cannot cost so much more in the reduced than in the full project, and probably the past expenditure in each case has been lost sight of in preparing the completion estimate. The large amounts put down in both projects for No. 7 sluice seem to indicate that it would have been better to have blocked up the old sluice, and to have constructed the new sluice at another site.

2. It might be well also to ask Mr. Lowry to explain the differences in quantity, in Mr. Fraser's and the revised 15-foot projects, of earthwork and revetment. Some is due to making the bund 3 feet higher than was intended, and to the bund across the supplying channel; but, after taking these into account, the difference remaining to be accounted for is still very great.

3. Mr. Lowry, in paragraph 28 of the Report on the 6-foot project, speaks of eight days as the time during which each year the Cooum may be expected to be in flood. On what registers, or other data, has this period been determined? Registers of the water at the Koratur Anicut for as long a period as possible should be prepared and sent to this office.

4. The waste weirs of the tank have, it is understood, discharged surplus this season, and it should be reported what depth was going over each weir each day, and what total quantity thus went to waste. Information on this point can first be given up to the end of November, and subsequently for December and other months, should any water pass over the weirs.

From the Assistant Engineer in charge No. 7 Range, Chingleput District, to the Superintending Engineer, 4th Division, dated Chembrumbaukam Tank, 16th December 1870, No. 180.

REFERRING to your endorsement, No. 3,877, dated the 15th December 1870, on the memorandum* of the Chief Engineer for Irrigation, pointing out a mistake made in the estimate

* No. 245, dated 30th November 1870.

*Proceedings of the Madras Government, Public Works Department,
9th March 1871.*

for the 6-foot project for the enlargement of this tank, I have the honour to give below a corrected statement showing how the expenditure and estimate for the sluices should stand:—

Sluices	15-foot Project Estimate	Past ex- penditure.	In esti- mate.	Total.
	RS.	RS.	RS. A. B.	RS. B.
No. 1. Pallanthandalum	5,032	...	1,429	1,429
„ 2. Cavanore	10,433	7,609	8,909	1,300
„ 3. Pillathunnan	12,819	183	8,067	7,884
„ 4. Mangaudoo	5,032	...	1,304	1,308
„ 5. Manapaukam	5,262	25	2,668	2,643
„ 6. Chetty	13,591	...	8,443	8,433
„ 7. Poonamallee	12,732	8,388	11,339	2,951
„ 8. Maypoor	5,450	1,200	4,604	3,404
Closing three sluices	1,842	...	1,839	1,839
	...	17,405	48,596	31,191

N.B.—The figures in columns A. and B. require to be transposed. The estimate in addition to past expenditure shows 31,191 as required.—J. M.

By this it will be seen that the outlay on the sluices up to the end of the last official year, amounting to Rupees 17,405, should have been deducted from the total cost of the sluices for this scheme, leaving Rupees 31,191 only as the balance required to complete them; that this was not done in the estimate was an oversight, which, I hope, may be excused when it is recollected how short-handed I was, the amount of work that had to be got through, and my anxiety to get the projects submitted in time.

2. With reference to No. 7 sluice, I also think it might have been better to have closed it up and constructed a sluice on another site; but until I had removed the sluice (a very costly proceeding) I could not tell that the foundations were so deep and the ground so bad, and as the sluice must be built near its pre-ent site, I did not think it prudent to risk the expense of opening the bund in another place on the chance of getting better soil for the foundations.

3. The difference of quantity of earthwork and revetment in Mr. Fraser's and in the revised estimate arises from the following causes.

4. The late Chief Engineer for Irrigation ordered that the revetment in the revised plans should be 24 inches instead of 21 inches in thickness, and that the slope be altered from $1\frac{1}{2}$ to 1 to $1\frac{1}{2}$ to 1, and in addition to the excess caused by those alterations there is the revetment for the bund* across the old supply channel and for that on each side of the calingulah. The enclosed

* This relates only to the 15-foot project. No bund across the old supply channel is required in the 6-foot project.—J. M.

statement shows, in detail, the increase caused by each of the alterations mentioned above, and also the items of increase in the earthwork, which are caused by the additional earth necessary to form the bund across old supply channel, that on each side of the calingulah and the low places in the 15-foot contour on the south side, and the very large additional quantity required to increase the height of the bund 6 feet throughout its whole length.

5. My estimate of the average number of days during which the Coom may be expected to be in flood was made on the strength of oral testimony, gleaned from various persons, such as the residents of the village of Koratur near the anicut, the late Monigar of the Anicut, and in fact, any and every one that I thought likely to know anything on the subject. No register has ever been kept until 1869. I will prepare the register for the last two years, and forward it in a day or two. I will also, at the same time, forward a statement giving the information required by the Chief Engineer respecting the surplus discharged over the waste weirs of the tank up to date.

*Proceedings of the Madras Government, Public Works Department,
9th March 1871.*

Additional Comparative Statement showing cause of excess in Revised Estimate for the enlargement of the Chembrambaukum Tank over Mr. Fraser's estimate in the two items of earthwork and revetment, called for by Chief Engineer in his Memorandum No 245, dated 30th November 1870.

Particulars.	Quantity of Mr. Fraser's Estimate.	Total of Revised Estimate.	INCREASE. Difference in Revised Estimate.	Items that make up increase in Revised Estimate.	Remarks.
Revetment ...	75,633	117,382	41,749	...	
Difference of thickness as 21 is to 24 gives	...	...	...	10,438	In this item there is a difference still remaining of cubic yards 626, which may be accounted for by some slight error of calculation
Difference of depth of slope as 16 is to 18-03 gives	...	...	...	10,963	
For bund across old supply channel	...	...	...	3,973	
For additional height of 3 feet ordered by Chief Engineer	...	...	...	14,277	
For bund on each side of calingulah, etc.	...	...	...	1,473	
Total...	...	...	...	41,123	
Earthwork ...	599,398	777,233	177,835	...	
Bund across old supply channel	...	...	...	21,180	
Bund on each side of Calingulah and low places on the north side	...	...	...	16,428	
Additional height of 3 feet to bund	...	...	...	140,200	
Total...	...	...	...	177,808	

CHEMBRUMBAUKUM TANK,
16th December 1870.

(Signed) R. J. LOWRY, Assistant Engineer,
In charge No. 7 Range.

No. 233.

ORDER THEREON, 9th March 1871, No. 705.

IRRIGATION, No. 16.

THE papers submitted by the Chief Engineer for Irrigation for the consideration of Government relate to the

revised estimates for the enlargement of the Chembrambaukum tank. The history of the project is given briefly in paragraphs 2 to 6 of the Chief Engineer's note, and shows the circumstances which prevented the work, as originally sanctioned, from being carried out, as also those which led to the preparation of estimates for a tank on a reduced scale. The Government have now to decide as to whether it will be advisable to make the capacity of the tank as large as was intended by Mr. Fraser, or to limit the enlargement to an additional depth of 6 feet.

2. In paragraph 8 of the Chief Engineer's note it is shown that, after making allowance for certain deductions,

Mr. Fraser's estimate for increasing the depth by 15 feet (tank only) was...	RS. 3,35,820
Mr. Lowry's do. including supply channel, etc.	8,60,433
Do. do. 6-foot project do...	4,33,041

The amount for the last-mentioned scheme has been further reduced, as explained in the supplemental note, to Rupees 4,14,000, and moreover a part*

* Paragraph 9 of note, Rupees 1,11,141. of this sum is due to expenditure already incurred, which would not have been necessary had this smaller project been carried out in the first instance.

3. The Chief Engineer is of opinion, for the reasons detailed in his note, that the water supply is altogether insufficient for the larger project, and he moreover thinks that the data available indicate that the smaller tank would not fill

*Proceedings of the Madras Government, Public Works Department,
9th March 1871.*

on the average more than nine years out of twenty-one. The larger reservoir

† 196,874 millions cubic yards at 6,750 cubic yards per acre, or 9,000 cubic yards per cawny.

‡ Note paragraph 11.

88.56 millions of cubic yards, or enough for 13,120 acres. The average cultivation of past years has not as yet been accurately ascertained, but it would appear to have been about 7,500 acres, and, if so, 5,620 acres would be the additional area on which a return for the outlay on the minor project would be obtainable. The available data do not admit of the assessment being reliably determined, but it is observed that an average of Rupees 5 an acre would yield a gross revenue of Rupees 28,100, or 6.8 per cent. on the reduced amount, Rupees 4,14,000, of the estimate. The net return, after allowing Rupees 5,620, in addition to the previous cost of annual repairs, would, consequently, probably not exceed 5.4 per cent.

4. After a careful consideration of the papers connected with the project, His Excellency the Governor in Council is of opinion that, notwithstanding the loss of expenditure already incurred, which the adoption of the reduced scheme will involve, the chances of the water supply for the larger project proving adequate are so indifferent, that it would not be wise to incur the large outlay that it has been shown would be necessary for its execution, and the Government therefore resolve to approve of the 6-foot project being carried to completion.

5. The Chief Engineer in paragraph 10 of his note has pointed out what revenue information is required in order to calculate the results which may be expected from the enlargement of the tank, and these Proceedings will therefore be communicated to the Revenue Department with a view to these particulars being obtained as early as possible. With regard to the rate of assessment it will be noticed that, were the old rates re-established in consideration of the large expenditure which has been, or is about to be incurred in the improvement of the water supply to the lands under the tank, the outlay would yield a return which would probably suffice to allow of the project being executed from Loan Funds, and as it is very desirable that the cost should not have to be met from the limited ordinary grant at the disposal of Government, special consideration should be given to the determination of a fair assessment.

(True Extract.)

(Signed) CHARLES A. ORR, Colonel, R.E.,

Secretary to Government.

To the Superintending Engineer, 4th Division.

.. Controller of Public Works Accounts.

.. Chief Engineer for Irrigation.

.. Revenue Department.

Ed. E. C. Shunker.

No 2
No 180
19 5 30
Range Office
Chembraukulam
16th December 1870

The Assistant Engineer
Ch. Ch. Range
The Superintending Engineer
11th Division

X
No 245 of 30th Dec 70

Referring to your endorsement No. 3877
dated the 15th December 1870 and the Memorandum
the Chief Engineer for Irrigation pointing out
Mistake made in the Estimate for the 6-foot
project for the enlargement of this tank
I have the honor to give herewith a corrected
estimate showing how the expenditure and cost
for the sluices should stand.

The figures
in columns

As it is required
to be transferred

the estimate in
the estimate in

the estimate in
the estimate in

the estimate in
the estimate in

the estimate in
the estimate in

the estimate in
the estimate in

the estimate in
the estimate in

Sluices	15 feet Project Estimate	16 feet Project Estimate			Remarks
		Cost	Estimate	Total	
No. 1 Pullanthandalam	5032	"	1429	1429	
" 2 Lavanare	10483	7609	8909	1300	
" 3 Pittathinai	12819	183	8067	7884	
" 4 Mangudor	5032	"	1308	1308	
" 5 Mangudor	5262	25	2668	2643	
" 6 Chetty	13591	"	8433	8433	
" 7 Ponnallee	12732	8388	11539	2957	
" 8 Mayford	5450	1200	4604	3404	
Closing 3 Sluices	1812	"	1839	1839	
		17405	48596	31191	

By this it will be seen that the outlay on
the sluices up to the end of the last official
year amounting to Rs. 17,405 should have
been deducted from the total cost of the
sluices for this scheme leaving Rs. 3,191 only
as the balance required to complete them,
had this been done in the estimate
was an oversight which I hope may be
excused when it is recalled I have short-
landed I was, the amount of work that
had to be got thro' and my anxiety to
get the Project submitted in time.

With reference to N. Y. Sluice I also
think it might have been better to have
closed it up and constructed a sluice
on another site but until I had examined
the sluice (a very costly proceeding) I could
not tell that the foundations were so deep
and the ground so bad and as the sluice must
be built near its present site I did not think
it prudent to risk the expense of opening the
sluice in another place on the chance of getting
better

32
better soil for the foundations.
The difference of quantity of Earthwork
and reclamation in Mr. Fraser's and in the
revised Estimate arises from the following
causes.

The late Chief Engineer for Irrigation
ordered that the reclamation in the revised
plans should be 24" instead of 21" in thickness
and that the slope be altered from $1\frac{1}{2}$ to 1 to
 $1\frac{1}{2}$ to 1 and in addition to the excess caused
by these alterations there is the reclamation for
the Bund across the old Supply Channel
and for that on each side of the Calingulak
tortoise project. The enclosed statement shows in detail
the increase caused by each of the alterations
mentioned above and also the sums of increase
in the Earthwork which are caused by the
additional earth necessary to form the Bund
across old Supply Channel that on each
side of the Calingulak and the low places
in the 15 feet Canton on the South side, and
the very large additional quantity required to
increase the height of the Bund throughout its

to water length.

My estimate of the average number
days during which the Cozum may be expected
to be in flood was made on the strength
of oral testimony gleaned from various
persons such as the residents of the village
of Paralco near the Anicut, the late manager
of the Anicut and in fact any and every
one that I thought likely to know anything
on the subject. No register has ever been
kept until 1869 I will prepare the register
for the last two years and forward it
in a day or two. I will also at the same
time forward a statement giving the information
required by the Chief Engineer respecting the
surplus discharged over the waste weirs of
the Falls up to date.

Yours Obedt &c

Sir

Yours Obedt (W. L. L. L.)

R. L. L. L.

A. J. L. L.

Exchange (N. Y. Range)

21

From:

Dr. J. Lowry Esq.
Assistant Engineer

To:

The Superintendent of
the Division

Dated 16th Decr.

1870

1870

According to explanation on
the subject in the 6 feet
fragment and former do
a statement showing the
cause of excess in removed
Estimates and Mr. Smees
in the two cases of Earthwork
and Retention.

True

Additional Comparative Statement showing cause of excess in removed Estimates for the enlargement
of the (Chesapeake and Potomac) South over Mr. Smees Estimates in the two cases of Earthwork and Retention
Called for by Chief Engineer in his Memo. No. 245 dated 30th November 1870.

Quantity of Total, Surplus, Items that
Mr. Smees of revised Estimate made up
Estimates (Estimate) revised, (Estimate)

Particulars

Remainder

Retainment	75.633	117.382	41.749
Difference of thicknesses as 21 is to 24 gues			10.438
Difference of depth of slope as 16 is to 18.03 gues			10.962
For Banks across old Supply Channel			3.973
Additional height of 3' ordered by Chief Engineer			11.277
Banks and earth sides of Chesapeake Bay			11.473
Totals			41.123
Earthwork	599.398	777.283	177.885
Banks across old Supply Channel			21.180
On each side of Chesapeake and Low places			16.178
Additional height of 2 feet to Banks			140.200
Totals			177.808

In this item there is a difference
still remaining of July 1870
626 which may be accounted
for by some slight error
of calculation.

For Range of feed
from the Chesapeake and
16th December 1870

R. L. Smith
Lieut. Col. M. J. D. Range

Brought Forward	146,916	154	97,793	58	
Alteration in the 20 mile of Trunk Road No 1	40,730	102	13,573	88	one third
Superintendence	503	85			
Sundries including Office brick sheds &c	4,279	37	1,658	60	Two thirds
Compensation for lands	3,578	103	3,578	103	Settled
Total Repairs	198,542	150	146,025	44	

7. Range Office
 25 November 1878
 R. Sherry.
 Assistant Engineer

N^o 3990.

Memorandum.

The undersigned has the honor to forward to the Chief Engineer for Irrigation Enclosures an original letter from the Assistant Engineer in Charge of Chembrumbankum tank project
1 Original letter in charge of Chembrumbankum tank project
1 Statement: N^o 180 dated 16th December 1870 together with a statement affording explanation on the entries in the estimate for the 6 feet Project Sluice, with reference to his Memorandum N^o 245 dated 30th November 1870.

The further statement promised by Mr. Lowry will be forwarded to the Chief Engineer for Irrigation immediately on its receipt.

W. W. W. Col. K. B.
Sup^r Eng^r to Gov^t

Sup^r Eng^r Office, Madras
Made 24th December 1870

To, The Chief Engineer
for Irrigation.

J. P.

7/11/71

Mr. C. M. D. D. D.
Chembrumbankum tank project

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Chembrumbankum tank project

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Chembrumbankum tank project

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Chembrumbankum tank project

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Chembrumbankum tank project

Mr. C. M. D. D. D.
Chembrumbankum tank project

Mr. C. M. D. D. D.
Chembrumbankum tank project

N^o 3513.

Sup^r Engineer's Office 4th Divⁿ
Madras 23rd November 1870.

From
Colonel C. V. McKieson R. E.
Superintending Engineer 4th Division

To
Major J. Mullins R. E.
Chief Engineer for Irrigation

Sir,

I have the honor to forward, for
your approval and eventual submission
to Government for sanction, two sets of Plans
15 feet scheme
Plans & Estimates for the improvement to the
6 feet scheme.
Plans & Estimates and Estimates for the improvement to the
Chemburam Tank and its sources.
Enclosures
1 Port folio of Plans
1 Estimate of 6 feet of water supply.
1 Specification
1 General Report amounting to Rupees 838,000 include
1 Estimate of 15 ft
Project the whole of the original project as
worked out by Mr. Fraser with certain
alterations and improvements suggested
at different times after inspections by
the Chief Engineer for irrigation and
Genl.

Mr. C. V. McKieson R. E.
Superintending Engineer 4th Division

To Mr. C. V. McKieson R. E.
Superintending Engineer 4th Division

Related 24th Dec 1870
No. 3513
3990.

Enclosure 2

Mr. C. V. McKieson R. E.
Superintending Engineer 4th Division

Mr. C. V. McKieson R. E.
Superintending Engineer 4th Division

Mr. C. V. McKieson R. E.
Superintending Engineer 4th Division

Lieutenant Colonel Bean duly recorded in the several orders on the subject; this project may be designated as the 15 feet project as the escape weir are proposed to be raised to that height above the present ones.

3. The other plans and estimates amounting to Rupees 1,18,000 is the revised project recommended by Major Mullins, this project may be designated as the 6 feet project as the waste weirs are only to be placed 6 feet above the present Calingulike.

4. It will be needless to recapitulate the whole design which has been so frequently before the Chief Engineer and the Government both in Mr. Ingers reports and in letters from the Superintending Engineer under date 30th June 1869. In preparing these projects the several points ordered in the several Memorandums and orders of the Chief Engineer

Engineer including those of 4th February and 14th May 1870 and the Government orders 21st April 1870 24th May 1870 N^o 1329- have been duly attended to.

5. The only remark that seems called for is that the waste weir for the escape of surplus water seems ample being 63 feet more than in the original and when the fact of these being ahead since to the old Pungaroo Channel is as to regulate the supply, is taken into consideration, this seems ample. Should there be any fear there is a ridge on the southern side, if the 6 feet scheme is adopted, that will answer the purpose of a natural waste weir being averaging one foot above the escapes.

6. Colonel Bean in submitting the 15 feet project on the 30th November 1869 showed that after all deductions the profit on the expenditure should be 7 1/2 per cent but the cost was only estimated at Rupees 741,000 and profits at Rupees 55,000 but now the revised estimate has come up to Rupees

Rupies 838000 which would reduce the per centage to 6.55 with the same profit of Rupies 55000.

7. In the new or 6 feet scheme Mr. Lowry estimates the clear gain to Government at 11 per cent but I should think that his calculations were faulty and that we could hardly reckon on more than ^{the 11%} full yearly Ayacut would be obtained, the difference being, that formerly the collections were a good deal below the revenue about Rupies 47462 averaging only 27000 for the last five years, while now with this improvement a good and certain feeding channel, that the full cultivation would be a certainty except in years of exceptional draught. There will be however water enough in excess of the old supply to irrigate some 4500 acres while the waste land is considerably more than that but still I doubt if more land will be taken up though I must write subject to correction, as I am not acquainted with the locality and judge only from my experience of similar projects. Suppose we take the difference between the Ayacut revenue Rupies 47462 and the average

average on the last 5 years Rupies 27394 it will give a certain permanent increase of Rupies 20068 yearly and this will on an expenditure of Rupies 448000 give on per centage of $4\frac{1}{2}$ per cent which in my opinion is about as much as can be depended upon.

8. I have not said anything regarding the designs of the sluices or other subsidiary works as they were completed long before I came to the Division. I believe chiefly under the personal orders of the Chief Engineer for irrigation.

9. Whichever scheme is adopted the amount already expended and that now being carried out will have to be deducted from the Estimate.

10. The amount expended in former years Rupies 194964 up to 31st October 1870-71 sanctioned this year 37739. Total 232703.

I have the honor to be

Sr

Your Most Obedient Servant

W. W. R. Col R. E.
Superintd. 4th Div.

13

My Dear Mr. Davis

Obwohl

1871

(2)
25-2-1971
28/1/80

20th Nov 1898

to Gov.

to Gov.

... lives
... minutes
... seconds to the

aditi

ad id est

General Specification to be observed

in constructing the several works proposed in the
revised project for the enlargement of the Chert
Brambleham Sanks.

1. I have taken from Mr. Fraser's Spec-
ification a few paragraphs, which relate to works
that are common to both his scheme, and mine,
which if described by me, must be done in the same
words, or nearly so. All such lines are marked by
inverted commas.

2. Form Dimensions &c. &c.

The said works are shown in
detail in the drawings and the dimensions
are figured therein.

3. Bunds For the mode in which the
land is to be enlarged. The slope on the
inner or Sand side will be finished up to
one and a half to one.

4. The outer Slope of the Bund is to be
2 to 1, as shown in the drawings, all the
trees and Shrubs having been removed, since
time

has since and the Earth work already carried
up on this slope, where to a height of 2 feet above
the old Band, all that need be said respecting
it is, that the remaining earth work necessary
to complete the Band to its full height, should
be as carefully ^{done} carried out, as has been that already
executed viz: all lumps should be carefully broken
up, and the top of the Band having been well
wet and pushed the earth should be laid in thin
horizontal layers of one foot in thickness, well watered
and panned down, leaving the top of the Band
when completed 9 feet wide, including the parapet
adhering in the form circum, the Band to the Strong
Sections which are set out every 100 Yards along
its length.

5 The Puddle Trench—is to be excavated
until sound earth impervious to water is met,
with. The bottom of the trench is to be wide
enough to take in the revetment puddle and
gravel. The bottom is to be thoroughly wet
and a layer of puddle twelve inches in thick-
ness laid and worked in over the whole. The
revetment and gravel are to be founded upon
this layer of puddle and according as they
are carried up round by course the puddle is
to be worked in behind them.

6 Clay—for puddle is procurable all round
the bank of the Tank, both inside and outside
except in the extreme Southern Side. As the
puddle is carried up, the space between it and
the old bank is to be filled in, with carefully
selected material laid in layers, not more than
six inches in thickness and thoroughly beaten
down with water. Before this material is laid
in, the old surface must be thoroughly saturated
with water. It is essential that there should
be joint in the puddle wall, but that the whole
should form one homogeneous mass. It accords

cecessary that the Surface of each successive layer must be kept wet until the next one is laid on.

Parapet.—The structure is to be carried up, as shown in the drawings, to the top of the bund, where it is to be levelled off to receive the parapet the base of which is to be three feet in width, the height two feet. It is to be built with squared laterite.

The Puddle Wall—is to be four feet thick at the base, and ten feet thick at the top.

Gravel.—Such of the stones in the present structure as could not answer for the new structure, might be broken up for gravel. The layer of gravel is to be twelve inches thick. It must fill up all spaces between the stones at the back of the revetment, and should be rolled and compacted. It should consist of several sizes of smaller pieces being used to fill the spaces between the larger ones and should be beaten down in the layers, and if and the puddle should be incorporated for a few inches in thickness.

10 Turfing &c.—In finishing the bund, the best vegetable soil should be laid upon the cut side for at least twelve inches in thickness. The turfing should be placed over this soil carefully fitted, beaten down, and watered.

11 Channels—to carry off rain water should be made diagonally up the face of the slope, and carefully turfed.

12 Sluices—The new Sluices are being constructed on the plans Sheet No 365. The foundations having been excavated to a sufficient depth to secure a perfectly sound footing 18" of concrete has been laid in over the whole surface. The concrete is to set hard in water in three days in a hop a fat cubic. I may here mention the proportions of the different ingredients, they are as follows.

follows.

Shell Lime	3 parts
Nodular do	2 1/2
Finely pulverised burnt Clay	4 1/2
Good coarse clean sand	1 1/2
Broken Bricks and Tiles	20 1/2
Total	30 do

These quantities were all used by measure and not by weight.

13. The concrete set very hard under water in less than three days. I may mention that I laid it in in layers, of six inches in depth setting each successive layer laid on the one below it before the latter had time to set hard, the layers were each well rammed down. Above the concrete to foundations, and walls, of the Sluices on being mixed up in brick carefully laid in good mortar. Arches of the Culverts being turned with the moulded bricks of excellent quality. The walls will be of courses of brick on edge in alternate with half brick bond.

It may be useful to state the materials of which the concrete is being used for the foundations, they are as follows.

Shell Lime	2 parts
Nodular do	3 do
Sand	8 do
Pulverised burnt Clay	4 do
Total	15 do

14. The mortar is also hydraulic in its qualities. The floors sides and approached to the Culverts in fact every surface that will be reached by water, will be lined with dressed Ashlar, averaging 9 in thickness laid head and stretch and well bedded, a reference to the plan of the Sluices will show how it is proposed this shall be effected.

15. Six of the six New Sluices which are required to be built, were old Sluices. Nos 2-3-4-9 and 10 these Sluices appeared to be in good and strong outwardly but on careful examination proved to be utterly unsound and unserviceable, in fact rotten and undermined to a dangerous degree, there are three others that are alike unworthy of trust, and are in a state of decay and make the New Sluices do duty for them, as well as supply the Channels that are properly their own, this as the New Sluices are double the capacity of the old ones, they can do without enlarging without causing any inconvenience to the dykes.

16. Not one of these old Sluices would have withstood for a week, the heat of water that would have been brought to bear in the Culverts if not. Traders plan if Sluice had been adopted, with the exception they were covered with sanding or coaming Slides, any thing but well joined between which the water would have been forced up into the earth work above and the land would have melted away in a very short space of time.

18. The Three Old Sluices that have been found sound will be altered as shown by the plans Nos 6, 7 & 8. Care must be taken in executing this work that the old and new masonry are very carefully joined, where they come into contact and that the foundations in front of the Sluices be carefully laid in and that the puddle be carried behind the retaining wall of each Sluice down to its foundations.

19. The Old Calingulahs are to be removed no part of the old masonry being allowed to remain and all low and unsound earth is to be removed and the spaces filled in with fresh earth which must be carefully joined to the earth work of the bank on each side by cutting batter into steps and these steps must be well

well watered before any earth be placed upon them, this work will require particular care and should be executed by Alianagar's daily census, and not by Contractors people.

19. Calingulah New will be 1000 feet in length and should be constructed according to the plan Sheet No 9. The foundation having been put down of the dimensions given in the plan to perfectly sound and safe ground, 18 of Concrete in layers of six inches in thickness are to be laid all over the surface and each layer having been well panned down and all the layers completed the body and retaining walls of the Calingulah, shall then be executed of brick laid in good mortar having the top course of laterite blocks if not less than one third of a cubic yard each block. The surface of the Apron being excavated to the requisite depth shall also have 18 of Concrete worked in over it and, in this must be set the dressed laterite blocks which form the upper surface, these blocks must be alternately of 3 and 1.5 in depth and be closely fitted and laid on the mortar before alluded to herein.

20. The crest of the body wall should be finished off with dressed square blocks, well fitted and laid in cement, the whole of the joints should be

to be carefully pointed.

22. The ground on both sides of the Colan.
gate, as well as by the Section given on
plan Sheet 22. 29. is not thought to allow
of a free approach to and delivery from the
Colan gate, this must be col. road
as shown Sept. 1886. 2-6 below the end of the Colan gate.
Bund 1886. 11110.

22. Run across Old Supply Channel - can
must be taken to get a look and secure, but for
laying the path work of this kind open, as the
ground is very irregular and the soil of rather
a friable nature.

The earth work of this bank must be executed with the same care and in a similar manner as has been that of the land proper

23. The Sluices proposed to be placed in the
land plans of which are shown in Sheet No. 18
must be very carefully founded as they will occupy
the bed of the old Channel, which is of irregular
depth, sandy but with a soft Sandstone under-
lying the sand, the foundations must be excavated
into this rock to a depth of 3 feet and 18 inches
of hydraulic Concrete laid in all over the founda-
tion and, on this must the masonry of the Sluices
be laid, which will be of brick built in hydraulic
mortar and, faced with talled white 9 inches across
thickness laid header and Stretcher wherever the

water will be likely to ~~enter~~ the spaces, then
 sills, joints, and heads of the Sluices where the
 Gates come in contact with them must be also
 of loaded Ashlar well loaded.

2^d The Gates of which details are shown
 in Sheet No. 11 will be suspending and should
 be made equal (or nearly so) in specific gravity
 to water, so that when the water rises an inch
 or two higher in the inside of the Pond than
 on the outside, the gates will close.

25 The Drainage Channel - To carry
the surplus water from the Kanien fields
out, old Supply Channel where the Gates are
shut in the fall across the latter. This drain
will discharge ~~into~~ into the irrigation Channels
under the head of the tank, so that all the water
will be utilized. - Now then help this drain
has been cut and the earth placed in the bank,
from which it is laid out at a distance of 80 yds.
there must be a head sluice placed near the head
of the Channel see plan Sheet No. 33 The Channel
when finished will have a bottom breadth of 20' and
a slope on its sides of 1:1 and a gradient of
2 ft. Note, see Section Sheet No. 15

26th The Alteration of the Embankment of the
20th Mile of Great Western Road where it crosses
the

the western shore of the Lake, was intended to be
the Officer in charge of the 3rd Range Abolition District
provided to my being placed in charge of the project
and, it still remains in that Officer's hands.

27. The original Estimate (No. 10000) for completing this work was \$15,700. Mr. Allmon not finding this sum sufficient submitted in the month of June 1860 a revised Estimate for \$21,700, a copy of which he forwarded to me to be included in the General Estimate for the whole project. He afterwards in the month of November 1860 requested me to return this document to him which I did, and on the 15th of July last I received another revised Estimate from him for the same work for \$23,117. I think this explanation requisite as I would not wish it to be thought that I am responsible for any thing in connection with this part of the project except the bridge over the Supply Channel. I have Mr. Allmon's Estimate ~~in~~ in obedience to orders and it will be found in its proper place.

28. The Bridge Sheet No. 14. It is proposed to place in the embankment indicated above, it is intended to span the Supply Channel from the cause which enters the Lake below the embankment. The Supply Channel being wide on the side, the bridge will be a segmental arches of 20 feet span. The piers raised some 8 feet and will be 9 feet in height from the

the intent to the springing, the intrados of the arch being 3 feet above the proposed Celing level. As there will be no rise of the water springing it. 29. The foundations must be put down until a suitable soil is met with, over which should be laid 18" of Concrete, hydraulic if necessary. This should be executed in layers, in the way so often described in this Specification, over this the abutments, piers, and wing walls, should be carried up of the dimensions, and in the manner shown in the plan, taking care that the wings and abutments are carried up evenly by courses together and, always at the same level. I mention this as, if not prevented, the bricklayers in this country are in the habit of building up the abutments and piers and turning the arches of a bridge first and afterwards running up the wing walls, which may account for the latter in getting cracking and, otherwise failing. The bridge with the exception of the arches to be constructed of square well burned bricks laid in good properly seasoned mortar. The arches to be built with close moulded bricks of the best quality to be laid in rings with half brick bond. The thickness of the arch to be 6 rings of bricks or 2 1/2 feet at the springing and 3 feet at the crown on edge and, the extrados to be covered from the haunches over the crown with six inches of concrete.

to concrete, the facing of the Arches above the high
to work to be with puddled clay, properly rammed
and done.

as 30. The wing walls are ^{intended} to follow
the slope of the embankment on each side and
should be of the dimensions and construction
shown in plan.

in 31. The roadway which will be 16' in width
will consist of 8' of best 2" broken material and
8' of gravel 12" to be constructed with a road in the
centre of 4' and to be brought to a proper surface
by watering, puddling and rolling. The rest of
the structure to be in accordance with the plan.

32. The foregoing comprises all the works
included in the Santhi paper and more with
the exception of the land across the old supply
channel and the drainage channel those which
were included in Mr. Harris's Estimate.

33. The following specifications for the additional
works, intended necessary ^{of Caneira}
already reported upon.

34. Anicut Head Sluice and Bridge over
Supply Channel and Sinnera Head Sluice

The Anicut will have 450' clear water way
the head Sluice of Supply Channel 18 openings
8 x 5' each, Sinnera Head Sluice 12 openings
5 x 5' giving a total lateral water way of 515' for
the Kerala Tributary has only 370' over the

33
Dam and the Sluice openings of 5' or 415' lateral
water way in all.

35. The foundation wells of these structures
must be put down to a depth of 10' feet below the
bed of the river; the wells for the body wall and re-
taining walls should be 5' in diameter, the fill-
ing up wells 4' in diameter, the wells to be 9'
in thickness and to be filled with concrete, or
stone wells as a foundation, the body wall and
retaining walls of the Anicut and the first
and abutment of the head Sluice and bridge
and the piers and abutments of Sinnera head
Sluice, must be built, the bottom course of the
body and retaining walls and the flooring of
head Sluices, must be dressed laterite proper size.
This should be well joined, and cemented with
hydraulic mortar (with which the wells must
also be constructed.) The first course of laterite
10' inches of brick in hydraulic mortar should
be laid and on this latter course, the floor of
the Sluices and Apron of the Dam should be
finished, with heavy blocks of dressed laterite
3 x 2 x 1 1/2, also laid in hydraulic mortar and
carefully cemented and joined.

36. The plans will show how the openings
in the head Sluices are closed. This is done in the
ordinary way with a number of boards long enough
to project a foot or 15' above the water level and

in three projections will be holes for the insertion
of a bar, which can be used as a lever for lifting
the boards; the center board should be made wedge
shaped and this need started with lubricate all
the others. There will be an iron bar 2 inches
across each opening, let into the masonry two thirds
down, which will support the boards and guide
them when being placed in the lower section, the
plans show every detail and render it needless
to say more about this part of the work.

37. The Sand Sluices and Gates, will also
be understood better by a reference to the plan
Sheet No. 10. than by any description that can
be given. The gates of the Sand Sluices will
be similar to those described ^{above} and there will be the
same method of closing them.

jungle streams, and pass down the latter for a distance of 7200 feet where it will join ^{it} being a dam with sluices across the stream when the Channel is taken off passing above the Namun Jank as shown in the India Map and thro' the dividing ridge between the valley of the Namun Jank and that in which the Chyabum Lachum Jank is situated the Channel will run along ^{the} north side of the latter the fall being reduced to what would be a safe gradient by three masonry drops having a fall of 6 feet each. The latter shown in Sheet No. 9. Should be put down to a perfectly safe foundation, one which 18" of concrete should be laid in the ground already described and the apron and body well & carefully executed with heavy blocks of dressed granite having a rough plan continuation of the apron for a depth of 20 feet. The sides of the Channel in continuation of the wing walls should be revetted on each side for a distance of 100 feet below the falls.

39. When the Channel once reaches the level of the bottom of the valley advantage should be taken of the Saphal Channel below the Mayvohar Casing Jank, by doing this a good deal of earth work will

will be saved
40. The Dam proposed to be across the Chumbun
at Kal. ————

Must be constructed according
2. to the plans Sheet No. 28. The foundation having
been ascertained to be not very hard & stiff, it will
be necessary to cut down into this as far as can be
done with the pick, then having levelled the surface,
place 10" of concrete in it in layers of 6"
each and before settling and, carry up the
structure of good sound masonry. All the surfaces
of the three openings should be lined with
tiled. As the said masonry and structure are
closely joined. This will do all the masonry
works specified herein being carried up & raised
by hand, on the level no portion being built
higher than another until completed. The
wall & verge the head of the Supply Channel
must also be built in the way shown in the
plan securely founded and carefully built
28. of good materials.

41. The Sweepwater Supply Channel
The Longitudinal and Cross Sections
Sheet No. 29 will show what is proposed to be done
for the improvement of this Channel.
The gradient of its bed is for the first

3 1/2 miles from the Colingulak of the Sweepwater
Sank, 12 1/4 feet per mile, but the ground is hard
and seems to stand without much if any sink.
The gradient from this point to where the Channel
enters the Chumbunbakhm Sank, is 4 feet per mile
nearly, and very regular; suddenly quite steep
enough to keep it from silting, as there is but
little deposit seen anywhere, there seems no
reason. The only obstructions being small
official dams placed by the villagers in the
bed of the Stream in the dry season, to store
back the water for piceallah irrigation, all which
ought to be removed before the rainy season.

42. It will be seen that raising and strengthening
the lower or right bank of the Channel is
the principal work to be done. It is this bank
that keeps the water when it rises to any con-
siderable height from flowing away to the Adyar.
The sections in red will show that it is pro-
posed to thoroughly strengthen this bank.

43. The earth work must be executed in
the same or a similar way to that of the Sank
bund before described herein, the materials
necessary being taken from the bed of the Channel,
where that would be advisable and practicable.

44. It is proposed to raise the Colingulak
Three

1. This job which it will be done by the Longitudinal &
2. Section is situated in the bank of the Channel & the
1. will be done in the way shown in the plan.

a. 45. The Sluice figured in this Sheet (N^o 24) must
2. be strengthened and a new head built to it as shown
on same Sheet. All the new earth work neces-
sary in strengthening the bank, must be carefully
laid and the turfing kept wet until the
grass has taken root and is growing.

46. The Old Bungeiroo Channel and Cerum

River Sheet N^o 25. The gradient of the
bed of the Channel ought to be improved for some
miles from the head, as shown in the Longitudinal
Section, and the Channel excavated to this bed
for a breadth of 175, as shown in the Cross Section.

The bank between the Channel and the Corbellian
river must where necessary be strengthened and
the Calinguloh situated in this bank built up.
There are many low weak places in the bank
from the 3rd to the 7th mile from the head of
the Channel. These should be raised and
strengthened in the manner shown in the
Longitudinal and Cross Sections, the top of the bank
must be so raised that 9' above the bed of the
Channel, the soil for exceeding this part of the bank
ought where practicable to be taken from the bed of
the Channel, where the bed is shown to be high

in the Cross Section. 139

47. The Causeway for rails obstructed by
high banks thrown up by the Zemindars and
ryots, when separating the Spring Channels in the
dry season, these banks they (the Zemindars and
ryots) ought to be made to remove. As the sand
of which they are composed is carried into the
Channel in freshes and, into Tanks to the serious
injury of both descriptions of works. Besides these
banks in any but very heavy freshes prevent any
water reaching the Chendian Tank and so on.

48. The Head Sluiceway Sheet N^o 23 Sheet Drainage Channel

to be constructed as shown in plan Sheet N^o 23 care
being taken to put down the piers and abutments
to a sound foundation, over which is to be laid 18" of
concrete and the structure carried up with good
brick in Chunar, the Sluice boards and apparatus
to be similar to that for closing the opening of the
head Sluice at the Anicut as described in para 36
of this Specification.

49. The one arch bridge Sheet N^o 17 to carry
great western Tank Road N^o 3 over drainage
Channel on the 15th mile, must be constructed in
accordance with the plan. It will consist of one
segmental Arch of 30' span and a raised one
of

of 10. The abutments and, wing walls must be
put down to a sufficient depth to secure a firm
solidly sand foundation, which must be covered
with 12" of Concrete, the Arch to be turned
with brick rings with regular half brick bond
throughout, there should be 5 of these rings, to be
constructed of the best table moulded bricks well
burnt. The rest of the structure being constructed
of good sound well burnt common bricks.

50. The skew Arch. Sheet No. 19. Is intended
to span drainage Channel or accommodation road
from the great Western Road to the road proposed
to the Tank Bund.

The abutments being put down to a safe
foundation and constructed according to the plan,
in the way so often described herein, the impost
must be prepared for the reception of the brick
rings or voussoirs, that is the back of the Abut-
ment, should be worked into vertical Steps, the
sides of which are respectively parallel with and
at right angles to the face of the Arch, the width
of the step being equal to that of the brick rings
with which it is proposed to turn the Arch. This
done the Centre should be set in its place and
well lagged, all the lagging should be fastened
down and should be put down to the end, should

be long enough to project a few inches (say six) beyond
the face of the Arch.

51. The Centre should now be marked in
the following manner. The lines for the faces of
the Arch ^{which form} the extreme outside and inside
are perfectly straight ^{on the plan} should be marked on the
lagging, then bisect each face and draw a line
joining the middle point of each. This line
should then be divided similarly to the impost
all the lines which have now to be put on are
Spirals and, to draw them in the lagging a long
thin ^{broad} flexible straight edge must be pro-
vided, on this straight edge must be marked
the number of voussoirs. Then apply the straight
edge from first division on the impost to the first
division at the Crown, marking carefully the
points where the divisions are marked on the
straight edge. This should be done on the
heading spiral nearest each face. Now draw
a line on the lagging with the straight edge
from the first division on the heading spiral next
to the face of the Arch to the bottom of the first divi-
sion or spine back in the impost, let the same
be done from the second to the second, the third
to the third, &c. until the whole are marked, the
lines thus drawn are the spiral coursing joints

of the joints, or those to which the courses of
the bricks must be laid parallel.
52. The brick work should have regular
half brick bond, and that it may look well,
heading spirals should be drawn at two bricks
distance apart, as a guide to the bricklayers.
The heading spirals are those which as described
above were divided for the coursing joint, they
will of course be drawn parallel to the first.

53. The Overseer or other in charge of
this work, will take care that the bricks are
laid carefully within the lines so laid out, taking
in care that they are properly bonded, when the Arch
is finished, the joints should be carefully pointed,
no plaster being put on any portion of the
work.

54. The Road over Tank Bund — There is on
the Cross Section Shot N^o 2 must be made 18' wide
in the clear, with 15' metalled, the extra width on
the top of bund must be made up by placing earth
on the outer slope with a slope of $1\frac{1}{2}$ to 1. The
surface of the road must be made by first leveling
the top of the bund and lining out 15' wide in its
center, cutting 6" of earth from the edges and banking
the

41
The road by placing this in the center. The banking
having been carefully done, irregular lumps of Surber
ballast of about 2' Cubic should be carefully laid on
this surface by hand, still keeping the form given
the surface, then this 2' of Cubic of the Surber should
be filled the interstices and, again 2' of Cubic and
over all this 18 inches of good latvite gravel, all
of which must be well watered and rolled down.
The Slopes by which the bund is extended on each
side must be formed at a gradient of 25 to 1
and care must be taken that the breadth of the
roadway ^{is} ~~is~~ not cut out of the thickness
of the bund but, ~~is~~ added on the outer
slope of the latter.

55. The portion between the new Bangalore
road and the bund is nearly completed, only
wanting the Skew bridge and Slope to be constructed
to complete it.

56. If the Southern or old Bangalore road
and there are 795 linear yards to be made to complete
the communication between it and the bund, this is
over hard soil and need not be expensive, the surface
of this portion will be made as above specified, there
will

will be a Culvert required at the junction of the two roads.

57. The Communication Channels below the land for conveying water from the Aor Sluices to the Channels of those that are shut up.

These Channels should be excavated according to the Longitudinal and Cross Sections Sheet No. 26 and, the gradient being reduced by masonry weir falls to 3 feet fall per mile. There will be three weir falls to be constructed as per plan on the Section. There must also be Sluice Gates for regulating the quantity of water admitted into each Channel, that is one at the head of each. The method of construction will be similar to that of the other masonry works so often described herein. The plan of the Sluice Gates will also be found on the Section above named.

58. Inverted Siphon Masonry and Aqueduct Suber Sheet No. 16.

Intended to carry the irrigation water from the fields above to those below the Supply Channel within the limits of the village of Trincoylo. It must be placed on solid ground and, carefully constructed according to the plan, nothing but the best materials being used. The Aqueduct and one of the Siphons are intended to pass the water from the Tank Sluices to the

Second Revised Estimate.

Alterations of 20 mile Road No. 1111 in connection with "Chembampakkam Project".

Specifications.

The work Estimated is an Embankment on the present line of road, revetted both sides, edges turfed, metaled, fenced both sides with quickset hedging to prevent accidents, and a bridge of 3 arches, with an extension of two of the former culverts, the other three being the up.

The "Embankment" will be raised in the ordinary manner: it will be on a dead level throughout, from at least, above high water level of the Lake. The south slope will be $1\frac{1}{2}$ to 1; the north slope 2 to 1. At the deepest part it will be 17 feet in height. The top will be rolled to section on completion, so as to consolidate the surface to receive the metaling. The length of the embankment will be 5500 feet. The top breadth will be 32 feet of which 18 will be metaled, 3 feet

feet on each side for foot plates, and
butcher & feet on each side, for
berms and hedging.

The "pitching" or "revetment" will
be of the ordinary description,
though more closely jointed. It will
be of rough luteite $1\frac{1}{2}$ feet thick,
with a foundation of $1\frac{1}{2}$ feet, and
will be laid on the slopes of the
embankment, and extend to within
15 feet of top thereof, which will
be 3 feet above high water. The
earth in rear of the stone will
be well tamped, during the con-
struction as each course is laid.
Each course, in the thickness will
consist of one stone generally, frag-
ments being used to fill up in
interstices at back.

The "Turfing", will be placed, on
the edges of the top of embank-
ment, for four feet each side, on
the slopes down to revetment on
both sides. - A furrow one foot wide,
in the centre of the 4 feet, on
each side will be left, for building
in the hedging. - The Turfing beds
will be got from Clay loam soil,
and laid closely, tamped and watered
are

further side of the Drainage Channel.

59. The Drawings Sheet No. 11. In detail

of the Apparatus for working the several Sluice
Gates, the plans will explain themselves.

60. Masonry Crossings Sheet No. 27. - To

allowing the water of the drainage Channel when
in flood to escape into the Channels below.

The footings of the body wall of both
slopes must be put down to a safe depth, and the
rough Stone in Channel of the pitching to the slopes,
and the Aprons should be founded on concrete one
foot in thickness, the banks of the Channel must
be raised to a sufficient height and distance back
from each fall to make up for the three feet of the
raised crossing. - A certain portion of this flood
water will be taken by each Channel (of which
there are three) in succession the Sluices being
shut mean time, but little water will be left to
pass into the Channel of the Centre Sluice.

61. In conclusion it may be necessary in a
few words as possible to say something as to how
the Masonry and other works should be executed
but such instructions unless enforced on the spot
where the work is being executed are seldom
found of any use.

62. All brick, latite, or stone should be well wet before being used for building.

63. Care should be taken that too much water is not used in ^{mixing} the mortar.

64. All masonry should be bonded, old English bond, that is one course of headers and one of stretchers, is the best for brick work and.

65. Flemish bond that is one header and one stretcher for the Ashlar facing, each course whether of brick or stone should be equal in height throughout, and the whole should be kept perfectly level.

66. The mortar should consist of good well slacked lime and clean coarse sand, with a proper proportion of pulverized burnt clay. These ingredients should be well mixed and ground up together in a mortar mill, not more than 24 hours before being used.

R. S. S. S.
Assistant Engineer
In Charge of N. 7 Bridge

Chembur Bactham Sauti Project
17 October 1870.

Superintendent
Superintendent

till it takes thoroughly. In this way
and roging, drains at every 4 feet
will be placed, to relieve the drain
age on the roadway.

The "paving" will consist of "Archa
paving" bedding, and placed as men
tioned before, in the centre of the
4 feet surf bedding both sides.
This will be raised from bed
and watered, till it has grown
up sufficiently. The bedding will
be temporarily protected with
bamboo thorn fencing on the in
side.

The "bridging" consists of a new
bridge of 3 vaults of 10 feet width
entirely of brick in chain, and
with 6 feet foundations. The arches
semicircular, spring from piers
and abutments, 12 feet in height.
The other details will be seen on
the plan. This bridge is to be lo
cated, between culverts No 2 and 3
(see plan).

The extension of the old culverts
No 4 and 5, needs no particular
description. They will be run out
both ends, to meet the slopes of
the embankment, and will follow
the original plan, exactly in

both cases. - These will be partly
of brick, and partly of latente in
chains. -

The estimate further provides for
diversion tracks, to serve the traf-
fic, till the embankment is ready.
These tracks are laid, one on the
north and two on the south
side. - These need no particular
descriptions, beyond that they
have to be maintained in order.
A portion of the northern track
is to be metalled, where it passes
under a tank bank. -

The "Metalling" over the embank-
ment, will be in keeping with
that of the Trunk Road generally.
It will be laid in latente, six
inches depth, with a width of
6 yards, in the usual manner.

(O'Brien)
Metalling and 3 lines
23 Aug. 1889

Pls 5/71
Presg March 171
In 1252.

Chas. 105/20.

Report

on the revised plans
of the 15th Scheme
for the enlargement

of the

Chembrembackum Tank

Project

46 52 34
Report on the revised plans for the
enlargement of the Chemburackum Tank.

With this Report Sheets of plans are
forwarded as follows.

1. Sheet No. 1 Index Map showing the several
portions of the revised project from the Kaisararam
Anicut on the north, to the Streptomatoro Tank to
the South, including the old Bungairao Channel, and
Crum river, and the site of the proposed Anicut across
the latter. The Supply Channel thence to the Chemburackum
Tank via the Chuanam Kal. The contour
plan of the Namem Tank on which the blue shaded
contour line shows the form and extent of the basin,
at the level of the present Calingulah, and the pink
shaded contour line would be the water spread, with a water level
as was proposed, by raising the Calingulah 6 feet.

2. The Contour plan of the Chemburackum
Tank is also shown on this map, only four contour lines
are drawn upon it, the red line is the Crest level of the
present Calingulah, the blue shaded one the water bound-
ary at the level of the top of the dam, the pink
line 6 feet above Calingulah Crest and the red shaded
line what it would be were the Calingulah raised
to the proposed height of 15 feet above its present
level. I may mention that this Map is common to
both this and the 6 feet scheme.

3. The site of the proposed head across the old
Supply

Supply Channel is also indicated on this plan as well as the proposed drainage Channel from above this land to the Nannamankulam Irrigated Channel by which it will discharge.

4. The Surplus Channel - The permanent Tank which is one of the features of the Chembambachum Tank is also laid down on this Map on the South side of the Tank.

5. The red contour line above Tunkal Road - No 3 Shaded in brown shows the extent of land which the villages under the Nannam Tank, that would have been submerged, had the original scheme been carried out, and the red line to the East between the points A and B is where a band 8 feet in average height and 10,000 feet long would have been then required to prevent the water flowing away towards Poonamallee.

6. Sheet No 2. Longitudinal Section of the top of the Band of Chembambachum Tank and of the Band along the foot of the slope inside and outside the Tank. On this Sheet are also drawn Longitudinal Sections showing the present height and slope of the Band and coloured red, how it is proposed to enlarge it. There are also shown on this Sheet Longitudinal and Cross Sections of the proposed Band for blocking up the old Supply Channel with the Sluices proposed to be placed in it.

In the plan drawn on this Longitudinal Section there the level of the Crest of the present Calingulah and the red lines show respectively the height of proposed

Calingulah and top of proposed parapet. The Datum line shown on the Section is 50 feet above mean sea level at Madras.

8. Sheet No 3 and 4 and 5. Plans proposed for

5 New Sluices which will replace the old Sluices No 4-7-9 and 10 which were in a very dangerous state. No 2 Sluice it is intended to place at the North end of the old Band, this Sluice will supply water for the irrigation of a considerable tract of land not before under the influence of this tank. Sluices No 2 and 3 will give water to the Channels of old Sluices No 2-3 and 4, and Sluice No 7 will supply the Channels of old Sluices No 8 and 9, and Sluice No 8 will irrigate the land under old Sluices No 10 and 11. There will be Channels outside the Band to communicate between the New Sluices and the extra Channels they supply. This arrangement will enable me to dispense with 3 of the old Sluices which were found in an untenable state and have been shut up.

9. Sheets No 6 to 8. Show how it is proposed to alter the 3 old Sluices which are retained.

10. Sheet No 9. Plans of proposed Calingulah and also plans of masonry falls for regulating the gradient of Supply Channels.

11. Sheet No 10. Plans of an Aricut and Head Sluice which it is proposed to place across the Coonoor river at the 23rd Mile from Madras on the North side of the Aricut are shown plans of a Head Sluice for the Pinnalore Tank.

12. Sheet No 11. Shows details of Sluice Gates and Apparatus

13. Apparatus for lifting the same and also details of
Sluices and selfacting Gates for the proposed Band
across old Supply Channel.

14. Sheet N^o 12. Longitudinal and Cross Sections
of the proposed Supply Channel from the Anikut across
Corum river to the Chumam Tal and thence by that stream
to where the Channel leaves it and is carried above the
Namum Tank this the dividing ridge into the Chum-
bumbachum Tank, with Cross Sections showing the
excavation that will be required.

15. Sheet N^o 13. Plans of Embankment 15th to carry
20th Mile of Trunk Road N^o 1 over the western end of the Tank

16. Sheet N^o 14. Plans of a Masonry Bridge of Three
Arches to span Supply Channel from the Corum river
in the embankment on the 20th Mile of great western
road.

17. Sheet N^o 15. Longitudinal and Cross Sections
of Drainage Channel from the Bridge over the old
Supply Channel at the 17th Mile of Trunk Road
N^o 3 to the Manapachum Channel near the Center
Sluice of the Tank.

18. Sheet N^o 16. Plans of Aqueducts and Inverted
Siphon, to pass irrigation water from the Chumbum-
bachum Tank Sluices to the further side of the drain-
age Channel.

19. Sheet N^o 17. Plans of Bridge to pass Trunk
Road N^o 3 over drainage Channel on the 15th Mile.

20. Sheet N^o 18. Plans of Sluices proposed to be placed
in the Band across the old Supply Channel.

21. Sheet N^o 19. Plans of a New Masonry Bridge
over drainage Channel to carry communication road

from Trunk Road N^o 3. to the Tank.

22. Sheet N^o 20. Plans of Culverts for Communication road

23. Sheet N^o 21. One Small Bridge and 12 Culverts on quarry
road from the Madras Heemata road to the Tank Band

24. Sheet N^o 22. Longitudinal and Cross Sections of the proposed
Channel from Anikut to Jinnonore Tank.

25. Sheet N^o 23. Plans of Head Sluice for drainage Channel

26. Sheet N^o 24. Longitudinal and Cross Sections of the Supply
Channel from Shepermatore Tank on which in red are drawn the
proposed alterations and improvements, this plan is common to both Projects.

27. Sheet N^o 25. Longitudinal and Cross Sections of the Corum
River and Old Bangraia Channel showing the obstructions and how
it is proposed to rectify the floods block up the Culingulah and strengthen
the bank between head of the Channel and the Corallian river and raise
and strengthen the bank. This plan is common to both Projects.

28. Sheet N^o 26. Sections of Channels to connect new Sluices with
the Channels of Old Sluices which are to be shut up.

29. Sheet N^o 27. Masonry Cappings to allow water of Drainage
Channel when in flood to pass into and out of Irrigation Channels.

30. Sheet N^o 28. Contains plans and sections of the dam proposed
to be placed across the Chumam Tal where the Supply
Channel leaves that stream, there are also figured on this
Sheet the details of the shutters for closing the Gates of the dam
and the apparatus for lifting and lowering them.

31. Sheet N^o 29. Shows sections of the ground at the site of the
Waste Weir showing what earth it will be necessary to remove
to give a free approach to and delivery from the Culingulah.

32. Sheet N^o 30. Shows the plan pursued in closing Old
Sluices N^o 3-8 and 11.

33. In Mr. Fraser's report the history and de-
scription of the Tank are so fully given that it would be
waste

13. Waste of time and paper to attempt to say any thing on this subject in this report. I would therefore refer any one desiring to know more than is contained herein on this subject to the above named documents.

14. The 34th Map Sheet will if carefully examined give a clear idea of the position of the Tank. How it is supplied and of the water spread at the different levels.

15. It would be giving the Collector unnecessary trouble to ask him for a fresh Statement of Agents and revenue of the Tank, I have consequently subtracted those supplied to Mr. Fraser and as I believe his (Mr. Fraser's) deductions from the information thus obtained are generally correct. I have adopted his Statement of the probable additional revenue to be expected from the enlargement of the Tank.

16. I have invariably acknowledged by inverted commas every line so quoted.

17. The principal supply which the Tank received is from the Corum River across which there is a dam and Head Sluice at Koratore the New Bangalore Channel conveying the supply thence to the Chumbambachum Lake.

18. The Corum receives the water of the Southern branch of the Kortelliar by the old Bangalore Channel. There being at the head of the latter at Masararam a dam across the Kortelliar for the purpose of throwing water into this Channel. There are 19 Tanks that receive water from the Corum the supply channels of which are situated above the Koratore Anicut.

19. Since the date of Mr. Fraser's report Head Sluices have been built to a number of these Channels but as it is there being no proper system of Control as yet established for regulating the quantity of water that each one receives when a crash occurs in the river.

20. Since the date of Mr. Fraser's report Head Sluices have been built to a number of these Channels but as it is there being no proper system of Control as yet established for regulating the quantity of water that each one receives when a crash occurs in the river.

The Supply Channels taken off the Corum River are as follows:

No.	Names of Channels	Taken off		Remarks
		North side	South side	
1	Condengerry Channel			Has a new Head Sluice
2	Pinjirakkuni do			do do
3	Athigathore do			do do
4	Agamy do			do do
5	Casam Nullatere do			do do
6	Cadumbathore do			do do
7	Yagatore do			do do
8	Pongatore do			do do
9	Salay do			do do
10	Peryacospum do			do do
11	Pelizancospum do			do do
12	Calacatore do			do do
13	Pethore do			do do
14	Thunneercolum do			do do
15	Tholeveer do			do do
16	Anavoyal do			do do
17	Godaspachum do			do do
18	Thiruvor do			do do
19	Tinnalore do			Old broken
Total Channels both on North & South				

Supply Channels taken off the New Bangalore Channel between Koratore Anicut and Chumbambachum Lake

No.	Names of Channels	Taken off		Remarks
		East side	West side	
1	Nidengary Channels			Old Sluice
2	Piriyembi do			none
3	Thiruvathishay do			Old Sluice
4	Manimbadu do			do do
Total Channels				

13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

Table showing the capacity and area of the Basin in which Chembrambakum Sant is situated at each contour line on the Plan No. 11

No. of Contour Lines	Area at each Contour in Square Yards	Average area of each pair of average cubic yards between each pair of contour lines	Total No. of cubic yards at each contour	Area in Square Miles	Area in Acres	Circumference in Miles	Remarks
5	34800180	33602195	196073925	11284	7190121	21275	Level of proposed Catingulab
4	32404203	31348746	163271730	10461	6695083	20525	
3	30293288	29012144	131922984	9779	6258043	19375	
2	27731000	25113600	102910840	8952	5729545	18575	Level of actual Catingulab
1	22496201	22191720	77797240	7262	4647975	17375	Level of top of dam Stone
0	21027356		53603462	6715	4298035	16093	Level of the thin Catingulab at the S. end of Basin

39. Catingulabs

There are Six Catingulabs to Chembrambakum. Four of them being near the South end, and one near the North end of the Basin as follows: Counting from the South end.

No. 1	Vettumaddy Catingulab	5 4 11	23
do 2	Resanbeg	7 3 8	39
do 3	Thallan	1 5 8	36
do 4	Nalliaman	4 6 11	40
do 5	Poniaman	2 2 3	40
do 6	Vettumaddy	6 7 11	80

Total length in feet 643 1/2

Deduct the aggregate width of the dam Stones 22

Total clear length 561 1/2

40. Of these Catingulabs Numbers 1, 2 and 3 are at the same level. 4 and 5 are 6 inches to 12 inches higher and No. 6 is nearly 2 feet higher. They are all with the exception of No. 6 very solidly built with dressed quoins and with the same exception they have all dam Stones 3 feet in height, as these Catingulabs are all to be removed plans of them are not sent up.

41. Sluices. The present Sluices are shown in number of these I have found to be very badly built and altogether so utterly insecure and dangerous that I have removed them and am building four new Sluices in their stead the other three being shut up. These old Sluices were apparently most massive and strong while on examination they proved to be utterly rotten and undermined.

42. The following is a Statement of the dimensions of the old Sluices counting from

13. From the South end.

No.	Names of sluices	Bottom of sluice below sluice and below sluice	Dimensions of sluice
1	Palanthundalam	14' 50	56' x 2' x 1'
2	Karanore	11' 00	65' x 2' x 1'
3	Thirumuddivakum	17' 50	51' x 2' x 3'-3"
4	Konnalore	19'	59' x 2' x 6'-0"
5	Maungaud	16'	116'-6" x 2' x 4'-3"
6	Manapakkum	21' 75	81'-6" x 2' x 5'-6"
7	Chetty sluice	13' 30	125'-3" x 2'-3" x 5"
8	Malayambakkum. Mettu	9' 40	61'-9" x 2'-3" x 3'-3"
9	Ponnamallee	8' 70	58'-9" x 3'-6" x 2'-6"
10	Maypoor	8' 30	53'-6" x 1'-6" x 2'-3"
11	Agaram	3' 75	52' x 1'-6" x 2'-3"

13. Land now Irrigated — Chemburam.

14. This has always been highly valued as an Irrigation Tank as the Cultivation of a large portion of the irrigated land lying on the west of Madras depends on it. It irrigates the whole, or parts of fifty eight villages. The Nuzjah Ayaent of which is 8,604 Cawnies, assessed at 63,842 Rupees. This includes 1163 Cawnies of Inam land assessed at 10,190 Rupees.

15. Very seldom, however, has there been sufficient water to irrigate the whole Ayaent. I have obtained from the Safford's Catechery, such information as has enabled me to give the following table showing the numbers and names of the fifty eight villages, the Ayaent in each of the Circar and Inam lands, the Average area irrigated during the last 1 1/2 years and the number of Cawnies in each Circar Village under dry cultivation or of waste land or of lots which could be converted into wet cultivation if there was sufficient water.

Statement of the Ayaent Assessment of the 58 villages irrigated from Chemburam Tank

Registered Number of Villages	Names of villages under the Tank	Circar	Sands	Inam	Sands	Average Number of Cawnies under wet cultivation for the last 1 1/2 years	No. number of Cawnies of which dry land is converted into wet cultivation
156	Maungaud	123	3586	153	1723	357	124
157	Matavilagam	37	361	18	86	29	2
158	Ragannathapuram	240	526	22	704	34	2
159	Chikkaroyapuram	44	515	25	126	33	15
160	Changanacathiralam	34	227	25	280	27	4
161	Arulapuram Pattayaram	13	114	8	73	28	0
162	Arulacuttalag	41	255	9	55	33	4
163	Chinnappuram	29	225	5	59	23	11
164	Malayambakkum	312	2429	44	402	129	266
165	Sathanpallam	4	20	...	...	3	...
166	Arulacathachery	39	372	...	...	7	...
167	Arulapuram Pattayaram	38	311	...	...	7	...
168	Arulacathachery	25	181	17	125	29	...
169	Arulacathachery	97	152	17	215	67	...
170	Syrianthangal	3	24	...	...	2	...
171	Arulacathachery	30	210	...	...	2	...
172	Arulacathachery	94	633	...	...	2	...
173	Arulacathachery	59	282	...	...	2	...
174	Ponparappuram	7	45	...	...	2	...
175	Arulacathachery	74	502	...	...	2	...
176	Arulacathachery	69	542	...	...	2	...
177	Arulacathachery	1258	8532	...	...	2	...
178	Arulacathachery	48	366	...	...	2	...
179	Arulacathachery	31	339	...	...	2	...
180	Arulacathachery	19	678	...	...	2	...
181	Arulacathachery	49	361	...	...	2	...

1201	Malayudachary	91	3	12	12	6	3	11	11	13
1202	Manamkulalay	500	6	8	8	1	1	12	12	51
1203	Caran	2116	59	3	3	13	13	17	17	403
1204	Gothevadoo	151	2	10	10	13	13	18	18	48
1205	Gooparaphy	151	2	10	10	13	13	18	18	108
1206	Sivoculathoo	1653	35	8	8	22	22	28	28	1342
1207	Caranore	1002	19	9	9	15	15	24	24	333
1208	Palanthundalam	3612	42	13	13	58	58	74	74	60
1209	Thiruvudachum	4284	38	2	2	53	53	81	81	5
1210	Thanthumbachum	1642	23	14	14	18	18	26	26	44
1211	Mathamunthapuram	900	19	14	14	18	18	26	26	3
1212	Agappenthagal	920	24	15	15	20	20	28	28	3
1213	Colatharanyang	531	40	3	3	20	20	31	31	3
1214	Manupathum	1086	34	5	5	30	30	41	41	3
1215	Elthorilly	137	1	2	2	3	3	4	4	2
1216	Mathamunthapuram	66	1	2	2	3	3	4	4	2
1217	Perumandor	155	9	10	10	13	13	18	18	2
1218	Thundalam	954	9	13	13	18	18	26	26	2
1219	Thyapamudhary	520	14	5	5	19	19	26	26	2
1220	Pendancullalay	769	20	18	18	24	24	31	31	2
1221	Thirupathum	708	12	16	16	21	21	28	28	2
1222	Panavillic	2030	28	8	8	33	33	44	44	2
1223	Agudharum	358	16	23	23	30	30	41	41	2
1224	Thoppathareilly	728	12	10	10	13	13	18	18	2
1225	Thoppo	1516	12	6	6	10	10	12	12	2
1226	Thoram	290	9	3	3	10	10	12	12	2
1227	Thrambady	220	4	4	4	5	5	6	6	2
1228	Suracumbachum	570	14	14	14	18	18	26	26	2
1229	Candagay	313	6	2	2	7	7	9	9	2
1230	Chithalhere	243	3	4	4	5	5	6	6	2
1231	Tharubachum	207	16	11	11	18	18	26	26	2
1232	Tharubachum	900	20	0	0	25	25	33	33	2
1233	Tharubachum	53652	1163	0	0	10100	10100	14	14	1534
1234	Tharubachum	7411	53652	1163	0	10100	10100	14	14	1534

As will be seen from Column No. 7 that the average area irrigated during the last fourteen years was only 4,345 Cawnies or little more than one half of the Ayacut and even over this area there was generally but one crop obtained in the year.

46. The average annual revenue received during these fourteen years was 38,975 Rupees but this was a period at which the Assessment was much higher than it is now. If we take the average number of Cawnies Cultivated at the present rate the average Annual Revenue will be 21,725 Rupees.

47. I have already shown that of the 8,604 Cawnies of the Ayacut only 4,347 have been cultivated in an average during the last 14 years leaving 4,257 Cawnies uncultivated.

The additional Cultivation of the Ayacut will stand thus:

- I. First Crop off 4,257 Cawnies @ 5 Rs per Cu = 21,285.
 - II. Second Crop off 8,604 do @ 3 do = 25,812.
- Additional Revenue of Chemburachum Ayacut 47,097

48. Other Villages may be cultivated. Between the Chemburachum Ayacut and Vadras (or rather Nungumbachum and Noylappan Taluk) and within the river's Corum and Adyat there are 28 Villages regarding which the following table is a Statement signed by the Government of Chemburachum. A list appended to paragraph 38. with the Survey of 1881 for average Cultivation is given for only five years.

Number of Villages	Names of Villages not under the State	Circular		Income		Expenditure		The number of families in each village who could be converted into out-cultivators
		The amount of each village and the whole	The amount of the expenditure of each village and the whole	Appropriation	The number of families under cultivation for the last five years	The average revenue during the last five years		
1	2	3	4	5	6	7	8	9
249	Jyotirgarh	117	2814	8	46	199	883	63
62	Chilaparkum	124	1314	32	1057	93	354	88
3	Sonjary	56	148	2	116	18	150	3
3	Asapharkum	59	176	12	120	30	1147	24
4	Agarhar Jagudi	31	125	12	118	10	40	15
5	Abulac Jagudi	95	218	26	132	14	24	2
11	Shom bakum	85	916	98	276	35	1681	28
155	Talagarabakum	422	402	63	266	67	312	205
253	Medun bakum	204	1416	103	266	364	1257	301
13	Agargum	367	946	103	64	21	98	99
1	Goor	317	1345	167	1215	121	931	41
16	Tanagarab	35	1239	24	966	130	1005	20
17	Caranabakum	70	275	12	197	76	162	23
22	Chithyagum	13	522	1	95	56	403	4
18	Villaparkum	37	108	1	11	12	102	00
19	Sinabakum	160	307	21	16	34	210	9
20	Shallyagum	86	760	15	131	83	388	135
21	Shallyagum	130	531	15	44	10	88	9
29	Shallyagum	343	1609	26	108	65	382	5
12	Shallyagum	579	1413	42	158	55	348	80
54	Shallyagum	79	3515	9	301	410	1900	114
14	Shallyagum	127	502	9	56	40	322	18
15	Shallyagum	180	622	45	45	69	355	10
24	Shallyagum	11	822	3	264	155	693	27
25	Shallyagum	65	71	11	22	8	56	00
22	Shallyagum	16	398	2	88	54	331	20
101	Shallyagum	80	160	0	15	8	55	00
155	Shallyagum	80	358	0	62	32	100	6
	Total Villages 28	4615	20949	851	4661	2301	11481	1347

1. — First crop off 2,414 Canvies }
at 5 Papers per Canvy } — 12,070

Total additional revenue off the rent
Agent of these Twenty Eight Villages) — 25,965

51. There would be one great advantage in applying the water to those lands which are already prepared for wet cultivation, that no expensive works of distribution would be necessary, as in most cases the water could be applied direct without delay and without additional cost.

[Faint handwritten notes at the bottom of the page]

*Statement showing the quantity of water received by the
Chembembakum Tank in each year from 1848 to 1868.*

Year	Half Tank	Full Tank	Number of days water passed Calingulah	Number of times the tank was full in a Year	Remarks.
Year	Months	Months	About days		
1848	.	12	120	1	
1849	2	.	110	1	
1850	3	.	110	1	
1851	.	12	110	1	
1852	.	12	110	1	
1853	5	.	110	1	
1854	3	.	110	1	
1855	3	.	110	1	
1856	.	12	110	1	
1857	.	12	110	1	
1858	.	12	110	1	
1859	.	12	110	1	
1860	5	.	110	1	
1861	2	.	110	1	
1862	3	.	110	1	
1863	6	.	110	1	
1864	.	12	110	1	
1865	6	.	110	1	
1866	.	12	110	1	
1867	11	.	110	1	
1868	3	.	110	1	

Chembembakum

Madras Collectors Office
on circuit
Puducherry 16th February 1869

(Signed) L. Janc
Collector

52. Near Mr. Fraser's very sanguine account
of the large supply of water that can be obtained
from any source, is not borne out by the facts of the case.
I append a Statement which the Collector of Madras
has been good enough to furnish me with, by which
it will be seen that the tank has only filled 9 times in
the last 20 years. I am however of opinion that this
supply can be very considerably increased in quantity by
the improvement to the Supply Channels which is here proposed.

53. Proposed Works. I have already examined
all the different portions of the revised project in
detailing the Survey Map.

54. The object in view is to enlarge the tank by
raising the level of the Calingulah 15 feet. This will give
141 millions of Cubic Yards additional storage
space for water, 15 feet is the highest point to which it
would be possible to raise the water in the tank, as the
ground on the South side is for three or four miles only
a foot or two above this level and, in two places it is
lower and will require to be bridged. As will be
seen by a reference to the Longitudinal Section Sheet
No 2. And further up the Sheepmature Channel
under Kattambakam Village it is only 10 feet
higher of the Channel, that would prevent the water
if at this level from flowing away into the Adyar
River.

55. Bund. It is proposed to raise the land to a
height of 9 feet above the proposed Calingulah level.

The top width of the bund will be 9 feet.

56. Read on top of Bund — The bund almost encloses the old and New Bangalore roads and a road over the top of it would be of considerable public convenience; but I am of opinion it would be wrong to saddle the project with the cost of it. I have shown this road in the plans and estimated for it as entered.

57. The trees in the bund have already been removed at a cost of Rupees 3345. There are 6,500 Talpura trees. Spent of 1000 of the best of the trees to Auction and as they realized, but Rupees 112. I thought it better to keep than for firewood.

58. The Cross Sections shown in Sheet 2 will make it clear, how it is proposed to enlarge the bund, already 5,33,000 Cubic Yards of the earth work of the water slope have been executed, which completes the outer slope to a width 2 feet above that of the top of the old bund, then four feet of the additional to the length of the bund at each end have also been completed.

59. Revetment — The proposed Slope of the inner side of the bund is 1 to 1 which is revetted with large roughly squared blocks of granite and laterite stones the former being placed in the lower courses and the latter above, this is cheaper and equally as secure as would be the more expensive project laterite revetment before proposed. The saving effected

by this change will be about a lac of Rupees. About some 12000 Cubic Yards of masonry of the old revetment have been reconstructed and 6500 Cubic Yards of the new masonry reconstructed.

60. New Sluices — A comparison of

Mr. Fraser's Sluice plans with Sheet No 6 to 8 will show how much the present design differs from that sent in by the Executive Engineer. The Sluice shown in the plans is a slight modification of the old Native Step System of openings which, altho it seems a rude way of effecting the purpose for which it is intended, yet the plan has several material advantages in its favor. 1st, simplicity, the almost impossibility of its being put out of order and, 2ndly the fact that it allows the water to escape from the tank without bringing pressure to bear on the Calends or sides of the Sluice. These qualities render it the best form of gate (if I may so call it) where natives are the sole custodians of a tank.

61. I have also designed a light frame work of iron over the plugs for the purpose of securing them from being accidentally knocked out of their places and to serve as an apparatus for lifting them.

62. Of the existing Sluices 11 in number only 3 have been found sound enough to be allowed to stand. These are old Nos 1-3 and 6. Five have been removed and are being reconstructed these are old

Set No 2-4-7-9 and 10. Three No 3-2 and 21
have been closed

63. The New Calingulah It is proposed that
the Escape should be placed in the ridge at the south
side of the Tank where is situated ~~one of the~~ ^{the} low
places that escaped Mr. Prad's Surveyors when
examining the Tank. This spot is about 500 yards
from the extreme South end of the Tank and
2 1/2 feet below the 15 feet contour line and is admi-
nably situated as a site for the Calingulah as it
gazes the valley of the Adyar and old Punnim
Tank towards which the ground slopes very gradually.

64. The Calingulah will be 1000 feet in length
as ordered by the Government of India. ^{Order of the Govt. of India No 162-25th October 1867} I cannot think
it will be necessary to cut any Surplus Channel for
conducting the water from the Calingulah. I have care-
fully gone over and examined the land under the old
Calingulahs and, altho there never was any Surplus
Channel from them. I see nowhere any indications
of erosion or injury done when the Tank is enlarged
there will be less chance of discharge over the Calin-
gulah and the quantity of water will be less on the
rare occasions when it does discharge. I therefore think
we may safely leave the Surplus Channel intact.

65. The length of the Calingulah and its con-
sequent great capacity renders it improbable that
any other outlet will ever be required as even in

the event of such a storm as that which is related
to have occurred on the 24th of October 1818, when
48 millions of Cubic Yards of water are said to
have entered the Tank in 8 hours, were the Tank
full up to the proposed level, as it would take
36 millions of Cubic Yards to raise it the next
3 feet and the Calingulah would have discharged
some 12 millions of Cubic Yards in 8 hours taking
an average of 1 1/2 millions per hour. (with a three
feet head its discharge would be over 2 1/2 millions)
the whole 48 millions would be accounted for.

66. There is however a natural Calingulah
on the extreme South west side of the Tank,
shown at that end of the Longitudinal Section
of the Tank (Sheet No 2) which being nearly
1000 feet in length and from 6 inches to 10 inches
above the proposed Calingulah level can be left
so that when the water rises say 2 feet above
the Crest of the proposed Calingulah it will
flow over here, which it may safely be allowed
to do as the soil is of a hard gravelly nature.

67. I think it will be evident from the
foregoing that the Tank will be safe from the
risk of the water rising to a dangerous height in it.

68. Embankment of 20th Mile of Great Western
Trunk Road No 3.

This

62. The part of the project and has
been since its commencement in the hands of
the Officer in Charge of 28th 3 Range of this
Division who is responsible for the work with
the exception of the masonry bridge over the
Supply Channel which (Channel) it will be
seen by the plan map suits the tank on the
upper or western side of this Sub-division.
The works described above are
shown which composed the project as sent up by
Mr. Fraser. Those about to be the subject of report
are the additional works which I have found to
be necessary to complete this irrigation work
successfully.

71. The proposed New Anicut and Head Sluice on the Caram River

The Anicut and Head Sluice are rendered necessary
by the fact of the Site of the Old Anicut being
situated at too low a level to allow of a Channel
being carried either above or thru the Namur Tank
which is the only way by which the low valley thro
which the Old Supply Channel flows could be avoided,
it will be seen by the red contour line marked with
yellow drawn on the inclos. Map under the Namur
Tank that some 2000 acres of land (which is very
valuable irrigated land with some Napier 300

for ure) and four villages would have been sub-
merged in this valley had the project as designed
by Mr. Fraser been carried out.

72. The Anicut and Head Sluice are
proposed to be placed about 2½ miles above the
old Anicut where the ground is very favorable
for the construction of the Dam and for the
excavation of the Channel to the Chumane Kol the
cutting being light and the distance short.

73. The bed of the Caram being sandy, both
the Anicut and Head Sluice are planned to be
founded on wills. The Anicut has a total length
of 450 feet and is placed in three lines
of wills.

74. There will be two sets of Sand Sluices
of 30 feet opening each, in the body wall of the
dam nearly in line with the face of the Head
Sluices as will be seen by the plans.

75. The Head Sluice which is also a bridge
to carry the Invalore road (Spurs Road No. 13)
over the Supply Channel has 18 Arched openings
of 8 x 5 giving a Section of 720 sq. ft. wall.

76. I have adopted the old masonry plan of
Sluice boards for closing these openings and they
are simple and effective enough.

It

77. It will be perceived that the road will
require to be diverted for some 200 yards to allow
of its passing over the Head Sluice and bridge. The
bridge shown in the first part of the road is diverted
is the Head Sluice of the Goda pānā Channel
which it will not be necessary to interfere with
the passage of a new Head Sluice will then
be saved.

78. The Head Sluice shown at the other
end of the Anicut is that proposed for Tennan
Tank which now receives its supply from an old
Head Sluice half a mile down stream. The
proposed Anicut and Channel would to a great
extent have cut off this supply. The Tennan
Zemindar perceiving this had petitioned Government
for a Channel from the Anicut and the justice
of his demand was allowed. This structure is also
founded on wells with four arched openings
of 5 x 5 feet.

79. It will be evident from the plans
Sheet No 12 how these several works are pro-
posed to be constructed. I will therefore not lengthen
out this report by going into a more detailed
description of them.

Supply

20. Supply Channel from the Anicut
to the Chembembakum Tank

This was originally designed to pass into and
down the Chembembakum Stream from the
junction of the Channel with that Stream until
it entered the Nannu Tank but as this arrange-
ment necessitated raising and strengthening
the banks of this Tank at a considerable cost
the present line was selected as being the least
expensive at the suggestion of the Chief Engineer
for Irrigation. The longitudinal and cross sec-
tions Sheet No 12 show the length and depth of
the cutting required, the latter is necessarily less
as it passes over the dividing ridge between the catch-
ment of the Nannu Tank and that in which is situ-
ated the Chembembakum Tank. Its length
is 41.093 feet and breadth of bed 86 feet
the sides having a slope of $1\frac{1}{2}$ to 1. It has
been sunk along its length to the level proposed
for its bed and the soil found particularly
favourable both as affording facilities for exca-
vation and for standing the attraction of flood
water. This Channel will be capable of discharging
388000 Cubic yards per hour.

21. As the fall is considerable (18 feet per mile) between the summit of the ridge and where the Channel would pass there the water level on the 20th mile of the Great Western Road, where the latter passes over the western end of the South River. The water falls to a height such are proposed to regulate the gradient. The plan for these falls will be found in Sheet No. 2. The plan in Sheet No. 28 are for a dam proposed to be placed across the Chumam River where the Channel leaves it. The design of this dam was suggested by Major Maitland. The plan has been understood and that the idea of it is put out in the drawing.

22. The lower sluices in this dam are intended to collect the ordinary supply to pass down the Channel to the Namun Tank in order that the water may have no cause of complaint. The sills of these lower sluices are at a level 2 $\frac{1}{2}$ feet below that of the head of the Channel. Thus when there is only a small supply in the Chumam and none coming from the Auck all the water will flow into the Namun Tank to which it of right belongs.

23. The upper openings in the dam are for the purpose of shutting off or admitting as the case may be the flood waters of the Chumam.

As in case the Namun Tank happened to be full on the occurrence of a flood the upper and lower gates would be shut and all the water be forced down the Channel which would safely convey any flood to be expected in this stream by the supply from the Auck were shut off at the head Sluice.

24. The head of the Channel it will be seen by the plan in this Sheet is proposed to be protected by a body wall across the stream and by wing walls at each side with 100 feet in length of revetment below the latter.

25. Bund across old Supply Channel. It will be seen by the Longitudinal and Cross Sections of this work on Sheet No. 2. That it is intended that it will fill up the cutting through the ridge which was either a natural fissure or made originally to pass the old Supply Channel thro into the Tank. The four sluices to be built into it (the bund) having openings of 6-6 x 5 will admit the surplus water from Namun fields and the drainage of the valley until the water rises to the height of the present Calingulah Crest. When the silencing gates of which details are shown in Sheet No. 11 will

will close and prevent the return of the water from the Tank as it rises higher; The construction of the Band is so similar to that of the Band round the other portions of the Tank that it need not say any more on the subject. The construction is shown in the Cross Sections.

36. The Drainage Channel from the old Supply Channel to the Manapakum Sluice

When the Sluices in the Band across the old Supply Channel shall be closed this Channel will then be opened to receive the drainage of the Narayan fields and valley, it discharges into one of the largest of the irrigation Channels and will on the occasion of extraordinary floods flow into those others, provision being made for its doing so. It is 20 feet wide at bottom with sides sloped to $1\frac{1}{2}$ feet to 1 and a gradient of 2' per mile. I have had it laid out for more than half its length within 80 yards of the water slope of the Band and thus have been able to use the earth excavated from it for raising and strengthening the Band which has effected a saving of some Rupees 2,000 See Sheet N^o 15.

37. The Aqueducts and Inverted Siphons

of which are shown in Sheet N^o 16. are intended for passing

the water from Irrigation Sluices over or under as the case may be, the drainage Channels. One of the inverted Siphons is intended to pass the water of the Anuvagal Corporation Tank over the Supply Channel.

38. The New Bridge shown in Sheet N^o 19 will carry the communication road from the great Western road to the Tank Band, over this drainage Channel I may mention that this road is finished for a distance of 1 Mile 798 Yards and there remains only this bridge and about 200 Yards of the road near the Tank to complete it.

39. A Quarry Road 1 Mile and 600 Yards in length, providing communication between the old Bangalore road and the Tank Band, has also been completed, so that the Tank is now accessible for Carriages from both the old and new Bangalore Roads there was formerly no means of getting to it except on foot across the paddy fields.

40. The improvement of the Manapakum Supply Channel

One of the principal feeders of the Tank is the whole of its length of 10 1/2 miles a great catch water drain which receives and discharges into the Tank all the water that falls in the ridge above it to the North and

and North West over a surface of about 28 square
Miles and as it also receives the surplus of the
Stuermation and Pillaian River Tanks, the
Channel must when rains are heavy and continu-
ous discharge a large quantity of water into the
Tanks. It will be seen by the Longitudinal and
Cross Sections on Sheet No 24 how it is proposed to
improve this Channel, which only requires the Section
enlarged and deepened in a few places and the
right bank to be raised and strengthened through-
out its length. The ground below the bank is
low and it is essential to the
effectiveness of the dam that it should not be over-
topped by floods and thus breached, which I have
seen an occurrence in past years. There
is a small Culvert that requires raising and strength-
ening and a Sluice that ought to be lengthened plans
of both of which may be seen on the Section Sheet
No 24.

The improvement of the old Bungairi Channel.

is fairly strong which separates the Channel from
the Cottellian river. This Channel is
intercepted by the Capocore Dam, but to prevent
the chance of its being breached by floods an escape
of water has placed in it 427 Yards distant from the

head of the Channel. The crest of this escape
is 2.53 feet above the bed of the Channel, so that
when the water rises above this level it flows back
into the Cottellian, and is of course lost to the tanks
below. This in my opinion is not a wise arrangement.
And I therefore propose (if I am allowed) to raise
the escape 6 feet full supply strengthen the head
between the Cottellian and the Channel, and re-
tify the levels which are very faulty for the
first three miles from the head of the Channel.

42 It will be seen by ~~the plan~~ ^{the} that the
banks in many places require to be raised and
strengthened ~~as will be seen by the Longitudinal~~
and Cross Sections. ^{Sheet No 25.} When taking the levels for
these Sections the Ryots holding land near the
Channel informed me that whenever a fresh comes
down the banks are breached in a number of places
and the water flows to waste to the destruction of
their cultivation.

43. I consider that a portion of the cost of
the improvement of this Channel to the extent
of the project should be charged to the 19 Tanks
that are supplied from it before any water can
reach the Chumbra Bachani Tank.

44. Channels of Communication between the New Sluices
and the Channels of the old Sluices that are to be
up ~~the~~ ^{the} will be excavated and regulating Sluices
placed

placed upon them, one at the head of each Irriga-
tion Channel given in all. Three crossings will
also be necessary for regulating the gradient of the
beds of these Channels. See Sheet No. 26

45. The Masonry Crossings No. 27. And.

intended for passing the water of the drainage
Channel in floods over the Mullaiah land and
Chetty and Akandapattam Strices, in order that
it may have room to expand itself in the larger
Channels of the Centre Strice

46. The following Abstract of the detailed Esti-
mate will show the cost of the works proposed
in the revised project. A comparison of this with
Mr. Fraser's Estimate will show a large additional
amount against the Scheme now submitted. This
is principally owing to the number of additional
expensive works which have been found necessary
to the very existence of the project, but in part also
to the rates having been in the first Estimate
much too low, the Advance of some 10 or 12 per
cent that has taken place in the cost of work in
the last three years, and the quantities of earth
work in the bund of the Tank and of stone
in the periment being much larger in the revised
in Mr. Fraser's Estimate. A comparative state-
ment the difference is afforded.

Dated Simla 5th October
1867. No. 1621.

47. In conclusion I would point out that
although there is now no probability of Mr. Fraser's
high Estimate of profit from the Tank being real-
ized, - Yet if the Estimate Rupees 75,000 here
given of the additional revenue to be derived from
the enlargement of the Tank be correct, the work
will pay 9 per cent which is as much as the
Government of India in the Order as per margin
calculated on its doing.

48. Colonel Anderson says para 21. of his
Report on the Irrigation works of this Presidency
dated the 27th January 1869. "That the
remunerative effect of Irrigation works is not the
only aspect under which they are to be regarded
and that if Government derive an exceptionally
high rate of profit from one System of works,
like those in the deltas, they ought to be prepared
to make a corresponding sacrifice to bring up
works less favourably situated to the highest
standard of efficiency."

49. Every one must allow this to be a
Statesmanlike and fair view of a great question.
It would be difficult to find a work with higher
claims to be exceptionally considered than has
the ^{Chumbacham Sagar} ~~Chumbacham Sagar~~. If even it must be completed

at a sacrifice in a revenue point of view (which I do not think need to the case) still the benefits the great Reservoir will confer on the country to the South and West of Madras are worth some sacrifice.

R. D. Murray

Assistant Engineer

In Charge of N. Y. Range

Chemburam Irrigation Project

17th October 1878

Abstract Estimate of the Chemburam Irrigation Project, 15th Scheme

No. of Items in Estimate	Description of works	Amount of each item	Total
A	Improvement of the Chemburam Irrigation Project	4,73,690	
B	Annual Canal 2. Road Sluices	42,293	
C	Supply Channel to Immamur	8,671	
D	Supply Channel from the River to Chudamkul and thence to Chemburam and South Cross Dam Masonry Falls by ph and sluice and Bridge	139,150	
E	Drainage Channel	20,138	
F	Reformation Supply Channel	7,713	
G	Improvement of the old Bangalore Channel from Karsanuram and thence up to its junction with Coom River	1,57,000	
H	Channels of Communications between New Sluice and Irrigation Channels of old Sluice	28,12	
I	Roads connecting the New and old Bangalore Roads carried over the head of Chemburam and South Cross	22,812	
J	Alteration of the 20 Mile of Irrigation Road	1,3,117	

Grand total 8,03,919

No. of Items in Estimate	Description of work	Amount of each work Rupees	Total Rupees
	Brought Forward	803929	
K	Add Sundries about 5 per cent	40646	
L	Compensation Chembrumbank and Sank for lands paid for the supply of 58,000	58,000	
M	Proposed Savings to be deducted from the Estimate viz.	63,000	
	I. Portion of Cost of repairs to old Bengurroo Channel including Sundry Charges	6,000	
	II. Branch Road and Road connecting the old & new Bengaloor Road with Sundry Charges	18,573	
	III. By Re-sale of Lands to be sold submerged in the Sank for which Compensation is charged	45,000	
		69573	858,000

Total Estimate Rupees 8,58,000

Witness on Behalf of
Supt. Engr. Lt. Col. R. L. S. S. S.

By Range Officer
17th Dec. 1870
In Charge (By Range
Chembrumbank Project)

125

PH 805/71
Prong March 11
in 232.

180
For L.O.E. Is informa
tion -

The portfolio of
plans connected
with the Chem Brn
bunker tank 6 ft
project was recd
with the Supg Sup
letter no 3113-27-23
Nov. 70 printed with
G.O. no 705 27-9
Dec. 71

The head assistant in the
Works Office is requested to
transfer the plans for
the 15 feet Project to the
Chief Engineer for Inspection
to be lodged in the Inspection Office -
Branch -

The plans connec
ted with the 15
foot project are
now in the Works

RM
4/2/78

D.M.H.
2-8-78

15 P. W. D.

RECEIPT.

RECEIVED from the Public Works Library the undermentioned Books:—

Madras. Distr. No. 40 A.

1. Book of Plans of 15 feet Project for the enlargement of the Chamberbakkam Tank—
(Sanctioned in L.O. No. 705 of 9th March 1871.)

Received. Shuts Nos 2-3-4-5-6-7-8-9-10-11-12-13-14-15
16-17-18-19-20-21-22-23-24-25-26-27-28-29

FORT SAINT GEORGE,
5. 2. 1878.

Total Shuts. 26.

17/2/78
P. Krishnaswami Mudaliar
Draftsman
Department

Handed over
with receipt
Green

Librarian
made over the
plan

MEMORANDUM.

REQUESTED for reference the under-mentioned papers

*Shingles connected with
the ¹⁸⁷⁵ ~~the~~ project of the
Chenabankam Bank.*

OFFICE OF THE CHIEF
ENGR. FOR IRRIGATION,
P. W. Department,

10-2 187*6*

To

The Registrar of the

D. M. Hamilton

Head Clerk.

M. W. Sealant

MEMORANDUM.

REQUESTED for reference the under-mentioned papers

Plans in connection with the
Chembumbankam Cante
Project

OFFICE OF THE CHIEF
ENGR. FOR IRRIGATION,
P. W. Department,
17 Sep 1873

To The Registrar of the

B. N. Hamilton

Head Clerk.

omlet

The following plans taken from
this portfolio sent to Col
Mullins on 8 Oct. 1873

Chembumbankam Tank
Propet

Plan no 10 & 11. Cross sections & longi-
tudinal section of the
New Bengaia -
do. no. 8/10/73. Bent twice of the
D. M. H.

MEMORANDUM.

REQUESTED for reference the under-mentioned papers.

*6-fth scheme for enlarging
the Chumbur bawtan
Tank with papers which
accompanied it from the
Supt. Engr.*

OFFICE OF THE CHIEF
ENGR. FOR IRRIGATION,
P. W. Department,

To

The Registrar of the

Head Clerk.

*Put off to 7-10-12
returned on 12
Aug 73 D. H.*

71

The specification of the 8 feet pin-
ket Chem brass lampwork tank.
Given to Capt. Hunter by Capt-
baker, the report to very high.
see remarks in note No 99.
" June / 72 - to Capt Hunter
15 July 1872

P. O. Dept
No. 705. 751

Proceedings of the Madras Government
Under date the 9th February 1870

Read the following

Chief Engineer
for Irrigation

S. E. No. 246 of 30. Nov. 1870

The papers submitted
by the Chief Engineer for
Irrigation for the conside-
ration of Govt. relate to the
revised estimates for the
enlargement of the Chem-
bramburam Tank.
The history of the project
is given briefly in paras
2 to 6 of the Chief Engineer's
note, and shows the cir-
cumstances which pre-
vented the work, as
originally sanctioned,
from being carried out,
as also those which led
to

to the preparation of estimates for a tank on a reduced scale. The Government have now to decide as to whether it will be advisable to make the capacity of the tank as large as was intended by Mr. Fraser, or to limit the enlargement to an additional depth of 6 feet.

2. In para 8 of the Chief Engineer's note it is shown that, after making allowance for certain deductions,

Mr. Fraser's estimate for increasing the depth by 15 feet (Tank only) was
 Mr. Lowry's do including supply channel &c.

6 feet project do
 The amount for the last mentioned scheme has been further

Rs 3,35,820

8,60,488

4,33,141

para 9 of note
 Rupees 11,11,41

further reduced, as explained in the supplemental note to Rs 4,14,000, and more. Over a part of this sum is due to expenditure already incurred, which would not have been necessary had this smaller project been carried out in the first instance.

3. The Chief Engineer is of opinion for the reasons detailed in his note, that the water supply is altogether insufficient for the larger project and he moreover thinks that the data available indicate that the smaller tank would not fill on the average more than 9 years out of 21. The larger reservoir

reservoir would if regularly
filled have sufficed for the
irrigation of 21,875 Canals
or 27,166 acres: the smaller
tank would hold 102.911
millions, but on the average
it is supposed that it
would receive only 88.56
millions of cubic yards or
enough for 13,120 acres. The
average cultivation of past
years has not as yet been
accurately ascertained, but
it would appear to have
been about 7,500 acres and,
if so, 5620 acres would
be the additional area
on which a return for the
outlay on the minor
project would be obtain-
able. The available data
do not admit of the
assessment

* 176.874 millions cubic yds
at 6760 cubic yards per acre
or 7,000 Canals

(*) note para 11

assessment being reliably
determined, but it is
observed that an average
of Rs 5 an acre would
yield a gross revenue
of Rs 28,100 or 6.8 per
cent on the reduced
amount, Rs 4,14,000, of
the estimate. The net
return, after allowing
Rs 5620, in addition
to the previous cost of
annual repairs, would,
consequently, probably
not exceed 5.4 per cent.
After a careful con-
sideration of the papers
connected with the project
His Excellency the Governor
in Council is of opinion
that notwithstanding
the loss of expenditure
already

already incurred, which
the adoption of the reduced
scheme will involve
the chances of the water
supply for the larger project
proving adequate are so
indifferent, that it would
not be wise to incur the
large outlay that, it has
been shown, would be
necessary ^{for its execution} and the Govt.
therefore resolve to approve
of the 6 feet project being
carried to completion.

5. The Chief Engineer
in para 10 of his note
has pointed out what
revenue information is
required in order to
calculate the results
which may be expected
from the enlargement
of

of the Tank, and these
Proceedings will therefore
be communicated to the
Revenue Department
with a view to these
particulars being obtained
as early as possible.
With regard to the rate of
assessment it will be
noticed that, were the
old rates re-established
in consideration of the
large expenditure, which
has been, or is about to
be, incurred in the
improvement of the water
supply to the lands under
the tank, the outlay
would yield a return
which would probably
suffice to allow of the
project being executed
from

from Loan Funds, and
 as it is very desirable
 that the cost should not
 have to be met from the
 limited ordinary grant
 at the disposal of Govt.,
 special consideration
 should be given to the
 determination of a fair
 assessment.

21/2/71

[Signature]

X 6 feet Project Cost
 and the P. & L. and Profit
 returned to the Clerk
 for Engraving and
 etc.

The Superintending Engineer
 Controller P. & L. and Profit
 Chief Engr. for Engr.
 Rev. Secy.
 Resd. 11/3/71

625 Feb 1/71 R. S. D. H. M. S.