Report of the Ad-hoc Committee in Connection with the Investigations of the River-Valley Projects

GOVERNMENT OF INDIA
MINISTRY OF WORKS, MINES AND POWER

REPORT OF THE AD-HOC COMMITTEE

CONTENTS

	Pages
(1) THE REPORT	1 to 8
(2) APPENDIX I (Terms of Reference)	10
(3) Important Data in respect of various Projects	11
(4) APPENDIX II (Kosi Project)	12 to 22
(5) APPENDIX III (Ministry's Note, dated the 4th March 1948)	23
(6) APPENDIX IV (Narbada Valley Projects)	24 to 42
(7) APPENDIX V (Tapti Valley Projects)	43 to 57
(8) APPENDIX VI (Sabarmati Project)	58 to 75
(9) APPENDIX VII (C. P., and Bastar Projects)	76 to 85
(10) APPENDIX VIII (Assam Projects)	86 to 96
(11) APPENDIX IX (Coorg Projects)	97 to 104
Index maps, etc. (Total 10)	In the pocket at the end

REPORT OF THE AD-HOC COMMITTEE, APPOINTED BY THE GOVERNMENT OF INDIA IN THE MINISTRY OF WORKS, MINES AND POWER, IN CONNECTION WITH THE INVESTIGATIONS OF THE RIVER-VALLEY PROJECTS, PREPARED BY THE CENTRAL WATERPOWER, IRRIGATION, AND NAVIGATION COMMISSION.

" We, the members of the Ad-hoc Committee met on 11th May 1948, and again on 18th May 1948, to examine the projects and estimates prepared by CWINC in connection with the Kosi , Narbada, Tapti, Sabarmati, C. P. and Berar rivers, Bastar State rivers, Assam Valley, and Coorg, in accordance with the terms of reference at Appendix I, *page 9*.

Messrs. Man Singh, *Member*, M. D. Mithal, *Director*, and G. N. Pandit and K. M. Bhatia, *Project Officers*, presented the proposals and explained the various features of the proposed developments.

They recast the relevant estimates in the light of some modification proposed during the first day's meeting.

Item I of the Terms of Reference

I. What would you consider to be reasonable cost of investigations of a project in relation to the overall capital cost of that project ?

As to the reasonable ratio which the cost of investigations of a project should bear to the overall cost of the project, in our opinion, no hard and fast figure can be laid down. Generally speaking, the cost of preliminary investigations will not be less than one per cent of the overall capital cost. It may go up as high as five per cent depending on the nature and features of the project.

1. KOSI PROJECT

(APPENDIX II)

Items II to VI of the Terms of Reference

II. Are the proposals in respect of each one of the above projects, as put forward by CWINC, in order ?

III. Is the cost of investigations, provided in the above proposals, justified ?

IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimates for the purpose, adequate ?

V. Is it possible, by a re-arrangement of programme, or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of the projects ?

The proposals in respect of investigations of the Kosi project, as put forward by CWINC, are in order.

The provision of Rs. 65 lakhs for investigations while adequate for the period in question appears to be on the low side for the completion of investigations. It will be more like one crore of rupees. The Kosi Dam, when constructed, will be the highest in the world—130′ higher than the present highest dam, the Boulder Dam on the Colorado river in U. S. A. which is 726′ above rock bottom. The dam site is situated in a highly seismic zone. The exploratory work and invesgitations at the site must therefore be very thoroughly done.

The proposed strength of engineering staff is adequate, for the present, but will have to be substantially increased if the recommendations under item *VI* are accepted.

The actual work of investigations at site was inspected by Dr. J. L. Savage and Mr. A. N. Khosla and is on sound lines. With more mechanisation in exploratory work and the operation of diamond drills—now that the Drill Foreman has joined—the work will be considerably accelerated.

Item VI. In respect of the Kosi Project in particular, what are your views as to :

(*a*) *the desirability of obtaining from Disposals construction machinery to the extent of nearly 40 lakhs in anticipation of the construction of barrage canals and dam ; the expenditure to be treated as suspense in the first instance and charged to the project when the latter receives sanction ; this course was followed in connection with the Hirakud Dam Project, and*

(*b*) *the desirability of*

(*i*) *undertaking the construction of a meter-gauge railway line to the barrage and dam site (length nearly 40 miles), and*

(*ii*) *undertaking the construction of the barrage and canal systems in advance of the construction of the dam.*

In view of the recurring havoc caused by the vagaries and floods of the Kosi, and the need for growing more food for the country, the construction of this project is an urgent and vital necessity. This project with a potential development of 2 million k. W. of power and 3 to 4 million acres of annual irrigation, offers immense scope of development in the industrial and agricultural fields. Therefore, any measures that are calculated to accelerate the work of investigations and, later, construction of this project, deserve to have the full support of the Government.

We fully endorse the proposals under (*a*), and (*b*) (*i*) and (*b*) (*ii*).

The exploratory work on the dam will take some time as also the trial load analysis which, it is hoped, the U. S. Bureau of Reclamation will undertake to do. In the meantime machinery and staff can be assembled and trained on the construction of the Barrage and Canal systems and kept ready for the bigger construction programme for the dam. In this way large areas of land will be brought under irrigation in advance of the completion of the dam and the country prepared to receive the full benefits from the dam 3 to 4 years in advance, thus bridging the gap between completion of the project and development of its potential.

2. NARBADA VALLEY PROJECTS

(APPENDIX IV)

Items II to V of the Terms of Reference

II. Are the proposals in respect of each one of the above projects, as put forward by CWINC, in order ?

III. Is the cost of investigations, provided in the above proposals, justified ?

IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimates for the purpose adequate ?

V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects

The Narbada basin appears to hold great potential of development, and such development is likely to have far-reaching effect on the economic advancement of the country in general, and the basin in particular. It appears feasible to bring under irrigation 37,00,000 acres of cultivated and cultivable land in the basin, generate continuous power of over a million K. W., and extend navigation from the river's outfall in the sea right up to and beyond Hoshangabad *i.e.*, almost to the heart of the country. The principal works involved would be construction of about eight storage reservoirs, a number of barrages and three systems of canals and some navigation locks. An overall estimate for investigation of the total plan has been prepared and amounts to Rs. 95,91,144. Estimates, prepared on the basis of expenditure from year to year, which were submitted to Government for sanction, were also placed before us. The amounts were Rs. 1,70,740 for 1947-48 and Rs. 25,91,000 for 1948-49. These have been examined by us in detail and appear to be in order.

In this connection Mr. Man Singh pointed out that the cost of topographical survey, provided in the estimates, could be brought down considerably if the contour-survey of the commanded-areas by the Survey of India Department could be reduced to just what was essential to enable the CWINC staff to pick up the channel alignments roughly, and thereafter do the detailed work themselves. This, he said, would have the added advantages, first, of reducing the work of the Survey of India, who had already too heavy a programme for the staff they have, and secondly train up the CWINC staff for such work. He said, he had tried this in Bengal and the resulting work was quite accurate. Mr. Pandit said, he was working on this basis in the Tapti basin and calculated that the overall cost would be reduced to half. This, in our opinion, is a good suggestion and should be adopted wherever possible. Taking the resulting economy into acccount the total cost of investigations will come down to about Rs. 74 lakhs.

At this stage we were also apprised of the views of the Secretary, W. M. P., and the reactions of the Chairman, CWINC, regarding cutting short the programme of work on account of present day shortages of men and materials. The notes on the subject are appended to this report (Appendix III). We entirely agree with this view and suggest that it will be desirable to restrict the work in the first 2-3 years to only such projects as will give the maximum results in the shortest possible time. Judged from this criterion, we recommend that invsetigations be concentrated on the following :—

Bargi Project. The project envisages construction of 3 dams and a system of canals to command 18,000,000 acres. It is calculated that in addition it would be

possible to generate 80,000 k. W. of firm power. As most of the water will be used up for irrigation it might not be possible to make the navigationa l feature very attractive.

Taiwa Project. This envisages construction of a dam on the tributary Tawa just above its outfall into the Narbada a few miles above Hoshangabad. A dam of 170 feet height will intercept the entire run-off from a catchment of 2,340 square miles. An area of 11,00,000 acres would be commanded from the reservoir itself for irrigation. The power potential is likely to be 12,700 k. W. continuous.

Punasa Project. A dam of 237 feet height will intercept almost the entire residual run-off of the main river at this site. It is proposed to reserve a portion of the capacity for controlling the floods which occur frequently in the Broach district of Gujrat in Bombay Province. Taking this into account, the power potential of this project would be in the neighbourhood of 2,33,000 k. W. continuous. The lake would be navigable right up to its upper end, very near Hoshangabad.

Barrage and canal system for the Broach District. With the regulated supplies available from the Punasa Project it would be possible to command the entire cultivated area of Broach district, measuring about 8,00,000 acres for perennial irrigation.

In addition to concentrated investigations on these projects we also recommend that the cost of collection of such essential data as discharge and silt observations at various important stations, meteorological, mineral, navigational and economic surveys and special tools and plant required should be provided for in the estimate for investigation of the projects on a basin-wide basis.

At our request fresh detailed estimates have been prepared to cover these investigations and these amount to Rs. 64,97,000. The cost will be spread over a period of three years, Rs. 26,97,000 in the first, Rs. 19,00,000 in the second and Rs. 19,00,000 in the third year.

The strength of engineering staff provided is adequate for the purpose in view.

While examining this project it was brought to our notice that there is a proposal to utilize the land to be commanded for irrigation by the Bargi and Tawa projects for resettling and rehabilitating refugees from Sind and Western Punjab. If, on this account, therefore, the investigations have to be speeded up, and construction has to be launched upon simultaneously, the staff for these two rojects will have to be considerably strengthened to suit the pace at which progress would be demanded.

3. TAPTI VALLEY PROJECTS

(APPENDIX V)

Items II to V of the Terms of Reference

II. Are proposals in respect of each one of the above projects, as put forward by CWINC, in order ?

III. Is the cost of investigations provided in the above proposals justified ?

IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff provided in the estimates for the purpose, adequate ?

V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects ?

Examination of the proposals reveal that potential of development in this basin is also fairly great, although it is not likely to be as attractive as in the case of the Narbada basin. The plan envisages construction of six dams and three barrages together with their canal systems. Of these the developments on Girna river are being investigated and undertaken by the Government of Bombay. The estimated cost for investigations of the rest of the project amounts to Rs. 42,25,034. The yearly estimates for the years 1947-48 and 1948-49, amounting to Rs. 2,60,540 and Rs. 20,56,000 respectively, were also placed before us. The provisions are in order. But the cost of surveys should be reduced by the CWINC doing most of the work, leaving only the essential part to be done by the Survey of India.

In this case also, we suggest that attention for the present be concentrated on the lowermost dam at Ukai and the Kakrapara barrage and canal system and only silt observations, and meteorological, mineral, navigation and economic surveys be carried out for the rest of the basin, for the present. At our request an estimate to cover this limited objective has been prepared and amounts to Rs. 19,95,500. This cost will be spread over a period of two years, *i.e.*, Rs. 12,00,000 in the first year, and Rs. 7,95,500 in the second year. The provisions and the strength of the engineering staff for the purpose are adequate.

4. SABARMATI PROJECT

(APPENDIX VI)

Items II to V of the Terms of Reference

II. Are the proposals in respect of each one of the above project, as put forward by CWINC, in order ?

III. Is the cost of investigations provided in the above proposals justified ?

IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimates for the purpose, adequate ?

V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects ?

This river passes by the industrial town of Ahmedabad where, we are informed the domestic water supply problem is acute. Authorities interested in the development of the basin are Bombay Province including Ahmedabad Municipality, Baroda State, Idar State and some States of Mahikantha, Sabar Kantha Agencies. Part of the catchment area lies in Udaipur State of the Rajputana Union. Projects for irrigation and improvement of domestic water supplies have been prepared by various agencies from time to time. But owing to disagreement regarding water-rights and other matters nothing has matured so far. Recently, we are informed, in a conference of representatives of various interests held at Bombay, it was decided to entrust the development of the basin on a unified basis to the CWINC in the hope that better progress will be made in finalising and then executing the projects. Some engineering staff was offered to be provided by governments of Bombay and Baroda for manning the organisation to be set up for the investigations. Accordingly, an estimate for preliminary investigations amounting to Rs. 15,10,000 was prepared. This and the

year to year estimates of Rs. 28,000 for the year 1947-48 and Rs. 5,20,000 for the year 1948-49 have been examined by us. No contour-levels are available in this basin. Maps of hilly portion merely show the form lines. It has, therefore, not been possible to indicate precisely the development that might be possible. Some preliminary investigations were done, in connection with a dam project at Dharoi. The result of the survey indicates roughly that the project would ensure irrigation for 1,00,000 acres and put the water supply position of Ahmedabad town on a surer footing. We recommend that, in the first instance, activities might be restricted to this one project only in this basin. At our request the estimate has been recast to provide for the necessary investigations of this project. It amounts to Rs. 7,87,000 and expenditure will be spread over two years, in the first year being Rs. 4,34,000 and in the second year Rs. 3,53,000. The provisions are reasonable and the staff provided is adequate.

In this, as in the case of Narbada and Tapti, discharge and silt observations, meteorological observations etc., will be taken up on basin-wide scale and provision has been made in the recast estimate.

5. C. P. & 6. BASTAR PROJECTS

(APPENDIX VII)

Items II to V of the Terms of Reference

II. Are the proposals in respect of each one of the above projects, as put forward by CWINC, in order ?

III. Is the cost of investigations, provided in the above proposals justified ?

IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimates for the purpose, adequate ?

V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects ?

5. (C.P.)

Besides Narbada and Tapti basins, it is also proposed to undertake investigations for development in the mid-Godavari and upper Mahanadi basins. The projects in the mid-Godavari basin were principally on the Wainganga and Wardha tributaries of the Godavari. In view of the fact that a very big project is being undertaken by the C. P. engineers on the lower Wainganga we consider it desirable for the present for the CWINC to concentrate on the upper Mahanadi basin only. There are four projects, three on the tributaries and one on the main river which appear to be very promising and will result in assuring irrigation for 6,50,000 acres of land and enable 23,000 k.Ws. of continuous power being generated. The regulated supplies from these projects will also increase the power potential of the Hirakud and other lower projects on lower Mahanadi. The work of investigations could be taken up by one Division.

At our request the estimate for investigations has been recast and now amounts to Rs. 27,04,500 for the Mahanadi basin in place of Rs. 47,44,000 for the Mahanadi and Godavari basins. In the recast estimate costs of surveys by Survey of India have been reduced as in other cases. Other provisions are reasonable and the staff provided adequate.

As in the case of other valley investigations, the silt mineral, meteorological and other general investigations will be carried out over the whole basin.

6. (BASTAR)

The area of what until recently was known as Bastar State is very sparsely populated. Cultivation is done on a very restricted scale and mineral resources, which are very great have not at all been explored or exploited. A good part of the state is on a plateau at an elevation of over 2,000 ft. above mean sea level. The rainfall is good and the climate exhilarating.

On these accounts it is not unlikely that the territory might be utilized for resettling and rehabilitating refugees from Western Pakistan. This, we find, can be achieved without disturbing or encroaching upon the areas occupied by the tribal population.

The principal river of the state, Indravati, has great potential for Power development which is absolutely necessary for the rich iron ores aggregating to over 1,000 million tons, containing 63 per cent to 70 per cent pure iron to be utilised for manufacture of steel etc. Some good sites have been located where development will be very attractive. The power potential of these projects will be in the neighbourhood of 3,00,000 k.Ws. continuous.

On the Sabri river one project has been located which would enable bringing under irrigation 6,90,000 acres of land, and produce 14,000 k.Ws. of continuous power.

We agree that all these projects should be investigated on a priority basis and the proposal to set up one Division for the purpose has our approval. The estimate amounts to Rs. 27,04,000 and the expenditure would be spread over 3 years. The provisions made in the estimate are reasonable and the staff proposed adequate.

One Superintending Engineer would be necessary to control the two Divisions in this region, *i.e.*, one in the Upper Mahanadi and the other in Bastar State. The estimates provide for the entertainment of a Superintending Engineer and his office staff.

Total expenditure on investigations in C. P. and Bastar rivers will thus be Rs. 54,09,000 spread over three years. The yearly expenditure will be Rs. 16,00,000 in the first year, Rs. 20,00,000 in the second year and Rs. 18,09,000 in the third year. They are in order and compare favourably with the estimates for the years 1947-48 and 1948-49 amounting to Rs. 16·52 lakhs (Provision was for 13 months only).

7. ASSAM PROJECTS

(APPENDIX VIII)

Items II to V of the Terms of Reference

II. Are the proposals in respect of each one of the above projects, as put forward by CWINC, in order ?

III. Is the cost of investigations provided in the above proposals justified ?

IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimates for the purpose, adequate ?

V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects ?

The territory, with its magnificent rivers and the narrow gorges in the Himalayan ranges through which they flow, offers an almost unlimited scope for power development. CWINC, in consultation with the Government of Assam, have selected for the present four projects for preliminary investigations. An estimate amounting to Rs. 50,00,000 to cover the cost and programmes of expenditure for the years 1947-48 and 1948-49 amounting respectively to Rs. 2,67,000 and Rs. 20,41,000 have been examined by us and are, in our opinion, reasonable. But, for considerations similar to those which have led us to recommend curtailment of activities in other basins, we suggest that only two out of the four projects should be taken up for investigation at present. These, in our opinion, should be Manas and Dihang. The priorities allotted to the projects should be changed to give Manas the higher, as it is close to the rest of India and not too far from the industrial area of Assam. This project has a bigger irrigation potential as well. Besides, the channel below is likely to provide a link for the navigation canal which is being thought of from the Teesta barrage to the Brahmaputra. The Dihang will be No. 2 priority, but taken up simultaneously for investigation.

In addition to discharge and silt observations, meteorological, mineral and economic surveys, and surveys for navigation should be planned for the entire area. A recast estimate to cover our recommendation has been prepared and now amounts to Rs. 30,73,700 spread over two years. Expenditure will be Rs. 14,00,000 in the first and Rs. 16,73,700 in the second year. The provisions are reasonable and staff provided adequate, one of the three divisions previously provided having been curtailed.

8. COORG PROJECTS

(APPENDIX IX)

Items II to V of the Terms of Reference

II. Are the proposals in respect of each one of the above projects, as put forward by CWINC, in order ?

III. Is the cost of investigations provided in the above proposals justified ?

IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimates for the purpose, adequate ?

V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects ?

The estimate to investigate the projects in Coorg *viz.* Herangi Irrigation and Power Project, the Baropole Hydel Project, the Lakshamantirtha Irrigation Project and the projects for renovation of irrigation tanks, amounting to Rs. 6,64,740 and one for the year 1948-49 amounting to Rs. 2,24,000 have been examined. We suggest that work of investigations on renovation of tanks be omitted and the proposals should be amended to provide for only two S. D. Os. and the adequate number of subordinates and clerical staff instead of one Executive Engineer and three S. D. Os. The work of investigations could be completed in about two years. The estimate has accordingly

been amended and now amounts to Rs. 4,52,000 and the expenditure for the year 1948-49 and 1949-50 will be respectively Rs. 2,20,000 and Rs. 2,32,000. The provisions are reasonable and the expenditure will be justified. The staff provided is adequate.

GENERAL

Before concluding we would like to bring to the notice of the Government that some special allowance should be given to officers and men on field duties in connection with investigation and construction of such projects as the localities where they have to work are generally unhealthy, communications are difficult and the work arduous. Unless an incentive in the shape of such allowance is given people would generally prefer to be on less arduous jobs elsewhere. This particular point was not amongst our terms of reference but we feel it would not be fair not to bring this aspect to the notice of Government, as it is only contented staff that could be relied upon to do the work efficiently and economically specially in these days of shortages.

The original estimates placed before us are appended as also the estimates now prepared which are approved by us."

(Sd.) A. N. KHOSLA

(Sd.) J. L. SAVAGE

(Sd.) M. NARASIMHAIYA

DATED NEW DELHI ;
the 18th May 1948.

APPENDIX I

Terms of Reference of the *Ad-hoc* Committee, appointed by the Government of India in the Ministry of Works, Mines and Power in connection with the investigations of the River-valley projects, sponsored by the C. W. I. N. C.

"The projects concerned are :—

1. Kosi,
2. Narbada,
3. Tapti,
4. Sabarmati,
5. Central Provinces and
6. Bastar rivers,
7. Assam Valley, and
8. Coorg.

Item I.—What would you consider to be a reasonable cost of investigations of a project in relation to the overall capital cost of that project ?

Item II.—Are the proposals in respect of each one of the above projects, as put forward by C.W.I.N.C. in order ?

Item III.—Is the cost of investigations provided in the above proposals justified ?

Item IV.—Keeping in mind the proposed progcamme and priorities of investigations, is the proposed strength of engineering staff provided in the estimates for the purpose adequate ?

Item V.—Is it possible, by a re-arragnement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects ?

Item VI.—In respect of the Kosi Project, in particular, what are your views ?
as to

(*a*) the desirability of obtaining from Disposals construction machinery to the extent of nearly Rs. 40 lachs in anticipation of the construction of barrage, canals and dams ; the expenditure to be treated as suspense in the first instance and charged to the project when the latter receives sanction : this course was followed in connection with the Hirakud Dam Project ; and

(*b*) the desirability of

(*i*) undertaking the construction of a meter gauge railway line to the barrage and dam sites (length nearly 40 miles), and

(*ii*) undertaking the construction of the barrage and canal systems in advance of the construction of the dam."

IMPORTANT DATA IN RESPECT OF VARIOUS PROJECTS

No.	Name of Project	Amount of original estimate by years in lakh of rupees			Overall cost of investigations for the whole Basin in lakh of rupees	Total cost of priority items approved by the *Ad-hoc* Committee	Allotment required from year to year			POTENTIAL DEVELOPMENT Whole Basin						Priority Projects				
											Irrigation in million acres					Irrigation in million acres		Continuous Power in k. W.	Navigation	Remarks
		1st	2nd	3rd			1948-49	1949-50	1950-51	Flood control	Gross commanded area	Irrigable area	Continuous Power in k.W.	Navigation	Flood control	Gross commanded area	Irrigable area			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	Kosi	16·44	15·00	..	One crore (approx).	One crore	18·82	14·00	14·00*	Would reduce 7 lakhs flood to 2½ lakh flood.	7·0	4·20	1·2 Million	Garuea junction to 50 miles above Barakshetra in Nepal.	..	Same as whole Basin				Barrage and canals may be constructed in advance of the dam.
2	Narbada Valley	1·71	25·91	..	95·91	64·97	26·97	19·00	19·00	Complete	3·7	2·22	Over one million k.Ws.	Sea to Dharamkund 400 miles	Complete	3·7	2·22	1,16,000	Sea to Dharamkund 400 miles.	
3	Tapti Valley	2·605	20·56	..	42·25	10·955	12·0	7·355	..	Complete	1·23	0·774	66,000	Kakrapar to Surat 40 miles	Complete	0·7	0·42	46,000	Kakrapar to Surat 40 miles.	
4	Sabarmati	0·28	5·20	..	15·10	7·87	4·84	3·53	..	Complete	0·2	0·12	Not calculated	Gulf of Cambay to Junction of Hathmati	Partial	0·1	0·04	..	Gulf of Cambay to junction of Hathmati.	Reserving 100 cusecs for Ahmedabad water supply.
5 & 6	C. P. & Berar Bastar	2·28	14·29	..	71·17	52·08	16·00	20·90	18·60	No problem	2·1	1·26	5,19,000	Penganga will open up to navigation through Godavari	Complete	1·35	0·81	1,62,000 with possibility of 8 lakhs by raising Dhoral Patnam Dam.		Investigation on Upper Godavari basin have been omitted.
7	Assam Valley	2·67	20·41	..	50·00	30·737	14·00	16·737	..	Partial exact extent cannot be worked out	2·6	1·56	16,97,000	Tezpur & Dibrugarh Manas will be Navigable for considerable distances in land	Partial	Not calculated	Not calculated	12·4 lakhs.	Manas and Dibang will be navigable for considerable distances up stream of the sites on them	Manas and Dibang to be investigated. Barak & Sonesbwari to be omitted for the dam for the present.
8	Coorg	2·24	..	..	6·6474	4·52	2·20	2·32	..	No problem	0·12	0·72	49,500	Nil	No problem	0·01	0·005	49,500	Nil	Renovation of Irrigation and pisciculture tanks omitted.

* While other investigations are expected to finish by 1950 thus enabling construction to be taken in hand before that year, survey work in the Kosi flood plain for irrigation and drainage work will continue for a number of years and the construction of canals and distributaries will progress as survey proceeds.

APPENDIX II

KOSI PROJECT

REPORT

At their meeting held on the 29th July 1946, the Standing Finance Committee agreed to an expenditure of Rs. 31·44 lakhs on the preliminary surveys and investigations for the Kosi Project during the year 1946-47 and 1947-48. This sanction was communicated in W. M. P. letter No. D. W. 1201 (1), dated, the 27th May 1946.

2. The previous estimate had been framed with a view to ascertain the feasibility of the scheme. Investigations so far carried out have now shown that the scheme is definitely feasible and therefore investigations have now to be carried out in greater detail. Owing to difficult situation of the site and the enormity of the magnitude of the work, the detailed investigations will have to extend beyond 1950 but they shall have progressed sufficiently by March 1950 to enable construction to be taken in hand. This estimate amounting to Rs. 65,26,000 has therefore been prepared to cover the period ending March 1950 and includes the amount of Rs. 31,44,000 already sanctioned. For completing the investigations the cost will be of the order of rupees one crore.

3. The present estimate covers the cost of investigations for the dam (excluding the cos of trial load analysis to be carried out in America, the cost for which will be included in the supplementary estimate for overall invetstigations) and the investigations for the barrage site and surveys for a portion of the area to be irrigated to the east of the Kosi. The survey work, owing to its magnitude, will take a number of years to complete. The construction of the barrage can however be taken in hand without waiting for the completion of surveys for the irrigation area and the construction of irrigation system can proceed as surveys progress. For the present, it is proposed to concentrate on the surveys and investigations of the canal system to the east of the Kosi. The cost of the remaining surveys will be included in the supplementary estimate for the overall investigations.

4. Credit has been allowed in the estimate for the recovery value of T.& P. as also of buildings most of which have been provided in pre-fabricated structures.

(Index map showing dam site, etc. is enclosed)

BALWANT SINGH NAG,
Project Officer (Kosi).

KOSI PROJECT

Estimate for preliminary surveys and investigations for the Kosi Project for the period, ending March 1950.

Abstract

		Rs.
1.	Surveys by Survey of India	22,70,000
2.	Surveys under C. W. I. & N. C.	37,500
3.	Discharge Observations	80,500
4.	Silt Observations	18,000
5.	Property Surveys	21,400
6.	Ground Water Surveys	Nil
7.	Meteorological Surveys	2,93,900
8.	Seismological Surveys	1,14,000
9.	Geological Investigations	12,03,750
10.	Roads and Paths	1,67,000
11.	Aerial Ropeways	48,000
12.	Soil conservation survey for controlling silting of Dam	80,000
13.	Agricultural and Soil surveys for Irrigation	60,000
14.	Survey of Fish Fauna	5,000
15.	Industrial and Load Surveys	5,000
16.	Wooden Models	10,000
17.	Temporary accommodation	2,70,000
18.	Camp equipage	96,000
19.	Tools and Plants new supply	2,33,900
20.	Repairs and carriage to T. & P.	60,000
21.	Laboratory at Barakeshtra	15,000
	Total	50,88,350
	Say	50,88,400
22.	Contingencies on Rs. 50,88,400 at 5 per cent	2,54,400
23.	Establishment (Salary, T. A. and contingencies)	11,83,000
	Grand Total	65,25,800
	Say	65,26,000

BALWANT SINGH NAG,
Project Officer (Kosi).

Estimate of preliminary surveys and investigations for the period, ending March 1960.

Serial No.	Item	Estimated cost	Total
1	2	3	4
		Rs.	Rs.
1	*Surveys to be carried out by Survey of India under guidance of the C. W. I. N.C.*—		
	(*a*) For dam Site		
	Comprising aerial-photography of the gorge and the reservoir area, survey and map publication of the dam site to scales still of		
	(*i*) 1 = 1000		
	(*ii*) 32" = 1 mile		
	Survey and map publication of the reservoir area and the Chatra gorge to a scale of 4" = 1 mile with 20' contour interval and 1" or near scale survey of Dudh Kosi reservoir site (in detail)	2,50,000	
	(*b*) For irrigation and drainage area to a scale of 4" = 1 mile East of Kosi including the river (part area only) 25,00,000 acres, at Re. 1 per acre .	20,00,000	
	(*c*) Cost of various photo-mosaics, and projects maps for detailed [illegible] and publication of map plates and expenditure for the "[illegible]" .	20,000	22,70,000
2	*Surveys to be carried out by or under the Direction of the C. W. & P. Commission.*—		
	(*a*) Longitudinal section of the river and x-sections (1000' apart) 50 miles at Rs. 100 per mile	5,000	
	(*b*) Surveys for railway and road alignments for the dam and the barrage .	20,000	
	(*c*) Alignment of Eastern Kosi Canal and branches : 500 miles at Rs. 25 per mile	12,500	37,000
3	*Discharge Observations.*		
	Number of sites	(6)	
	Expenditure per site (non-recurring) . . .	Rs.	
	Current Meters 1½	1,250	
	Boat large 1	1,000	
	Boat small 1	600	
	Sounding rods, etc..	150	
	Ropes	500	
		3,500	21,000
	Recurring Expenditure for 2 years per site.		
	Head boatman at Rs. 75 p. m.	1,800	
	4 khalasis *cum*-boatmen at Rs. 60 p.m. . . .	5,760	
	Ropes at Rs. 200 per annum	400	
		7,960	
		(Say Rs. 8,000)	48,000
	Temporary gauge readers for flood season 24 Nos. for 4 months per year for two years at Rs. 60 p.m. . .	11,520 Say	11,500 80,500
4	*Silt Observations.*		
	Number of sites	(5)	
	Equipment (non-recurring) per site Rs. 1,000	Rs. 5,000	
	Recurring expenditure for 2 years: 2 khalasis per site at Rs. 55 p.m.	13,200	
		Say 13,000	
			18,000 18,000

5 *Property Survey.*				
For 9 months.				
4 Surveyors at Rs. 180 p.m.	6,480			
10 Khalasis at Rs. 55 p.m.	4,950			
Camp charges	5,000			
Staff on deputation from Nepal	5,000			
	21,420		Say 21,400	21,400
			Rs.	Rs.
6 *Ground Water Surveys.*				
These will be done by staff.				Nil
7 *Meteorological Surveys.*				
(Figures given by Meteorological Department)				
Class I Observatories, 2 Nos.				
Class II Observatories, 2 Nos.				
Class III Observatories, 6 Nos.				
Class IV Observatories, 20 Nos.				
	Rs.	Rs.		
(a) Non-recurring expenditure.				
(i) Equipment	79,700			
(ii) Installation charges including buildings	48,800	1,28,500		
(b) Recurring charges for two years.				
Pay of Officers	4,800			
Pay of Staff	1,00,000			
Dearness allowance	50,000			
T. A. & contingencies	10,000	1,64,800	2,93,300	2,93,300
8 *Seismological Surveys.*				
(Based on figures given by Meteorological Department)				
(a) Equipment (non-recurring)				
One Cambridge Universal Vibrograph				
One Venner's 12" Accelerograph		45,000		
Two units milneshaw horizontal component Seismograph				
One Benioff vertical seismograph				
Six wood-Anderson seismographs		24,000		
		69,000		
(b) Buildings for observatories		20,000		
(c) Recurring expenditure for two years.				
Pay of staff	13,000	...		
Allowances & Honoraria	6,000	..		
Contingencies	6,000	25,000	1,14,000	1,14,000
9 *Geological Investigations.*				
(a) Equipment (non-recurring)				
Diamond drills 6 Nos.	1,80,000			
Diamonds & spares for above	2,40,000			
Calyx drill complete	20,000			
Spares for above	5,000			
Special boats for drills 4 sets	10,000			
Derrick, steel cables etc.	5,000			
Compressors 4 Nos. at 5000	20,000			
Pumps 2 Nos.	6,000			
Hoists for vertical shafts : 2 Nos.	10,000			
	4,96,000			

(*b*) Labour and consumable stores for			
(*i*) 30,000′ of diamond drilling at Rs. 12 por foot	3,60,000		
(*ii*) 2 Vertical shafts for under river tunnel 200′ deep each 48″ diameter at Rs. 100 a foot	40,000		
(*iii*) Cross tunnel under the river 500′ at Rs. 100 per foot	50,000		
(*iv*) Drifts 7′×5′ length 8000′ at Rs. 50 per foot	4,00,000		
	8,50,000		
(*c*) Specialists.			
One drill foreman at Rs. 2000 p.m. for 2 years	48,000		
Subsistence allowance for above at Rs. 584 p.m.=14,016 say	14,000		
Passage both-ways	7,500		
Consulting Geologist's fees	15,000		
Resident Geologists 2 Nos. for one year at Rs. 350 p.m.	8,400		
Dearness Allowance, T. A., etc.	3,600		
	96,500		14,42,500
Deduct cost of tools and plants detailed below which will be available for use on other works to be taken on stock suspense for further use on other works.	Rs.	Rs.	
	Rs.		
75 per cent of Rs. 1,80,000, the cost of drills	1,35,000		
75 per cent of Rs. 20,000, the cost of calyx drill	15,000		
Spares	50,000		
75 per cent of Rs. 10,000 the cost of special boats	7,500		
75 per cent of Rs 5,000, the cost of Derrick steel cables	3,750		
75 per cent of Rs. 20,000, the cost of compressors	15,000		
75 per cent of Rs. 6,000, the cost of pump	4,500		
80 per cent of Rs. 10,000, the cost of hoists	8,000	2,38,750	12,03,750
10 *Roads and Paths.*			
(*a*) Construction			
(*i*) Widening and improving existing path between Barakeshtra and Chatra	20,000		
(*ii*) Tow Path from Chatra to Dam site right bank 6 miles	10,000		
(*iii*) Footpath from Barakeshtra to Tribeni, left bank	25,000		
(*iv*) Footpath from Barakeshtra to Tribeni right bank	17,000		
(*v*) Footpaths along both banks of the Tamur, from Tribeni to gauge site	4,000		
(*vi*) Footpath along the Sun Kosi from Tribeni to gauge site	2,000		
(*vii*) Footpath along the Arun from Tribeni to Machwaghat 3 miles	4,000		
(*viii*) Improvement of cart track and constructing kutcha road from Chatra to barrage site	20,000		
		1,02,000	

	(*b*) Maintenance of Roads & Paths.			
	(*i*) Kutcha road from Jogbani to Chatra 40 miles and Chatra to barrage site 16 miles	40,000		
	(*ii*) All other foot-paths	25,000	65,000	1,67,000
11	Aerial ropeway across the Sapt Kosi, the Tamur, the Arun and the Sun Kosi, 4 Nos. at Rs. 12,000 each		48,000	48,000
12	Soil Conservation Surveys		80,000	80,000
13	Agricultural and soil survey for irrigation 4 million acres at 15,000 per million acres		60,000	60,000
14	Survey of Fish Fauna		5,000	5,000
15	Industrial and Load Survey		5,000	5,000
16	Wooden models		10,000	10,000
17	*Temporary Accommodation*			
	(*a*) Dam Investigation			
	Non-Residential			
	Administrative Quarters at Barakeshtra . . .	8,500		
	(*i*) Inspection Houses at Barakeshtra and Jogbani at 7,000 each	14,000		
	(*ii*) M. B. Sheds for stores and workshops at Barakeshtra	11,000		
	(*iii*) Store Shed at Chatra	8,000		
	(*iv*) Laboratory and Store shed at Barakeshtra and Tribeni 2 Nos.	16,000		
	(*v*) M. B. Shed Class IV	10,000		
	(*vi*) Petrol godown	1,000		
	(*vii*) Magazine for explosives	4,000		
	(*viii*) Dispensary building	3000		
	(*ix*) Office building for Divisional and Sub-Divisional offices	18,000		
	(*x*) Sheds for skilled and unskilled labour 200 Nos. .	10,800		
	(*xi*) Sheds for cooking meals for the above labour .	4,200		
	(*xii*) Miscellaneous buildings	14,000	1,22,500	
		Rs.	Rs.	Rs.
	Residential			
	(*i*) Executive Engineer's Bungalow	6,000		
	(*ii*) Residences for six gazetted officers (3 S. D. Os., 2 Geologists and 1 Meteorologist) . . .	18,000		
	(*iii*) Accommodation for clerks, drawing staff, store-keepers, compounders and laboratory assistants 25 Nos.	25,000		
	(*iv*) Accommodation for Supervisors, Silt Analyst, Research Assistant 25 Nos.	40,000		
	(*v*) Drill Foreman's quarter : 1 No.	5,000		
	(*vi*) S. D. Os. visiting quarter at Tribeni . . .	1,500		
	(*vii*) Time Keepers, Gauge Readers, Daffadars, Barkandazes, Peons, Chowkidars, Dak Runners, Boatmen, Nepalese guards, Sweepers' quarters at Rs. 350 each 80 Nos.	28,000		
	(*viii*) Servants quarters at camp sites : 3 Nos. . .	1,500		
		1,25,000	1,25,000	

(b) Irrigation and Drainage investigations.

Accommodation for officers and stores sheds, etc. L. S. 50,000 for each division 2 Nos.		1,00,000	
		3,47,500	
Deduct the cost of materials from prefabricated structure like M. B. Sheds, Lahore Sheds, Nissen Sheds which will be available for use on other Projects to be taken on stock suspense and credited to this work		77,000	
		2,70,000	2,70,000

18 *Camp Equipage.*

(i) *For Dam Division.*

4 Tents 14′×14′ @ 1,400	5,600	
12 Tents 10′×10′ @ 800	9,600	
6 necessary tents @ 150	900	
30 shoulderies @ 350	10,500	
Camp furniture	7,500	
Repairs and carriage of furniture . . .	5,000	39,100

(ii) *For Irrigation Divisions.*

4 Tents 14′×14′ @ 1,400	5,600		
8 tents 12′×12′ @ 1,100	8,800		
15 tents 10′×10′ @ 800	12,000		
30 shouldaries @ 350	10,500		
Camp furniture	10,000		
Repairs and carriage of Camp equipage . .	10,000	56,900	96,000

19 *Tools and Plant.*

(i) *Special Tools*

For Kosi Dam Division.

Jeeps with Trailers 2 Nos. @ 6,000 . . .	12,000*
Weapon carrier trucks 6 Nos. @ 6,000 . .	36,000*
G. M. C. Trucks 4 Nos. @ 10,000 . . .	40,000*
Country boats 18 Nos. @ 1,000 . . .	18,000
Inspection boats 4 Nos. @ 1,200 . . .	4,800*
Motor boats 2 Nos. @ 8,000	16,000*

For Irrigation Division.

Jeeps and trucks 2 Nos. @ 6,000 . . .	12,000*
Weapon carriers 8 Nos. @ 6,000 . . .	48,000*
Boats 8 Nos. @ 1,000	8,000

Instruments.

For Kosi Dam Division.

Levels 12 Nos. @ 1,000	12,000**
Theodolites 3 Nos. @ 3,500	10,500**
Binoculars 4 Nos. @ 200	800**
Cameras 2 Nos. at 400	800**
Miscellaneous Surveying and Drawing Instruments	5,000

		Rs.	Rs.	Ps.
	For Kosi Irrigation Division.			
	Levels 24 Nos. at 1,000	24,000**		
	Theodolites 6 Nos. at 3,500	21,000**		
	Other surveying and drawing instruments	10,000		
	Soil testing and Laboratory equipment	10,000		
	(*iii*) *Office Furniture and other T. & P.*			
	For Kosi Dam Division.			
	Office furniture for Executive Engineer and S. D. Os.	6,000		
	For Kosi Irrigation Divisions.			
	Miscellaneous T. P. at 10,000 Per Division	20,000		
	Office furniture for Executive Engineer and Sub-Division Officers	12,000	3,26,900	
	Deduct cost of stores likely to be available for use on other works and projects after completion of the investigation to be taken on stock suspense and cost to be credited to this work as under :—			
	25% of the cost of items marked *pro-page	42,000		
	75% of the cost of items marked ** above	51,000		
			93,000	2,33,900
20	Repairs and Carriage of vehicles	60,000	60,000	
21	Silt and chemical laboratory at Barakeshtra	15,000	15,000	
22	Contingencies at 5% on the amount of Rs. 50,88,400	2,54,400	2,54,400	
23	*Establishment.*			
	(*i*) *Kosi Dam Investigation Division.*			
	1 Executive Engineer for 3 years @ 1,150 p.m.	41,400		
	3 Asstt. Engineers for 3 years @ 350 p.m.	37,800		
	15 Supervisors for 3 years @ 150/- p.m.	81,000		
	1 Accountant for 3 years @ 235/- p.m.	8,460		
	1 Head Clerk for 3 years @ 170/- p.m.	6,120		
	3 Sub Divisional Clerks for 3 years @ 80/- p.m.	8,640		
	1 Accounts Clerk for 3 years @ 100/- p.m.	3,600		
	4 Clerks for 3 years @ 55/- p.m.	7,920		
	6 Clerks for 2 years @ 55/- p.m.	7,920		
	1 Sr. Draftsman for 3 years @ 150/- p.m.	5,400		
	1 Jr. Draftsman for 3 years @ 140/- p.m.	5,040		
	1 Tracer for 2 years @ 60/- p.m.	1,440		
	1 Ferro Printer for 2 years @ 60/- p.m.	1,440		
	1 Civil Asstt. Surgeon for 3 years @ 370/- p.m.	13,320		
	1 Compounder for 3 years @ 60/- p.m.	2,160		
	1 Research Asstt. for 3 years @ 160/- p.m.	5,760		
	3 Silt Analysts for 3 years @ 100/- p.m.	10,800		
	1 Silt Analyst for 2 years @ 100/- p.m.	2,400		
	1 Laboratory Asstt. for 2 years @ 60/- p.m.	1,440		
	1 Laboratory Attendant for 2 years @ 40/- p.m.	960		
	1 Seismological Asstt. for 1 year @ 160/- p.m.	1,920		
	1 Senior Observer for 1 year @ 100/- p.m.	1,200		
	1 Junior Observer for 1 year @ 60/- p.m.	720		
	6 Guage Readers for 3 years @ 35/- p.m.	7,560		
	4 Daffadars for 3 years @ 30/- p.m.	4,320		
	6 Barkandazes for 3 years @ 30/- p.m.	6,480		
	8 Peons for 3 years @ 30/- p.m.	8,640		
	7 Nepalese Police Guards for 3 years @ 35/- p.m.	8,820		
	1 Dispensary servant for 3 years @ 30/- p.m.	1,080		
	2 Storekeepers for 2 years @ 80/- p.m.	3,840		
	4 Special pays for handling cash for 3 years at 20/- p.m.	2,880		
	Add provision for increments	10,000		
			3,10,480	

(*ii*) *Irrigation and Drainage Investigation Divisions.*

2	Exec. Engineers for 2 years @ 1,000/- p.m.	48,000
6	Asstt. Engineers for 2 years @ 350/- p.m.	50,400
20	Supervisors for 2 years @ 150/- p.m.	72,000
2	Accountants for 2 years @ 200/- p.m.	9,600
2	Head Clerks for 2 years @ 160/- p.m.	7,680
2	Accounts Clerks for 2 years @ 100/- p.m.	4,800
6	Sub-Divisional clerks for 2 years @ 80/- p.m.	11,520
16	Asstt. Clerks for 2 years @ 55/- p.m.	21,120
2	Storekeepers for 2 years @ 80/- p.m.	3,840
1	Sr. Draftsman for 2 years @ 150/- p.m.	3,600
2	Jr. Draftsmen for 2 years @ 100/- p.m.	4,800
2	Tracers for 2 years @ 60/- p.m.	2,880
2	Ferroprinters for 2 years @ 60/- p.m.	2,880
6	Guage Readers for 2 years @ 35/- p.m.	5,040
8	Daffadars for 2 years @ 30/- p.m.	5,760
24	Barkandazes for 2 years @ 30/- p.m.	17,280
16	Peons for 2 years @ 30/- p.m.	11,520
1	Asstt. Soil Specialist for 1 year @ 350/- p.m.	4,200
6	Soil Analysts for 2 years @ 100/- p.m.	14,400
1	Peon for 1 year @ 30/- p.m.	360
8	Special pays for handling cash for 2 years at 20/- p.m.	3,840
	Add provision for increments for 1 year	20,000
		3,29,120

(*iii*) *Direction Office.*

1	Stenographer for 2 years @ 170/- p.m.	4,080
1	Superintendent for 2 years @ 250/- p.m.	6,000
1	Circle Clerk 2nd for 2 years @ 160/- p.m.	3,840
3	Upper Division Clerks for 2 years @ 80/- p.m.	5,760
4	Lower Division Clerks for 2 years @ 55/- p.m.	5,280
1	Sr. Draftsman for 2 years @ 150/- p.m.	3,600
1	Jr. Draftsman for 2 years @ 100/- p.m.	2,400
1	Tracer for 2 years @ 60/- p.m.	1,440
1	Ferroprinter for 2 years @ 60/- p.m.	1,440
1	Daftri for 2 years @ 35/- p.m.	840
6	Peons for 2 years @ 30/- p.m.	4,320
1	Barakandaz for 2 years @ 30/- p.m.	720
1	Special Pay for handling cash for 2 years at 20/- p.m.	480
	Add provision for increments	2,200
		42,400

(*b*) Dearness and Nepal Compensatory allowances.

Serial No.	Class of Estt.	No.	Period in Yrs.	D. A.	Nepal Allce.
				Rs.	Rs.
1	Executive Engineer	1	3	4,140	5,400
	Executive Engineers	2	2	4,800	—
2	Asstt. Engineers	3	3	7,560	8,100
		6	2	10,800	1,800
3	Supervisors	15	3	24,300	21,600
		20	2	19,200	3,000

4	Accountants	1	3	1,800	1,080		
		2	2	2,160	..		
5	Circle Supdt.	1	2	1,200	..		
6	Circle 2nd Clerk	1	2	1,080	..		
7	Head Clerk	1	3	1,620	1,080		
8	Accounts clerk	1	3	1,260	900		
9	Head Clerks	2	2	2,160	..		
10	Accounts clerks	2	2	1,680	..		
11	Upper Div. Clerks	3	2	2,520	..		
12	Sub-Div. Clerks	3	3	3,780	2,160		
		6	2	5,040	480		
13	Steno for Project officer	1	3	1,620	..		
14	Clerks	4	3	5,040	2,880		
		26	2	21,840	3,360		
15	Storekeepers	4	2	3,360	1,440		
16	Sr. Draftsman	1	3	1,440	1,080		
		2	2	960	..		
17	Draftsman	1	3	1,440	1,080		
18	Tracers	4	2	3,360	480		
19	Forroprinters	4	2	3,360	480		
20	Civil Asstt. Surgeon	1	3	2,520	2,700		
21	Compounder	1	3	1,260	720		
22	Dispensary Servant	1	3	900	360		
23	Research Asstt.	1	3	1,620	1,440		
24	Silt Analysts	3	3	3,780	2,700		
		1	2	840	600		
25	Asstt. Soil Specialist	1	2	1,680	..		
26	Soil Analysts	6	2	5,040	600		
27	Laboratory Asstt.	1	2	840	480		
28	Laboratory Attendant	1	2	600	240		
29	Seismological Asstt.	1	1	540	480		
30	Sr. Observer	1	1	420	300		
31	Jr. Observer	1	1	420	240		
32	Guage Readers	6	3	5,400	2,160		
33	Daffadars	6	2	3,600	480		
		4	3	3,600	1,440		
		8	2	4,800	240		
34	Barkandazes	6	3	5,400	2,160		
		25	2	15,000	720		
35	Peons	8	3	7,200	2,880		
		22	2	13,200	240		
36	Daftri	1	2	600	..		
37	Peon	1	1	300	..		
				2,17,080	77,580	2,94,660	9,76,660
						Say	9,77,000

(c) *Travelling Allowances.*

(*i*) For Kosi Dam Division; @ 11,000 per year for 3 years	33,000		
(*ii*) For 2 Irrigation and Drainage Investigation Divisions @ 11,000 each per year for 2 years	44,000		
(*iii*) For Supdtg. Engineers Camp staff etc. 4,000 per year for 2 years	8,000	85,000	85,000

(d) Contingencies			
(*i*) For Dam Investigation at 13,000 per year for 3 years	39,000		
(*ii*) For 2 Investigation Divisions 13,000 each per year for 2 years	52,000		
(*iii*) For Direction Office 15,000 per year for 2 years	30,000	1,21,000	1,21,000
Total Establishment charges Rs.	11,83,000		

BALWANT SINGH NAG,
Project Officer (Kosi).

APPENDIX III

MINISTRY OF WORKS, MINES AND POWER

One of the factors governing the attitude of the S. F. C. to River Valley Projects is the high cost of preliminary investigations. Considering the difficulties of transport and the availability of steel and cement, I do not think that Government would be able to undertake a large number of river valley projects within a measurable period. Government are already committed to the Damodar Project as a whole, the Hirakud Dam Project, the Bhakra and Nangal Projects, Rihand, Tungabhadra and Ramapadasagara to mention only a few of the prominent projects which must go ahead in any case. The Kosi Project on which we have already spent a large amount on preliminary investigations must also go ahead. Similar considerations would seem to apply to some of the dams on the Chambal, the Narbada and the Tapti. These projects will tax all our resources and the capacity of CWINC to the utmost for the next 5 years, if not for a longer period. In the circumstances, I am of opinion that CWINC should try and reduce the cost of preliminary surveys on all other projects which are now under contemplation, *e.g.*, projects in the Assam Valley, in the C.P., Coorg and so on. It is quite unnecessary at this stage to undertake aerial survey of all these projects, nor does it seem worthwhile taking up a large number of such projects even for preliminary investigations. We should pick and choose and only take up projects which appear most likely to be profitable and concentrate our energies on such projects. For instance, it will not be possible for many years to utilize all the electrical potential in Assam. The utmost we can aim at is to build one large dam at a suitable site in Assam which will provide power and irrigation. A very rough investigation of the various projects in view will suggest which of them should be taken up for preliminary investigations ; similarly in the Central Provinces and other areas. Even on the Mahanadi, I am inclined to think that we should not spend any more money on the third site, *viz.*, Naraj. It will be quite enough if Tikkarpara site is explored. The investigations on the third site may well be undertaken 10 years hence,- after Hirakud and Tikkarpara are nearing completion.

2. I have put down my tentative views as a basis for discussion with Mr. Khosla. If he agrees with me, will he kindly reduce his estimates for preliminary investigations of the Narbada-Tapti, Assam Valley, and other schemes before the next meeting of the S. F. C. I do not want the investigations on the Kosi to be curtailed nor on any other projects which are likely to be actually constructed during the next 5 years. But there is no point in spending large sums of money on other investigations which are not likely to be fruitful, at least for the next 5 or 7 years.

Sd. B. K. GOKHALE,
4-3-48.
(*Secretary*).

Mr. Khosla

D. S. P.

I am in complete agreement with Secretary's views. Will Members and Directors note above and take immediate action as to " A " above in consultation with me so that I can discuss this with Secretary on Monday or Tuesday before I go on tour. This note should come back to me for return to Secy.

Sd. A. N. KHOSLA,
4-3-48.
(*Chairman, CWINC.*)

APPENDIX IV

NARBADA VALLEY PROJECTS

REPORT

The Narbada river has hitherto been considered as useless for being exploited for either irrigation, power, or navigation, the latter beyond a certain small distance above its outfall into the Gulf of Cambay. In its course through the Broach district of the Bombay Presidency it frequently overflows its banks and floods the country-side on both banks. This fact as well as the projected development of other river basins in the country led the Governments of Bombay and C. P.-Berar to request the CWINC to take up the investigations for a basin-wide development of the river with flood control, irrigation, power generation and extension of navigation as the chief objectives in view. They offered to depute some of the engineering staff necessary for the work and also bear the cost of investigations in case no projects matured.

Accordingly the topography and hydrology of the basin were taken up for study in the CWINC at the beginning of the year 1947. The river drains an area of nearly 40,000 sq. miles. The total annual precipitation of rain in the basin is normally over 90 million acre feet of water. At present the entire amount is running to waste into the sea. The river has a deep channel almost throughout its course except in the plains of Broach after it emerges from the last narrow gorge near Rajpipla. The bed slopes vary from a maximum of about 40 feet a mile to about 3·75 ft. a mile through the last gorge. In the Broach plains it flattens out to about $2\frac{1}{2}$ to 3 inches per mile. Almost throughout its course it flows over basaltic formations.

A study of the topography has revealed that excellent storage sites exist both on the main river and on some of its tributaries where, by constructing dams of medium heights, reservoirs of varying capacities can be formed to hold back the excessive precipitation of rain during monsoon months and utilize the water for purposes of perennial irrigation, power generation, extension of navigation, fish culture and supplies for domestic uses all over the basin. Floods in the Broach area can be completely controlled by reserving the upper portion of their capacities for flood absorption in some of the lower reservoirs.

Most of these sites have been inspected both by Engineers and Geologists and the preliminary ground surveys have revealed that development of projects at the sites is feasible. It has been decided to take up, for the present, investigations of only 7 projects, a list of which is appended. The last two items of the list show the power and irrigation potential of the projects, which will aggregate to nearly one million K.W. of continuous power and a gross command of nearly 4 million acres respectively. The estimate amounting to Rs. 95,91,144 has been prepared to meet the cost of detailed investigations of these projects. Provisions have been made for collection of hydrological data including rainfall, temperature, and humidity and river gauging ; surveys of dam sites, the reservoir areas and areas to be commanded for irrigation ; soil surveys of the commanded area and geological surveys of the dam sites. Such other surveys as minerals of the entire basin, electrical load surveys, surveys for navigation, soil erosion and also economic surveys by Gokhale Economic Research Institute, Poona, have also been included in the programme of investigations and requisite provisions made in the estimate. Surveys of dam sites, reservoir areas and irrigation areas will be done through the agency of the Survey of India Department, while surveys of main canals and other channel alignments for distribution system for irrigation water will be done by CWINC staff. The hydrological surveys will be undertaken in close co-operation with the Indian Meteorological Department. Geological surveys both for minerals and foundation explorations will be done in close co-operation with the Geological Survey of India. Similarly surveys for pisciculture will be undertaken under the direction of the Director, Zoological Survey of India.

Two divisions have been formed to do the work. Each Division will have four sub-divisions together with requisite subordinate and ministerial staff. Such other staff as Meteorological Assistants, Research Assistants for soil survey, Silt Observers, Geologists, Drill foreman, etc. has also been provided for, as detailed in the estimate.

The work will take nearly four years to complete. But the investigations will be so phased that construction can be launched upon in case of features which can be taken up independently before the investigations on all projects are completed so as to obtain quick and maximum results. As soon as such stages are reached, estimates for construction will be prepared for sanction.

Adequate provision for acquiring necessary tools and plant and transport vehicles has been made at rates which prevail in the market at present.

A statement showing the rough data for the dam sites and the anticipated benefits from the projects is given below.

The following map and chart are enclosed—

(1) An index map of the Narbada basin showing the proposed dam sites and projects.

(2) A profile of Narbada river and its main tributaries.

G. N. PANDIT,
Project Officer (Narbada and Tapti).

NARBADA BASIN—ROUGH DATA FOR THE DAM SITES

1. Name of the river	Narbada	Burhner	Narbada	Tawa	Narbada	Narbada	Narbada
2. Name of the dam site	Bilghara	Ghugri	Bargi	Ranipur	Punasa	Barwani	Weir below gorge
3. Length along river (Miles)	153	85	249	95	513	665	750 (approx.)
4. Latitude and Longitude of dam site	80°29′20″E 22°49′40″N	80°42′0″E 22°44′45″N	79°55′30″E 23°1′0″N	77°59′0″E 22°35′30″N	76°28′0″E 22°17′0″N	74°41′0″E 22°2′0″N	
5. Catchment area above dam site (Sq. miles)	1900	1290	6180	2340	23600	32000	
6. Average rainfall in catchment (Inches)	60	60	55	59	45	42	
7. Probable mean annual runoff (m.a.ft.)	3·06	2·06	4·8	3·12	15·63	22·23	
8. R. L. of river bed	1520	1570	1240	1020	650	350	
9. Proposed F. T. L.	1750	1745	1350	1190	887	590	
10. Maximum height of the dam at F. T. L. (feet)	230	175	110	170	237	240	
11. Length of the dam at F. T. L. (feet)	3960	5300	5120	2700	2400	2060	
12. Gross capacity of reservoir at F. T. L. (m.a.ft.)	1·90	1·57	2·59	5·0	17·14	25·18	
13. Dead storage (m.a.ft.)	0·19	0·13	0·29	1·5	1·52	2·35	
14. Max. area of water spread (acres)	22900	32000	62200	89600	320000	390400	
15. Losses due to evaporation (m.a.ft.)	0·08	0·10	0·25	0·36	1·03	1·26	
16. Reserve for flood control		..	..	..	..	..	
17. Net storage available		1·34	2·05	3·14	14·60	21·00	
18. Continuous regulated discharge (cusecs)	3275	2380	9700	4140	20500	28980	
19. R. L. of the top of dead storage	1613	1638	1308	1147	790	470	
20. R. L. of tail race	1540	1585	1280	1125	670	375	
21. Average head available (feet)	141·5	106·5	50	47	168·5	155	
22. Continuous power available k.W.	30800	17500	32500	12700	223000	300000	
23. Gross area commanded (acres)	..	..	18,00,000	11,00,000	..	..	8,00,000

I.—Total live storage impounded . 31·13 m.a.ft. Total gross area commanded 37,00,000 acres.

II.—Continuous power generable

Bilghara	30,800	k.W.
Ghugri	17,500	,,
Bargi	32,500	,,
Tawa	12,700	,,
Punasa	223,000	,,
At the dam between Punasa and Harinphal	112,600	k.W.
Harinphal	250,000	,,
At the two dams in the gorge	320,000	,,
Total	9,98,500	,,

G. N. PANDIT,
Project Officer (Narbada and Tapti).

NARBADA PROJECTS ESTIMATES

Overall estimate for preliminary surveys and investigations in connection with projects for the multipurpose development of the Narbada Basin.

Abstract

	Rs.
I. WORKS—	
1. Dams and Appurtenant works	
A. Preliminary expenses	,74,000
K. Buildings	1,00,000
2. Main canal and Branches	45,46,500
3. Discharge and silt observations	2,00,000
4. Meteorological Observations	25,800
5. Mineral surveys	10,000
6. Surveys for Pisciculture	2,000
7. Malaria surveys	5,000
8. Electric Load surveys	10,000
9. Surveys for Navigation	1,00,000
10. Economic and property surveys	60,000
11. Soil erosion surveys	7,500
12. Communications	3,00,000
13. Special Tools and Plant	4,60,000
	67,00,800
2 per cent Contingencies	1,34,016
Total Works	68,34,816
II. TOOLS AND PLANT	
Tools and Plant for the Divisions	4,38,000
2 per cent Contingencies	8,760
Total Tools and Plant	4,46,760
III. ESTABLISHMENT	
Establishment for 4 years including establishment contingencies	23,09,568
Grand Total	95,91,144

I. WORKS — Details

Dams and Appurtenant Works

A. Preliminary Expenses

1. Survey of reservoir basins by air photography and ground survey and plotting contours at 10 ft.—5 ft. intervals on a scale of 4"-=1 mile.

1. Ghugri Dam	50 sq. miles
2. Bilghra	25·8 ,,
3. Bargi	97 ,,
4. Tawa	139 ,,
5. Hoshangabad	25 (Approx.)
6. Punasa	500 ,,
7. Harinphal	140 ,,
8. Dam site between Punasa and Harinphal	25 ,,
9. 2 Dam sites in Rajpipla gorge	15 ,,
	15 ,,
	1031·8 Sq. miles

1031·8 Sq. miles at Rs. 375 per sq. mile — Rs. 3,87,000.

2. Survey of Dam sites and Weir sites by air photography and ground surveys and plotting on a scale of 32"=1 mile.

7500 acres at Rs. 4 per acre — Rs. 30,000

3. Geological investigations for foundations of Dam sites and Weir sites and of the reservoir basins by boring, core drilling, making drifts and tunnelling, etc. including testing.

	No. of bores.
Bilghara	40 Nos.
Ghugsi	56 „
Bargi	52 „
Tawa	30 „
Punasa	100 „
Harinphal	20 „
Hoshangabad	32 „
Dam site between Punasa and Harinphal	27 „
2 Dam sites in Rajpipla gorge	50 „
Pick-up Weir for Broach project	25 „
	432 Nos. each 50′ in depth.
21,600 R. Ft. at Rs. 20 per R. Ft.	Rs. 4,32,000.

		Rs.
4. Soil analysis and borrow surveys for earthen dams including testing	L.S.	10,000
5. Model Experiments by Indian Waterways Station, Poona	L.S.	15,000
K. Buildings		
Temporary buildings—10 sites	L.S.	1,00,000
		9,74,000

II. *Main Canals and Branches*

(a) Survey of the commanded areas for alignments of canals

Canals ex-Bargi	18,00,000 acres.
Canals ex-Tawa	11,00,000 „
Canals ex-Broach	10,00,000 „
	39,00,000 acres.

		Rs.
39,00,000 acres @ Rs. 1/2 per acre		43,87,500
(b) Miscellaneous surveys	L.S.	20,000
(c) Explorations for foundations of cross drainage works and necessary surveys	L.S.	1,00,000
(d) Soil surveys 39,00,000 acres at Rs. 11 per 100 acres		39,000
		45,46,500

III. *Discharge and Silt Observations (period 4 years)*

One Boatman and four Khalasis at each discharge site and cost of ropes, discharge rods, floats, gauges, silt samplers and laboratory equipment

10 sites (8 on the Narbada and 2 at Tawa and Burhner) at Rs. 5,000 per site per year . 2,00,000

IV. *Meteorological Observations, Raingauges, Temperatures, Humidity and Wind Velocity Observations*

Equipment and installations of 15 new raingauges some of these to be of the integrated self-recording type, humidity and wind velocity apparatus at 8 stations at an average rate of Rs. 1,000 15,000

Recurring Expenditure on part-time observers
15 observers at Rs. 15 p.m. for 4 years . 10,800

25,800

V. *Mineral Surveys L. S.*	10,000
VI. *Survey for Pisciculture L. S.*	2,000
VII. *Malaria Surveys L. S.*	5,000
VIII. *Electric load Surveys L. S.*	10,000
IX. *Surveys for Navigation L. S.*	1,00,000
X. *Economic and property Surveys L. S.*	60,000
XI. *Surveys for Soil Erosion L. S.*	7,500

XII. *Communications*

Constructing 100 miles of temporary roads and their maintenance for 2 years at Rs. 3,000 per mile 3,00,000

XIII. *Special Tools and Plant*	Rs.
6 Diamond drills complete with accessories at Rs. 60,000 each	3,60,000
Testing apparatus and laboratory and workshop equipment for compressive strength of rocks and testing soils for shear strength, optimum moisture content and consolidation, etc. L. S.	1,00,000
	4,60,000
	67,00,800
2% Contingencies	1,34,016
Total Works	68,34,816
II. TOOLS AND PLANT	
1. Motor vehicles for survey parties	..
14 vehicles at Rs. 7,000 each	98,000
Working expenses for four years	1,40,000
2. Scientific Instruments	1,20,000
3. Ordinary Tools and Plant	10,000
4. Camp equipage	30,000
5. Office furniture	40,000
	4,38,000
2% Contingencies	8,760
Total Tools and Plant	4,46,760

III. ESTABLISHMENT.

1. Pay of Officers—	Expenditure per year Rs.
Executive Engineers 2 Nos. @ Rs. 875 p.m.	21,000
Assistant Executive Engineers 4 Nos. @ Rs. 600 p.m.	28,800
Assistant Engineers 4 Nos. @ Rs. 560 p.m.	26,880
Geologist 1 No. @ Rs. 875 p.m.	10,500
Assistant Geologists 2 Nos. @ Rs. 500 p.m.	12,000
Officer to conduct economic surveys 1 No. @ Rs. 550 p.m.	6,600
Drill Foreman 1 No. @ Rs. 1,000 p.m.	12,000
	1,17,780
2. Pay of Establishment—	Rs.
3 Meteorological Assistants @ Rs. 240 p.m.	8,640
2 Accountants @ Rs. 200 p.m.	4,800
2 Head clerks @ Rs. 180 p.m.	4,320
6 Senior clerks @ Rs. 150 p.m.	10,800
2 Storekeepers @ Rs. 150 p.m.	3,600
14 Junior clerks @ Rs. 93 p.m.	15,624
2 Senior Draftsmen @ Rs. 200 p.m.	4,800
4 Junior Draftsmen @ Rs. 143 p.m.	3,432
4 Tracers @ Rs. 104 p.m.	4,992
2 Sub Assistant Surgeons @ Rs. 170 p.m.	4,080
2 Compounders @ Rs. 50 p.m.	1,200
32 Overseers @ Rs. 240 p.m.	92,160
6 Research Assistants @ Rs. 240 p.m.	17,280
2 Laboratory Assistants @ Rs. 230 p.m.	5,520
2 Silt-Analysts @ Rs. 200 p.m.	4,800
2 Assistant Silt Analysts @ Rs. 93 p.m.	2,232
10 Gauge readers @ Rs. 70 p.m.	8,400
10 Senior Observers @ Rs. 90 p.m.	10,800
2 Dafadars @ Rs. 33 p.m.	792
10 Barkandazes @ Rs. 33 p.m.	3,960

		Rs.
	14 Peons @ Rs. 33 p.m.	5,545
	6 Laboratory Khalasis @ Rs. 33 p.m.	2,376
	10 Chowkidars @ Rs. 33 p.m.	3,960
	Total	2,24,112
3.	Dearness allowances of Officers.	16,020
4.	Dearness allowances for establishmen t	66,480
5.	Travelling allowances for Officers	40,000
6.	Travelling allowances for establishment	60,000
7.	Cost of project Circle office debited to Narbada	33,000
8.	Establishment contingencies	20,000
	Establishment per year	5,77,392
	Grand Total—Establishment for 4 years	23,09,568

G. N. PANDIT,
Project Officer (Narbada & Tapti).

II. *Estimate for preliminary surveys and investigations in connection with projects for multipurpose development in the Basin of the Narbada River for the year* 1947-48 *submitted to Government for sanction.*

I. WORKS

Dams and appurtenant works

			Rs.
(*i*) Preliminary expenses			
(*ii*) Survey to be carried out by the Survey of India Department	L.S.		2,500
1. Survey to be carried out by or under the directions of C.W.I.N.C.	L.S.		14,000
2. Discharge and silt observations	L.S.		1,990
3. Geological investigations and mineral surveys	L.S.		1,000
4. Communications	L.S.		10,000
5. Contingencies at 2 per cent			650
Total Works			30,140

II. TOOLS AND PLANT

(*Including transport, conveyance and its carriage and repair charges, survey and mathematical instruments, camp equipage, silt, observation apparatus, etc.*)

	Rs.
(*a*) New Supplies	
9 Weapon carriers @ Rs. 7,000 each	63,000
3 Jeeps with trailers @ Rs. 7,000 each	21,000
2 Chronographs @ Rs. 100 each	200
2 current meters @ Rs. 1,000 each	2,000
2 large boats @ Rs. 1,000 each	2,000
2 small boats @ Rs. 500 each	1,000
Discharge rods	200
Sounding rods	100
Ropes	500
One set of apparatus for silt observations @ Rs. 1,500 each and remaining laboratory equipment	2,200
(*b*) Repairs and Carriage	
Repairs to trucks etc.	1,500
Grand Total of Tools and Plant	93,700

III. ESTABLISHMENT

		Rs.
(*a*) *Pay of Officers*		
2 Executive Engineers for 3 months @ Rs. 900 p.m.		5,400
4 Assistant Engineers for 3 months @ Rs. 350 p.m.		4,200
1 Geologist for 3 months @ Rs. 600 p.m.		1,800
	Total	11,400
Pay of establishment		
11 Overseers for 3 months @ Rs. 180 p.m.		5,940
2 Accountants for 3 months @ Rs. 200 p.m.		1,200
2 Head clerks for 3 months @ Rs. 160 p.m.		960
1 Sub-Assistant Surgeon for 2 months @ Rs. 200 p.m.		400
3 clerks for 3 months @ Rs. 80 p.m.		720
4 Sub-Divisional clerks for 3 months @ Rs. 75 p.m.		900
1 Head Draftsman for 3 months @ Rs. 250 p.m.		750
2 Junior Draftsmen for 3 months @ Rs. 100 p.m.		600
4 Tracers for 3 months @ Rs. 80 p.m.		960
1 Dispensor for 2 months @ Rs. 80 p.m.		160
1 Daffadar for 2 months @ Rs. 35 p.m.		70
3 Barkandazes for 3 months @ Rs. 30 p.m.		270
7 Peons for 3 months @ Rs. 30 p.m.		630

	Rs.
4 Peons for 3 months @ Rs. 30 p.m.	380
5 Chowkidars for 3 months @ Rs. 30 p.m.	450
4 Dak runners for 3 months @ Rs. 30 p.m.	360
11 Khalasis for overseers for 3 months @ Rs. 30 p.m.	990
7 Gauge readers for 3 months @ Rs. 30 p.m.	630
Geologist—staff—L. S.	1,000
	17,350
Dearness allowance and Special pay of Officers L. S.	1,150
Dearness allowance of establishment L. S.	7,000
Travelling allowance for officers	
1. Executive Engineers	1,400
2. Assistant Engineers	1,800
3. Geologists	1,000
	4,200
Travelling Allowance of Establishment	
Supervisors	2,000
Other staff (Executive Engineers)	2,000
Geologist—Other Staff	400
	4,400
(*b*) *Establishment Contingencies*	
Rent for Divisional and Sub-Divisional Offices	1,000
Rent for Geologists' Offices	400
	1,400
Grand total of establishment	46,900

I. Works	30,140
II. Tools and Plant	93,700
III. Establishment	46,900
Total	1,70,740

G. N. PANDIT,

Project Officer, (Narbada and Tapti).

III. Estimate for the preliminary surveys and investigation in connection with the project for multipurpose developments in the Basin of the Narbada River for the year 1948-49, submitted to Government for sanction.

I. WORKS

			Rs.
1. *Dams and appurtenant works.* (A—Preliminary expenses)			
Survey to be carried out by the Survey of India		L.S.	3,00,000
Survey to be carried out by or under the direction of C.W.I.N.C.		L.S.	20,000
K. Buildings		L.S.	50,000
2. *Main canal and branches*			
Miscellaneous surveys such as canal alignments, special reservoir surveys, etc.		L.S.	40,000
Soil surveys		L.S.	70,000
3. *Meteorological surveys*			
Rain gauges—It is proposed to install 70 new rain gauges (*i*) Equipment and installation of gauges—70 new rain gauges including temperature, humidity and wind velocity apparatus at 35 places and some self-recording gauges at an average rate of Rs. 500 each	35,000		
(*ii*) Observation Expenditure per year			
3 Meteorological Assistants @ Rs. 200 p.m.	7,200		
3 Senior Observers @ Rs. 120 p.m.	4,320		
70 part time Observers @ Rs. 15 p.m.	12,600		
70 part time Retainers @ Rs. 12 p.m.	10,080		
	34,220		69,000 (say)
5 Geological investigations and mineral surveys		L.S.	20,000
6 Communications.		L.S.	50,000
7 Special Tools and Plant (Drill equipment and apparatus for soil laboratory)		L.S.	12,00,000
8 Economic surveys		L.S.	6,000
9 Hydro Electric Installations—A. preliminary expenses—Electric Load surveys		L.S.	5,000
10 Contingencies @ 2%			61,000
TOTAL—Works			19,41,000

II. TOOLS AND PLANTS

7 country boats @ Rs. 1,000 each	7,000
3 outboard motors @ Rs. 1,000 each	3,000
16 chronographs at Rs. 100 each	1,600
18 levelling instruments at Rs. 800 each	14,400
3 theodolites at Rs. 1,500 each	4,500
3 Binoculars at Rs. 200 each	600
1 camera at Rs. 600	600
18 measuring chains @ Rs. 15 each	270
60—100 ft. tapes at Rs. 30 each	1,800
60—50 ft. tapes at Rs. 20 each	1,200
7 steel tapes @ Rs. 100	700
7 drawing boards at Rs. 30 each	210
7 2nd class drawing instrument boxes @ Rs. 200 each	1,400
2 first class drawing instrument boxes @ Rs. 300 each	600
Scales with offsets, etc., french curves and miscellaneous scientific instruments and tools and plant	100
10 current meters @ Rs. 1,000 each	10,000
10 large boats at Rs. 1,000 each	10,000
10 small boatss at Rs. 500 each	5,000
Discharge rods	2,300

	Rs.
Sounding rods	1,100
Ropes	2,500
1 set of apparatus for silt observations	1,500
Recurring laboratory expenses	300
15 Nos. 14′ × 14′ tents @ Rs. 1,200 each	18,000
40 Nos. 10′ × 10′ tents @ Rs. 800 each	32,000
40 Nos. shouldaries at Rs. 600 each	24,000
40 servants' tents at Rs. 500 each	20,000
Camp furniture	58,000
Office furniture for Divisional and Sub-Divisional offices	15,000
Office furniture for soil physicist's office and laboratory	2,500
Office furniture for geologist's office	2,500
Repairs and Carriage—yearly repairs to trucks	5,420
Contingencies at 2%	4,000
TOTAL—Tools and Plant	2,00,000

III. ESTABLISHMENT

(a) *Pay of officers*

2 Executive Engineers at Rs. 900 p.m. for 12 months	21,600
8 Assistant Engineers at Rs. 350 p.m. for 12 months	33,600
1 Geologist at Rs. 600 p.m. for 12 months	7,200
2 Assistant Geologists at Rs. 400 p.m. for 12 months	9,600
1 Soil Physicist at Rs. 275 p.m. for 12 months	3,300
	75,300

(b) *Pay of establishment*

32 Overseers at Rs. 180 p.m. for 12 months	69,120
2 Accountants at Rs. 200 p.m. for 12 months	4,800
2 Lead clerks at Rs. 160 p.m. for 12 months	3,840
2 Sub-Asstt. Surgeons at Rs. 200 p.m. for 12 months	4,800
10 Clerks at Rs. 80 p.m.	9,600
16 Sub-Divisional Clerks at Rs. 75 p.m. for 12 months	14,400
2 Head draftsmen for 12 months at Rs. 250 p.m.	6,000
2 Junior draftsmen for 12 months at Rs. 100 p.m.	2,400
4 tracers for 12 months at Rs. 80 p.m.	3,840
2 dispensers for 12 months at Rs. 80 p.m.	1,920
2 daffadars for 12 months at Rs. 35 p.m.	840
10 barakandazes for 12 months at Rs. 30 p.m.	3,600
22 peons for 12 months at Rs. 30 p.m.	7,920
12 peons for 12 months at Rs. 30 p.m.	4,320
10 chowkidars for 12 months at Rs. 30 p.m.	3,600
12 Dak runners for 12 months at Rs. 30 p.m.	4,320
32 khalasis for overseers for 12 months at Rs. 30 p.m.	11,520
20 gauge readers for 12 months at Rs. 30 p.m.	7,200
Geologist's staff L.S.	4,000
6 sub-overseers at Rs. 50 p.m. for 12 months	3,600
3 Laboratory assistants at Rs. 100 p.m. for 12 months	3,600
2 clerks at Rs. 40 p.m. for 12 months	960
1 computor at Rs. 40 p.m. for 12 months	480
1 tracer at Rs. 40 p.m. for 12 months	480
3 laboratory peons at Rs. 25 p.m. for 12 months	900
2 peons at Rs. 25 p.m. for 12 months	600
1 Tapali at Rs. 25 p.m. for 12 months	300
4 Auger measures at Rs. 40 p.m. for 12 months	1,920
	1,80,880

			Rs.
Dearness allowance and special pay of officers			26,420
Dearness allowance of establishment L.S.			73,000
Travelling allowance of officers		Rs.	
Executive Engineers		5,800	
Asstt. Engineers		14,400	
Geologists		8,000	
Asstt. Geologists		9,000	
Soil Physicist		5,000	42,200
Travelling allowance of establishment			
Supervisors		28,000	
Other staff—XEN's		10,000	
Other staff (Geologist)		1,600	
Soil survey staff—			
Sub-overseers		2,000	
Auger measures		2,000	
Other staff		2,000	45,600
(c) *Establishment contingencies*			
Rent for Divisional and Sub-Divisional offices		4,600	
Rent for soil physicist's office and lab.		1,000	
Rent for Geologist's office		1,600	6,600
TOTAL—Establishment			4,50,000

Abstract

I. Works	19,41,000	
II. Tools and Plant	2,00,000	
III Establishment	4,50,000	
GRAND TOTAL	25,91,000	

G. N. PANDIT,

Project Officer (Narbada and Tapti).

IV. Estimate for preliminary surveys and investigations in connection with Projects for the multi-purpose development of the Narbada Basin prepared in accordance with the instructions of the ad hoc Committee.

ABSTRACT

	Rs.
1. Bargi Project	27,39,114
2. Tawa Project	15,42,677
3. Punasa Project	7,35,329
4. Broach Project	11,02,255
5. General Surveys	37,770
TOTAL	64,97,081
Say Rs.	64,97,000

Estimate for the preliminary surveys and investigations for dam sites on the Narbada at Bilgarh and Bargi and on the Burhner River at Ghugri and a canal system taking off from Barg.

ABSTRACT

I. WORKS		
1. *Dams and appurtenant works*		
A. Preliminary expenses		2,35,800
K. Buildings		30,000
2. Main Canals and Branches		10,98,500
3. Malaria Surveys		1,000
4. Electric Load Surveys		2,000
5. Property Surveys		7,500
6. Communications		1,00,000
7. Special Tools and Plant		1,60,000
		16,34,800
	2% contingencies	32,696
		16,67,496
II. TOOLS AND PLANT		2,05,530
III. ESTABLISHMENT		8,66,088
	TOTAL	27,39,114

DETAILS

I. WORKS

Dams and appurtenant works

A. *Preliminary Expenses*

1. Survey of Reservoir basins by air photography and ground survey and plotting of contours at 10 ft.—5 ft. intervals on a scale of 4" = 1 mile.

Ghugri dam	50 sq. miles
Bilghara	25·8 sq. miles
Bargi	97 sq. miles
	172·8 sq. miles

172·8 sq. miles at Rs. 375 per sq. mile. — 65,000

2. Survey of dam sites by air photography and ground survey and plotting on a scale of 32" = 1 mile.
2,700 acres at Rs. 4 per acre — 10,800

3. Geological investigations for foundations

No. of bores

Bilghara	40 Nos.
Ghugri	56 Nos.
Bargi	52 Nos.
	148 Nos.

		Rs.
148 bores each 50 r.ft. at Rs. 20 per r.ft.		1,48,000
4. Soil analysis and burrow surveys	L.S.	7,000
5. Model experiments	L.S.	5,000
		2,35,800
K. *Buildings*		
Temporary Buildings	L.S.	30,000
II. MAIN CANALS AND BRANCHES		
(*a*) Survey of commanded area 18,00,000 acres at (As. 9) per acre		10,12,500
(*b*) Miscellaneous surveys	L.S.	8,000
(*c*) Exploration for founds of cross-drainage works		60,000
(*d*) Soil surveys 18,00,000 acres at Re. 1 per 100 acres		18,000
		10,98,500
III. Malaria surveys		1,000
IV. Electric load surveys		2,000
V. Property surveys 173 sq. miles at Rs. 43 per sq. mile		7,500
VI. Communications		1,00,000
VII. Special Tools and Plant		
2 Diamond drills		1,20,000
Testing apparatus		40,000
		1,60,000
II. TOOLS AND PLANT		
Motor vehicles 7 vehicles at Rs. 7,000		49,000
Working expenses for 3 years		52,500
Scientific Instruments		60,000
Ordinary Tools and Plant		5,000
Camp equipage		15,000
Office furniture		20,000
		2,01,500
2% contingencies		4,030
		2,05,530
III. ESTABLISHMENTS		
Cost of 1 Division for 3 years at Rs. 2,88,696 per year		8,66,088

2. *Estimate for the preliminary surveys and investigations for a dam site on the Tawa River, and a left bank canal taking off from the dam for purposes of irrigation.*

ABSTRACT

I. WORKS		
1. *Dams and appurtenant works*		
A. Preliminary expenses		87,125
K. Buildings		25,000
2. Main canals and branches		6,59,750
3. Malaria surveys		1,000
4. Electric load surveys		500
5. Property surveys		6,000
6. Communications		80,000
7. Special Tools and Plant		1,35,000
		9,94,375
2% contingencies		19,888
TOTAL—Works		10,14,263
II. TOOLS AND PLANT		95,370
III. ESTABLISHMENT		4,33,044
TOTAL		15,42,677

DETAILS

I. WORKS

1. *Dams and appurtenant works*

A. *Preliminary Expenses*			Rs.
1. Survey of reservoir basin by air photography and ground survey and plotting contours at 10 ft.—5 ft. intervals on a scale of 4"=1 mile 139 sq. miles at Rs. 375 per sq. mile			52,125
2. Survey of dam site by air photography and ground survey and plotting on a scale of 32"=1 mile 500 acres at Rs. 4 per acre.			2,000
3. Geological investigations for foundations of dam and reservoir basin by boring, core drilling making drifts, tunnelling, etc. including testing 30 Nos. bores each of 50 Rft. at Rs. 20 per Rft.			30,000
4. Soil surveys and burrow surveys		L.S.	1,000
5. Model experiments by Indian Waterways Station, Poona			2,000
			87,125
K. *Buildings*			
Temporary buildings		L.S.	25,000
2. *Main Canals and Branches*			
1. Survey of the commanded area for Canal alignment 11,00,000 acres at As. 9 per acre			6,18,750
2. Miscellaneous surveys		L.S.	5,000
3. Explorations for foundations of cross-drainage works and necessary surveys		L.S.	25,000
4. Soil surveys 11,00,000 acres at Re. 1 per 100 acres			11,000
			6,59,750
3. Malaria Surveys		L.S.	1,000
4. Electric load survey		L.S.	500
5. Property surveys 139 sq. miles at Rs. 43/- per sq. mile			6,000
6. Communications Constructing and maintaining for 3 years temporary roads		L.S.	80,000
7. Special Tools and Plant			
1. 2 Diamond drills complete with accessories at Rs. 60,000 each			1,20,000
2. Testing apparatus and laboratory equipment for compressive strength of rocks and testing soils for shear strength, optimum moisture content and consolidation, etc.		L.S.	15,000
			1,35,000
			9,94,375
	2% contingencies		19,888
	TOTAL—Works		10,14,263

II. TOOLS AND PLANT

1. Motor vehicles for survey parties 3 Nos. at Rs. 7,000 each		21,000
2. Working expenses for above for 3 years		22,500
3. Scientific Instruments		30,000
4. Ordinary Tools and Plant		2,500
5. Camp equipage		7,500
6. Office furniture		10,000
		93,500
2% contingencies		1,870
		95,370

III. ESTABLISHMENT

Cost of 1 Division for 3 years—8,66,088. 50% chargeable to Tawa	4,33,04

3. *Estimate for the preliminary surveys and investigations for a dam site on the Narbada River near Punasa, for purposes of flood control and generating hydro-electric power.*

ABSTRACT

		Rs.
I. Works		
1. *Dams and Appurtenant Works*		
A. Preliminary Expenses		3,04,500
K. Buildings		30,000
2. Malaria surveys		3,000
3. Electric load surveys		7,500
4. Property surveys		21,500
5. Communications		1,00,000
6. Special Tools and Plant		1,45,000
		6,11,500
	2% contingencies	12,230
	Total—Works	6,23,730
II. Tools and Plant		24,990
III. Establishment		86,609
	Total	7,35,329

DETAILS

I. Works

1. *Dams and appurtenant works*

A. *Preliminary Expenses*

1.	Survey of Reservoir basin by air photography and ground survey and plotting contours at 10 ft.—5 ft. intervals on a scale of 4″=1 mile 500 sq. miles at Rs. 375 per sq. mile		1,87,500
2.	Survey of dam site by air photography and ground survey and plotting on a scale of 32″=1 mile, 2,000 acres at Rs. 4 per acre		8,000
3.	Geological Investigations for foundations of dam site and reservoir basin by boring, core drilling, making drifts, tunnelling, etc. including testing 100 Nos. bores each 50′ deep= 5,000 Rft. at Rs. 20 per Rft.		1,00,000
4.	Soil analysis and burrow surveys for earthen dykes including testing	L.S.	2,000
5.	Model Experiments by Indian Waterways Station, Poona	L.S.	7,000
			3,04,500

K. *Buildings*

1.	Temporary Buildings	L.S.	30,000
2.	Malaria Surveys	L.S.	3,000
3.	Electric load surveys	L.S.	7,500
4.	Property surveys 500 sq. miles at Rs. 43 per sq. miles		21,500
5.	*Communications*		
	Constructing temporary roads and their maintenance for 3 years	L.S.	1,00,000
6.	*Special Tools and Plant*		
1.	2 diamond drills complete with accessories at Rs. 60,000 each		1,20,000
2.	Testing apparatus for Laboratory and workshop equipment for compressive strength of rocks and testing soils for shear strength, optimum moisture content and consolidation, etc.	L.S.	25,000
			1,45,000
			6,11,500
	2% contingencies		12,230
	Total—Works		6,23,730

		Rs.
II. Tools and Plant		
Motor vehicle for survey party 1 No. at Rs. 7,000		7,000
Working expenses for 3 years		7,500
Scientific instruments		6,000
Ordinary Tools and Plant		500
Camp equipage		1,500
Office furniture		2,000
		24,500
	2% contingencies	490
		24,990
III. Establishment		
Cost of 1 Division for 3 years—8,66,088. 10% chargeable to Punasa		86,609

4. *Estimate for preliminary surveys and investigations for the Broach Project consisting of a Pick-up Weir at the end of the Rajpipla Gorge, and left and right bank canals taking off from the weir for purposes of irrigation.*

ABSTRACT

I. Works		
1. *Dams and Appurtenant works*		
A. Preliminary Expenses		28,000
K. Buildings		15,000
2. Main Canals and Branches		5,94,500
3. Communications		20,000
		6,57,500
	2% contingencies	13,150
	Total—Works	6,70,650
II. Tools and Plant		85,170
III. Establishment		3,46,435
	Total	11,02,255

DETAILS

I. Works

1. *Dams and appurtenant works*

A. *Preliminary Expenses*

1. Survey of weir site by air photography and ground surveys and plotting on a scale of 32"= 1 mile, 500 acres at Rs. 4 per acre		2,000
2. Geological Investigations for foundation of weir site by boring, core drilling, etc. including testing. 25 Nos. bores, each of depth 50'=1,250 Rft. at Rs. 20 per Rft.		25,000
3. Model Experiments by Indian Waterways Station Poona	L.S.	1,000
		28,000

K. *Buildings*

Temporary Buildings	L.S.	15,000
2. *Main Canals and Branches*		
1. Survey of commanded areas for alignments of canals, 10,00,000 acres at As. 9 per acre		5,62,500
2. Miscellaneous surveys	L.S.	7,000
3. Explorations for foundations of cross-drainage works and necessary surveys	L.S.	15,000
4. Soil surveys 10,00,000 acres at Re. 1 per 100 acres		10,000
		5,94,500

		Rs.
3. *Communications*		
Constructing temporary roads and maintaining them for 3 years	L.S.	20,000
		6,57,500
2% contingencies		13,150
Total Works		6,70,650
II. TOOLS AND PLANT		
Motor vehicles for survey parties 3 Nos. at Rs. 7,000 each		21,000
Working expenses for 3 years		22,500
Scientific Instruments		24,000
Ordinary Tools and Plant		2,000
Camp equipage		6,000
Office furniture		8,000
		83,500
2% contingencies		1,670
		85,170
III. ESTABLISHMENT		
Cost of 1 Division for 3 years 8,66,088. 40% chargeable to Broach Project		3,46,435

5. ***Estimate for the general investigations and surveys in the whole basin in connection with Projects for the multi-purpose development of the Narbada Basin.***

ABSTRACT

	Rs.
I. WORKS	
1. Discharge and Silt Observations	2,00,000
2. Meteorological Observations	25,800
3. Mineral Surveys	10,000
4. Surveys for Pisciculture	2,000
5. Surveys for Navigation	1,00,000
6. Economic Surveys	25,000
7. Surveys for soil erosion	7,500
	3,70,300
2% contingencies	7,406
Total	3,77,706

DETAILS

I. WORKS

1. *Discharge and silt observations*

One boatman and four khalasis at each discharge site, and cost of ropes, discharge rods, floats, gauges, silt samplers, and laboratory equipment.

10 sites (8 on Narbada and 2 at Tawa and Burhner) at Rs. 5,000 per site per year for 4 years — 2,00,000

2. *Meteorological Observations (Raingauge)*

Raingauges, Temperature, humidity, and wind velocity observations.

(*i*) Equipment and installation of 15 new raingauges (some of these to be of the integrated self-recording type), humidity and wind velocity apparatus at 5 stations at an average rate of Rs. 1,000 — 15,000

(*ii*) Recurring expenditure on part-time observers. 15 observers at Rs. 15 p.m. for 4 years — 10,800

		2,25,800
3. Mineral Surveys	L.S.	10,000
4. Surveys for Pisciculture	L.S.	2,000
5. Surveys for Navigation	L.S.	1,00,000
6. Economic Surveys	L.S.	25,000
7. Surveys for soil erosion	L.S.	7,500
		3,70,300
2% contingencies		7,406
Total Works		3,77,706

Details of the establishment of the two Divisions provided for in the preceding five estimates.

1. *Pay of Officers*	*Details of establishment of the two Divisions*	Expenditure per year Rs.
2 Executive Engineers @ Rs. 875 p.m.		21,000
4 Asstt. Executive Engineers @ Rs. 600 p.m.		28,800
4 Asstt. Engineers @ Rs. 560 p.m.		26,880
1 Geologist @ Rs. 875 p.m.		10,500
2 Asstt. Geologists @ Rs. 500 p.m.		12,000
1 Officer to conduct economic surveys @ Rs. 550 p.m.		6,600
1 Drill Foreman @ Rs. 100 p.m.	1 No. at Rs. 1,000 p.m.	12,000
		117,780
2. *Pay of Establishment*		
3 Meteorological Asstts. @ 240 p.m.		8,640
2 Accountants @ Rs. 200 p.m.		4,800
2 Head Clerks @ Rs. 180 p.m.		4,320
6 Senior Clerks @ Rs. 150 p.m.		10,800
2 Storekeepers @ Rs. 150 p.m.		3,600
14 Junior Clerks @ Rs. 93 p.m.		15,624
2 Senior Draftsmen @ Rs. 200 pm.		4,800
2 Junior Draftsmen @ Rs. 143 p.m.		3,432
4 Tracers @ Rs. 104 p.m.		4,992
2 Sub-Asstts. Surgeons @ Rs. 170 p.m.		4,080
2 Compounders @ Rs. 50 p.m.		1,200
32 Overseers @ Rs. 240 p.m.		92,160
6 Research Asstts. @ Rs. 240 p.m.		17,280
2 Laboratory Asstts. @ Rs. 230 p.m.		5,520
2 Silt Analysts @ Rs. 200 p.m.		4,800
2 Asstt. Silt Analysts @ Rs. 93 p.m.		2,232
10 Gauge Readers @ Rs. 70 p.m.		8,400
10 Senior Observers @ Rs. 90 p.m.		10,800
2 Daffadars @ Rs. 33 p.m.		792
10 Barkandazes @ Rs. 33 p.m.		3,960
14 Peons @ Rs. 33 p.m.		5,544
6 Laboratory khalasis @ Rs. 33 p.m.		2,376
10 Chowkidars @ Rs. 33 p.m.		3,960
		2,24,112
3. Dearness Allowance for officers		16,020
4. Dearness Allowance for establishment		66,480
5. T. A. for officers		40,600
6. T. A. for establishment		60,000
7. Cost of Project circle office debited to Narbada		33,000
8. Establishment contingencies		20,000
		5,77,392

Cost of establishment of 1 Division per year

$$\frac{5,77,392}{2} = 2,88,696$$

Cost of 1 Division for 3 years Rs. 8,66,088

G. N. PANDIT,
Project Officer, (Narbada and Tapti).

APPENDIX V

TAPTI VALLEY PROJECTS

As in the case of the Narbada, no work for utilising the waters of the Tapti river has so far been executed. This river drains a total area of about 30,000 square miles and approximately 45 million acre feet of water precipitate in the basin during the monsoon months. The entire quantity runs to waste to the sea. The Surat plain often gets flooded causing a lot of damage to life and property. During the last 60 years as many as 15 floods have been reported within this area. The maximum discharge has been calculated to have reached the figure of 900,000 cusecs. Towards the end of the last century a proposal for irrigating lands in the Surat plain was investigated but the scheme did not materialise.

Government of Bombay approached CWINC about a year and a half ago with a request to investigate and formulate schemes which would mitigate the evil of flood and enable the water resources of the basin being utilised for such other beneficial purposes as irrigation, extension of navigation and generation of hydel power. Studies of topographical and hydrological data of the basin were accordingly taken up by the CWINC early in 1947. These studies have revealed that quite a number of suitable sites for development exists in the basin whereby construction of dams of low to medium heights reservoirs can be created for storage of water during monsoons, regulated discharges from which can be utilized for the multipurposes of irrigation and power generation. By allowing a reserve for flood absorption in the lowermost reservoir, floods in the Surat plain can be completely controlled.

For the present it has been decided to investigate only six projects of which four are on the main river and two on the tributaries. Another project on an important tributary Girna is being investigated by the Government of Bombay. Total storage at these sites will amount to about 4·5 million acre feet, slightly less than in the case of the Damodar Valley Projects. A gross area of 12,85,000 will be commanded for irrigation and 63,010 kW. of continuous power generated. Such other benefits as fish culture in the reservoirs, recreational amenities and assurance of adequate domestic water supplies will also accrue to the entire basin with the development of these projects. A list of the projects as well as their details is appended to this note.

The estimate amounting to Rs. 42,25,034 has been prepared to cover the cost of necessary surveys and investigations in order to prepare the projects in detail for execution. It is proposed to set up one division with four sub-divisions and requisite number of subordinate and ministerial staff to do the work. Details of the work to be done are shown in the estimate. Topographical surveys of the dam sites, reservoir areas, areas to be commanded for irrigation will be done through the agency of the Survey of India Department. Geological surveys of the dam sites and mineral surveys of the basin will be undertaken in collaboration of the Geological Survey of India. Hydrological surveys will similarly be done in close co-operation with the Indian Meteorological Department. Provisions have also been made for soil surveys of the area to be irrigated and such other items as electrical load surveys, malaria control surveys, fish culture survey and economic and property survey. Necessary staff for geological and other surveys has been provided. It is anticipated that a period of two years will be required to complete all these surveys and investigations. Accordingly staff has been provided for that period. Necessary tools and plant such as survey instruments, core drills, camp requisites have also been provided for.

A statement showing the rough data for the dam sites and the anticipated benefits from the projects is given on page 44. The following maps and charts are enclosed.

(1) An index map of the Tapti basin showing the proposed dam sites and projects.

(2) A profile of the Tapti river and its main tributaries.

G. N. PANDIT,

Project Officer (Narbada and Tapti).

Tapti Basin—Rough Data for the Dam Sites

1. Name of the river . . .	Tapti	Tapti	Tapti	Tapti	Waghur	Panjhra
2. Name of dam site . . .	Atwadhana	Nawtha	Hatnur	Ukai	Bhagpur	Akalpada
3. Length along river (miles) . .	91	259	315	487	44	36
4. Latitude and Longitude at dam site	77° 20′ 0″ E 21° 49′ 15″ N	76° 27′ 0″ E 21° 26′ 0″ N	75° 57′ 0″ E 21° 3′ 30″ N	73° 35′ 30″ E 21° 15′ 30″ N	75° 42′ 0″ E 20° 56′ 0″ N	74° 28′ 0″E 20° 57′ 0″ N
5. Catchment area above dam (sq. miles).	1,049	3,100	11,750	23,365	789	510
6. Average rainfall in catchment (inches).	43	41·88	34·42	30·37	30	30
7. Probable mean annual run-off. (m. a. ft.)	0·92	1·4	2·5	3·43*	0·17	0·108
8. R. L. of river bed . . .	1,190	800	625	175	730	1,170
9. Proposed F. T. L. . . .	1,340	900	690	400	Not worked out.	
10. Maximum height of dam up to F. T. L. (ft.).	150	100	65	225	Not worked out.	
11. Length of dam at F. T. L. (ft.) .	2,700	2,640	20,000	16,000	Not worked out.	
12. Gross capacity of reservoir at F. T. L. (m. a. ft.).	0·82	0·51	..	6·19	Not worked out.	
13. Dead storage (m. a. ft.) . .	0·11	0·20	..	1·71	Not worked out.	
14. Maximum area of water spread (acres).	11,900	19,400	..	1,76,000	Not worked out.	
15. Losses due to evaporation (5·5 ft. per year) (m. a. ft.)	0·042	0·075	..	0·49	Not worked out.	
16. Reserve for flood control (m. a. ft.)	..	..	..	1·05	Not worked out.	
17. Net Storage available (m. a. ft.)	0·67	0·28	..	2·94	Not worked out.	
18. Continuous regulated discharge (cusecs).	890	1,285	1,285	4,000	Not worked out.	
19. R. L. of top of dead storage	1,252	875	..	360	Not worked out.	
20. R. L. of Tail Race . .	1,160	810	..	195	Not worked out.	
21. Average head available for power (ft.).	141	77·5	..	181	Not worked out.	
22. Continuous power available (kW.)	8,360	6,650	..	48,000	Not worked out.	
23. Gross area commanded (acres)	..	..	5,00,000	7,00,000	50,000	35,000

*Excluding run-off intercepted above.

I. Total live storage impounded . . . . . 4·497 m. a. ft.

II. Total continuous power generated . . . . . 63,010 kW.

III. Total gross area commanded for irrigation . . . . . 12,85,000 acres.

Tapti Projects Estimates

Overall Estimate for Preliminary Surveys and Investigations in connection with Projects for the multi-purpose development of the Tapti Basin

Abstract

	Rs.
I. WORKS	
1. Dams and Appurtenant works	
A. Preliminary expenses	5,80,000
K. Buildings	60,000
2. Main canals and Branches	14,78,800
3. Discharge and Silt Observations	1,40,000
4. Meteorological Observations	17,200
5. Mineral survey	5,000
6. Surveys for Pisciculture	1,000
7. Malaria surveys	2,500
8. Electric Load surveys	5,000
9. Surveys for Navigation	[40,000
10. Economic and property survey	20,000
11. Survey for soil erosion	5,000
12. Communications	1,50,000
13. Special Tools and Plant	2,30,000
	27,34,500
2 per cent contingencies	54,690
Total Works	27,89,190
II. TOOLS AND PLANT	
Tools and plant for the Division	2,19,000
2 per cent contingencies	4,380
Total Tools and Plant	2,23,380
III. ESTABLISHMENT	
Establishment for 4 years including establishment contingencies	12,12,464
Grand Total	42,25,034

Details

I. WORKS

Dams and Appurtenant Works

A. *preliminary Expenses*

1. Survey of the reservoir basins by air photography and ground survey and plotting contours at 10ft.—5 ft. intervals on a scale of 4" = 1 mile.

	sq. miles
(*a*) Tukai/Tokarwa dam	275
(*b*) Nawtha Dam	34
(*c*) Atawadhna dam	18·6
(*d*) Waghar and Panjhra dam	15
Total	342·6

342·6 Sq. Miles @ Rs. 375 per Sq. Mile			Rs. 1,28,000
2. Survey of the dam sites and weir sites by air photography and ground surveys and plotting on a scale of 32″=1 mile.			
		acres	
(*a*) Ukai/Tokarwa dam site		3,000	
(*b*) Kakarpar weir site		600	
(*c*) Hatnur weir site		600	
(*d*) Nawtha dam site		600	
(*e*) Atawadhna dam site		600	
(*f*) Panjhra dam site		800	
(*g*) Waghur dam site		1,800	
		8,000	
8,000 acres at Rs. 4 per acre			32,000
3. Geological investigations for foundations of the dam sites and weir sites and of the reservoir basins by boring, core-drilling making, drifts and tunnelling etc., including testing.			
		Nos.	
(*a*) Kakarpar Weir		22	
(*b*) Ukai/Tokarwa dam		160	
(*c*) Hatnur weir		20	
(*d*) Nawtha dam		27	
(*e*) Atawadhna dam		27	
(*f*) Waghur dam		40	
(*g*) Panjhra dam		100	
		400	
400 nos. each of 50,20,000 Rft. @ Rs. 20 per Rft.			4,00,000
4. Soil analysis and burrow surveys for earthen dams, including testing		L.S.	10,000
5. Model Experiments by the Indian Waterways Station, Poona		L.S.	10,000
			5,80,000
K. *Buildings*			
Temporary buildings		L.S.	60,000
II. *Main canals and branches*			
(*a*) Surveys of the commanded areas for alignment of canals.			
		acres	
Canals ex. Kakarpar		7,00,000	
Canals ex. Hatnur		5,00,000	
Canals ex. Waghur and Panjhra		50,000	
		12,50,000	
12,50,000 acres at Rs. 1/2 per acre			14,06,300
(*b*) Miscellaneous surveys		L.S.	10,000
(*c*) Exploration for the foundation of cross-drainage works and necessary surveys			50,000
(*d*) Soil surveys 12,50,000 acres at Re. 1 per 100 acres			12,500
			14,78,800
III. *Discharge and Silt Observations (period 4 years)*			
One boatman and four khalasis at each discharge site, cost of ropes, discharge rods, floats, gauges, silt samplers and laboratory equipment.			
7 sites (5 on Tapti and 2 on Waghur and Panjhra) at Rs. 5,000 per site per year.			1,40,000
IV. *Meteorological Observations, rain gauges, temperature, humidity and wind velocity observations*			
Equipment and installation of ten new rain gauges (some of these to be of integrated self recording type), Humidity and wind velocity apparatus at five stations, at an average rate of Rs. 1,000			10,000
Recurring expenditure on part-time observations 10 observers at Rs. 15 p.m. for 4 years			7,200
			17,200

V. Mineral Surveys	L.S.	5,000
VI. Surveys for Pisciculture	L.S.	1,000
VII. Malaria survey	L.S.	2,500
VIII. Electrical Load surveys	L.S.	5,000
IX. Surveys for navigation	L.S.	40,000
X. Economic and property surveys	L.S.	20,000
XI. Surveys for soil erosion	L.S.	5,000
XII. Communications		
Constructing 50 miles of temporary roads and maintenance for 4 years at Rs. 3,000 per mile		1,50,000
XIII. Special Tools and Plant		
3 Diamond drills complete with accessories at Rs. 60,000 each		1,80,000
Testing apparatus and lab. and workshop equipment for compressive strength of rocks and testing soils for shear strength, optimum moisture content, consolidation, etc.	L.S.	50,000
		2,30,000
		27,37,500
2 per cent contingencies		54,690
Total Works .		27,89,190

II. TOOLS AND PLANT

	Rs.
1. Motor vehicles for survey parties 7 vehicles at Rs. 7,000 each	49,000
Working expenses for 4 years	70,000
2. Scientific Instruments	60,000
3. Ordinary Tools and Plant	5,000
4. Camp equipage	15,000
5. Office furniture	20,000
	2,19,000
2 per cent contingencies	4,380
Total Tools and Plant	2,23,380

III. ESTABLISHMENT

	Expenditure per year
1. *Pay of officers*	
Executive Engineer 1 No. at Rs. 875 p.m.	10,500
Asstt. Executive Engineers 2 Nos. at Rs. 600 p.m.	14,400
Asstt. Engineers 2 Nos. at Rs. 560 p.m.	13,440
Geologist 1 No. at Rs. 875 p.m.	10,500
Asstt. Geologists 2 Nos. at Rs. 500 p.m.	12,000
Drill Foreman 1 No. at Rs. 1,000 p.m.	12,000
	72,840

2. ***Pay of establishment***	
1 Meteorological Assistant at Rs. 240 p.m.	2,880
1 Accountant at Rs. 200 p.m.	2,400
1 Head Clerk at Rs. 180 p.m.	2,160
3 Senior Clerks at Rs. 150 p.m.	5,400
1 Storekeeper at Rs. 150 p.m.	1,800
1 Senior Draftsman at Rs. 200 p.m.	2,400
7 Junior Clerks at Rs. 93 p.m.	7,812
1 Junior Draftsman at Rs. 143 p.m.	1,716
2 Tracers at Rs. 104 p.m.	2,496
1 Sub-Asstt. Surgeon at Rs. 170 p.m.	2,040
1 Compounder at Rs. 50 p.m.	600
16 Overseers at Rs. 240 p.m.	46,080
3 Research Assistants at Rs. 240 p.m.	8,640
1 Laboratory Assistant at Rs. 230 p.m.	2,760
1 Silt Analyst at Rs. 200 p.m.	2,400
1 Asstt. Silt Analyst at Rs. 93 p.m.	1,116
5 Gauge Readers at Rs. 70 p.m.	4,200
5 Senior Observers at Rs. 90 p.m.	5,400
1 Dafadar at Rs. 33 p.m.	396
5 Barkandazes at Rs. 33 p.m.	1,980
7 Peons at Rs. 33 p.m.	2,772
3 Laboratory khalasis at Rs. 33 p.m.	1,188
5 Chowkidars at Rs. 33 p.m.	1,980
	1,10,616
3. Dearness allowance for officers	9,720
4. Dearness allowance of establishment	32,940
5. Travelling allowance for officers	20,000
6. Travelling allowance for establishment	13,000
7. Cost of Project Cirlce office debited to Tapti	17,000
8. Establishment contingencies	10,000
Establishment per year	3,03,116
Total establishment for four years	12,12,464

G. N. PANDIT,

Project Officer, (Narbada and Tapti).

II. Estimate for Preliminary Surveys and Investigations in connection with Projects for Multi-purpose Development in the Basin of Tapti River for the Year 1947-48 submitted to Government for sanction.

ABSTRACT

	Rs.
I. WORKS	61,960
II. TOOLS AND PLANT	1,56,684
III. ESTABLISHMENT	41,895
Grand Total	2,66,540

DETAILS

I. WORKS			
1. Dams and appurtenant works		Rs.	
(i) Survey to be carried out by the Survey of India Department	L.S.	2,500	
(ii) Survey to be carried out by or under the directions of the C. W. I. N. C.	L.S.	19,000	
2. Main canals and Branches —Soil surveys	L.S.	12,640	
Discharge and silt Observations		4,570	
Geological investigations and mineral surveys		1,000	
5. Communications		10,000	
6. Special Tools and Plant (Drill equipment and apparatus for soil laboratory)	L.S.	11,000	
7. Contingencies 2 per cent		1,250	
Total Works		61,960	
II. TOOLS AND PLANT—			
6 weapon carriers at Rs. 7,000 each		42,000	
2 jeeps with trailers at Rs. 7,000 each		14,000	
2 country boats at Rs. 1,000 each		2,000	
3 outboard motors at Rs. 1,000 each		3,000	
6 chronographs at Rs. 100 each		600	
8 levelling instruments at Rs. 800 each		6,400	
1 theodolite at Rs. 1,500		1,500	
1 Binocular at Rs. 200		200	
8 measuring chains at Rs. 15 each		120	
30—100 ft. tapes at Rs. 30 each		900	
30—50 ft. tapes at Rs. 20 each		600	
3 steel tapes at Rs. 100 each		300	
5 Drawing boards at Rs. 30 each		150	
5 second class drawing instruments boxes at Rs. 200 each		1,000	
2 First class drawing instruments boxes at Rs. 300 each		600	
Scales with offset, French curves and miscellaneous scientific instruments and tools and plant		800	
8 current meters at Rs. 1,000 each		8,000	
6 large boats for discharge observations at Rs. 1,000 each		6,000	
6 small boats at Rs. 500 each		3,000	
Discharge rods		800	
Ropes		4,000	
1 set of laboratory apparatus for silt observations at Rs. 1,500		1,500	
Recurring laboratory equipment			200
14 by 14 tents 5 Nos. at Rs. 1,200 each		6,000	
10 by 10 tents 15 Nos. at Rs. 800 each		12,000	
15 shouldaries at Rs. 600 each		9,000	
15 servant's tents at Rs. 600 each		9,000	
Camp furniture L. S.		4,000	
Office furniture for Divisional and Sub-Divl. offices		9,000	
Office furniture for soil physicist's office and laboratory		3,000	
Office furniture for geologist's office		2,996	
Total		1,52,436	200
(b) Repairs and Carriage—Repairs to Trucks			1,000
(c) Contingencies 2 per cent		3,049	
Total Tools and Plant		1,55,485	1,200
Grand Total		1,56,685	

III. ESTABLISHMENT

(a) Pay of officers

1 Executive Engineer for 3 months at Rs. 900 p.m.		2,700
2 Assistant Engineers at Rs. 350 p.m.		2,100
1 Geologist for 3 months at Rs. 600 p.m.		1,800
1 Soil Physicist for 4 months at Rs. 275 p.m.		1,100
	Total	7,700

Pay of establishment

5 Overseers for 3 months @ 180 p.m.	2,700
1 Head clerk for 3 months @ 160 p.m.	480
1 Accountant for 3 months @ 200 p.m.	600
1 Sub-Assistant Surgeon for 1 month @ 200 p.m.	200
2 Clerks for 3 months @ 80 p.m.	480
4 Sub-Divl. clerks for 3 months @ 75 p.m.	900
1 Junior Draftsman for 3 months @ 100 p.m.	300
2 Tracers for 3 months @ 80 p.m.	480
1 Dispenser for 1 month @ 80 p.m.	80
1 Daffadar for 1 month @ 35 p.m.	35
2 Barkandazes for 1 month @ 30 p.m.	60
4 Peons for 3 months @ 30 p.m.	360
2 Peons for 3 months for officers @ 30 p.m.	180
2 Dak runners for 3 months @ 30 p.m.	180
5 Khalasis for 3 months for overseers @ 30 p.m.	450
3 Gauge readers for 3 months @ 30 p.m.	270
Geologists' staff L. S.	600
6 Sub-overseers for 4 months @ 50 p.m.	1,200
3 Laboratory Assistants for 4 months @ 100 p.m.	1,200
2 Clerks for 4 months @ 40 p.m.	320
1 Computor for 4 months @ 40 p.m.	160
1 Tracer for 4 months @ 40 p.m.	160
3 Laboratory peons for 4 months @ 25 p.m.	300
2 Peons for 4 months @ 25 p.m.	200
1 Tapali for 4 months @ 25 p.m.	100
4 Auger measurers for 4 months @ 40 p.m.	640
Total	12,630

Dearness allowances and Special Pay of Officers L. S.	1,965
Dearness allowance of establishment L. S.	8,000
Travelling allowance of officers	
1 Executive Engineer	800
2 Assistant Engineers	800
1 Geologist	1,800
1 Soil Physicist	1,750
	5,150

Travelling allowance of establishment	
Supe visors	1,200
Other staff (Executive Engineer)	1,600
Geologist—Other staff	200
Sub-overseers	600
Auger measures	600
Other Staff	500
	4,700
(b) *Establishment Contingencies*	
Rent for Divisional and Sub-Divisional offices	1,000
Rent for Soil Physicist's office and laboratory	500
Rent for Geologist's office	250
	1,750
Total of establishment	41,895

III. Estimate for the Preliminary Survey and Investigations with the Projects for Multi-purpose Development in the Basin of the Tapti River for the Year 1948-49 submitted to Government for sanction.

ABSTRACT

	Rs.
I. WORKS	16,76,000
II. TOOLS AND PLANT	1,00,000
III. ESTABLISHMENT	2,80,000
Grand Total	20,56,000

DETAILS

I. WORKS

1. Dams and Appurtenant Works—A. Preliminary Expenses		
Survey to be carried out by the Survey of India Deptt.		2,00,000
Surveys to be carried out by or under directions of C.W.I.N.C. L.S.		20,000
K. Buildings L. S.		25,000
2. *Main canal and Branches*		
Misc. surveys as canal alignments, special reservoir surveys etc.		25,00
Soil surveys L. S.		45,000
3. Discharge and Silt Observations L. S.		50,000
4. *Meteorological surveys*		
(*a*) Rain gauges—It is proposed to instal 30 new gauges (*i*) Equipment and installation of gauges 30 new rain gauges including temperature, humidity and wind velocity apparatus at 15 places and some self recording gauges at an average rate of 500/- each		15,000
(*ii*) Observation expenditure per year		
1 Meteorological Assistant at 200/- p.m.	2,400	
1 Senior observer at 120/- p.m.	1,440	
30 Part-time observers at Rs. 15 p.m.	5,400	
30 Part-time retainers at Rs. 12 p.m.	4,320	13,560
		28,560
(*b*) Seismological surveys L. S.		10,000
		38,560
Say		38,000
5. Geological Investigations and mineral surveys etc. L. S.		10,000
6. Communications L. S.		25,000
7. Special Tools and Plant (Drill equipment and apparatus for soil laboratory) L.S.		12,00,000
8. Economic surveys L. S.		3,000
9. *Hydro-Electric Installations.*—A. Prlieminary expenses		
Electric Load surveys L. S.		2,00
Contingencies at 2 per cent		33,000
Total Works		16,76,000

II. TOOLS AND PLANT

3 country boats at Rs. 1000 each	3,000
6 Chronographs at Rs. 100 each	600
4 Levelling instruments at Rs. 800 each	3,200
2 Theodolites at Rs. 1,500 each	3,000
2 Binoculars at Rs. 200 each	400
1 Camera at Rs. 600	600
4 Measuring chains at Rs. 15 each	60
10—100 ft. tapes at Rs. 30 each	300
10—50 ft. tapes at Rs. 20 each	200
2 Steel tapes at Rs. 100 each	200

Scales with offsets, french curves and Misc.		
Scientific instruments, tools and plant	200	
4 current meter at Rs. 1,000 each	4,000	
6 Large boats at Rs. 1,000 each	6,000	
6 Small boats at Rs. 500 each	3,000	
Discharge rods	200	
Recurring laboratory equipment	200	
Ropes	1,500	
7 Nos. 14′ × 14′ tents at Rs. 1,200 each	8,400	
20 Nos. 10′ × 10′ tents at Rs. 800 each	16,000	
20 Shouldaries at Rs. 600 each	12,000	
20 Servants, tents at Rs. 600 each	12,000	
Camp furniture	3,000	
Office furniture for Divl. and Sub-Divl. offices	12,000	
Office furniture for soil Physicist's office and Lab.	2,000	
Office furniture for geologist's office	2,000	
(*b*) Repairs and Carriage-Yearly repairs to trucks	3,500	
2 per cent contingencies	2,000	
Total Tools and Plant	99,560	
	Say	1,00,000

III. ESTABLISHMENT

Pay of Officers

1 Executive Engineer for 12 months @ Rs. 900 p.m.	10,800
4 Assistant Engineers for 12 months @ Rs. 350 p.m.	16,800
1 Geologist for 12 months @ Rs. 600 p.m.	7,200
2 Asstt. Geologists for 12 months @ Rs. 400 p.m.	9,600
1 Soil Physicist at Rs. 275 p.m.	3,300
Total	47,700

Pay of establishment

16 Overseers for 12 months @ Rs. 180 p.m.	34,560
1 Head clerk for 12 months @ Rs. 160 p.m.	1,920
1 Accountant for 12 months @ Rs. 200 p.m.	2,400
1 Sub-Asstt. Surgeon for 12 months @ Rs. 200 p.m.	2,400
5 Clerks for 12 months at Rs. 80 p.m.	4,800
8 Sub-Divl. clerks for 12 months @ Rs. 75 p.m.	7,200
1 Head Draftsman for 12 months @ Rs. 250 p.m.	3,000
1 Junior Draftsman for 12 months @ Rs. 100 p.m.	1,200
2 Tracers for 12 months @ Rs. 80 p.m.	1,920
1 Dispenser for 12 months @ Rs. 80 p.m.	960
1 Daffadar for 12 months @ Rs. 35 p.m.	420
5 Barkandazes for 12 months @ Rs. 30 p.m.	1,800
11 Peons for 12 months @ Rs. 30 p.m.	3,960
6 Peons for 12 months for officers @ Rs. 30 p.m.	2,160
5 Chowkidars for 12 months @ Rs. 30 p.m.	1,800
6 Dak runners for 12 months @ Rs. 30 p.m.	2,160
16 Khalasis for overseers for 12 months @ Rs. 30 p.m.	5,760
10 Gauge readers for 12 months @ Rs. 30 p.m.	3,600
Geologist's staff L. S.	7,400
6 Sub-Overseers for 12 months at Rs. 50 p.m.	3,600

3 Laboratory Asstts. for 12 months @ Rs. 100 p.m.		3,600
2 Clerks for 12 months @ Rs. 40 p.m.		960
1 Computor for 12 months @ Rs. 40 p.m.		480
1 Tracer for 12 months @ Rs. 40 p.m.		480
3 Laboratory peons for 12 months @ Rs. 25 p.m.		900
2 Peons for 12 months @ Rs. 25 p.m.		600
1 Tapali for 12 months @ Rs. 25 p.m.		300
4 Auger measurers for 12 months @ Rs. 40 p.m.		1,920
Total		1,02,260
Dearness allowance and Special pay of Officers L. S.		12,235
Dearness allowance of establishment		49,000
Travelling Allowance of officers		
Executive Engineers	3,200	
Assistant Engineers	6,200	
Geologist	7,200	
Asstt. Geologists	9,000	
Soil Physicist	5,250	30,850
Travelling allowance of establishment		
Supervisors	14,800	
Other staff—XEN'S	6,400	
Geologist other staff	2,300	
Soil survey staff		
Sub overseers	1,900	
Auger measurers	1,900	
Other staff	2,155	29,455
Establishment contingencies		
Rent for Divl. and Sub-Divl. offices		4,000
Rent for soil physicist's office and laboratory		1,500
Rent for geologist's office.		3,000
		8,500
Total Establishment		2,80,000

IV. ESTIMATE FOR PRELIMINARY SURVEYS AND INVESTIGATIONS IN CONNECTION WITH PROJECTS FOR THE MULTI-PURPOSE DEVELOPMENT OF THE TAPTI BASIN, PREPARED IN ACCORDANCE WITH THE INSTRUCTIONS OF THE *ad hoc* COMMITTEE.

ABSTRACT

	Rs.
I. WORKS	
1. Dams and appurtenant Works	
A. Preliminary Expenses	3,19,525
K. Buildings	40,000
2. Main Canals and Branches	4,36,750
3 Discharge and Silt observations	70,000
4. Meteorological observations	13,600
5. Mineral surveys	5,000
6. Surveys for Pisciculture	1,000
7. Malaria survey	2,500
8. Electric Load Surveys.	4,000
9. Surveys for Navigation	40,000
10. Economic and Property surveys	15,000
11. Surveys for soil erosion	4,000
12. Communications	90,000
13. Special Tools and Plant	1,70,000
	12,11,375
2 per cent contingencies	24,227
	12,35,602
II. TOOLS AND PLANT	1,87,680
III. ESTABLISHMENT	5,72,232
Grand Total	19,95,514
Or Say	19,95,500

DETAILS

I. WORKS

1. *Dams and appurtenant works*

A. Preliminary Expenses

	Rs.
1. Survey of the Reservoir Basin by Air photography and ground survey and plotting contours at 10 ft.—5ft. intervals on a scale of 4″=1 mile 275 sq. miles of Ukai/Tokarwa Dam at Rs. 375 per sq. mile	1,03,125
2. Survey of dam and weir site by air photography and ground survey and plotting on a scale of 32″=1 mile	
	acres
Ukai/Tokarwa dam site	3,000
Kakarpar weir site	600
	3,600
3,600 acres at Rs. 4 per acre	14,400
3. Geological investigations for foundations of dam site and weir site and of the reservoir basin by boring, core drilling, making drifts and tunnelling, etc. including testing—	
	Nos.
Kakarpar weir	22
Ukai/Tokarwa dam	160
182 Nos. each of 50 R. ft.—9,100 R ft. at Rs. 20 per R ft.	1,82,000
4. Soil Analysis and burrow surveys including testing. L.S.	10,000
5. Model experiments by the Indian Waterways Station, Poona L.S.	10,000
	3,19,525
K. Buildings—Temporary Buildings. L.S.	40,000

II. *Main Canals and Branches*		
(*a*) Surveys of the commanded area for canal alignment 7,00,000 acres at 0-9-0 per acre.		3,93,750
(*b*) Miscellaneous surveys	L.S.	6,000
(*c*) Exploration for the foundations of cross-drainage works and necessary surveys	L.S.	30,0
(*d*) Soil surveys 7,00,000 acres at Re. 1 per 100 acres		7,000
		4,36,75000
III. *Discharge and Silt observations*		
(Period 2 years)		
One boatman and four khalasis at each discharge site, cost of ropes, discharge rods, floats, gauges, silt samplers and laboratory equipment 7 sites at Rs. 5,000 per site per year		70,000
IV. *Meteorological observations*		
Rain gauges, temperature, humidity and wind velocity observations		
Equipment and installation of ten new rain gauges (some of these to be of the integrated self-recording type) and humidity and wind velocity apparatus at 5 stations, at an average rate of Rs. 1,000		10,000
Recurring expenditure on part-time observations 10 observers at Rs. 15 p.m. for 2 years		3,600
		13,600
		Rs.
V. Mineral surveys	L.S.	5,000
VI. Surveys for Pisciculture	L.S.	1,000
VII. Malaria survey	L.S.	2,500
VIII. Electric load survey	L.S.	4,000
IX. Survey for Navigation	L.S.	40,000
X. Economic and Property surveys	L.S.	15,000
XI. Surveys for soil erosion	L.S.	4,000
XII. *Communications*		
Constructing 30 miles of temporary roads and their maintenance for 2 years at Rs. 3,000 per mile		90,000
XIII. Special Tools and Plant		
1. 2 Diamond Drills complete with accessories at Rs. 60,000 each.		1,20,000
2. Testing apparatus and laboratory and workshop equipment for compressive strength of rocks and testing soils for shear strength, optimum moisture contents, consolidation, etc.	L. S.	50,00
		1,70,000
		12,11,375
2 per cent contingencies		24,227
		12,35,602
II. TOOLS AND PLANT		
1. Motor vehicles for survey parties 7 vehicles at Rs. 7,000 each		49,000
Working expenses for 2 years		35,000
2. Scientific Instruments		60,000
3. Ordinary tools and plant		5,000
4. Camp equipag		15,000
5. Office furniture		20,000
		1,84,000
2 per cent contingencies		3,680
Total tools and plant		1,87,680

III. ESTABLISHMENT

	Expenditure per year. Rs.
1. Pay of officers	
1 Executive Engineer at Rs. 875 p.m.	10,500
2 Asstt. Executive Engineers at Rs. 600 p.m.	14,400
2 Asstt. Engineers at Rs. 560 p.m.	13,440
1 Geologist at Rs. 875 p.m.	10,500
2 Asstt. Geologists at Rs. 500 p.m.	12,000
1 Drill Foreman at Rs. 1,000	12,000
	72,840
2. Pay of Establishment	
1 Meteorological Asstt. at Rs. 240 p.m.	2,880
1 Accountant at Rs. 200 p.m.	2,400
1 Head Clerk at Rs. 180 p.m.	2,160
3 Senior Clerks at Rs. 150 p.m.	5,400
1 Storekeeper at Rs. 150 p.m.	1,800
1 Senior Draftsman at Rs. 200 p.m.	2,400
7 Junior Clerks at Rs. 93 p.m.	7,812
1 Junior Draftsman at Rs. 143 p.m.	1,716
2 Tracers at Rs. 104 p.m.	2,496
1 Sub-Asstt. Surgeon at Rs. 170 p.m.	2,040
1 Compounder at Rs. 50 p.m.	600
16 Overseers at Rs. 240 p.m.	46,080
3 Research Asstts. at Rs. 240 p.m.	8,640
1 Laboratory Asstt. at Rs. 230	2,760
1 Silt Analyst at Rs. 200	2,400
1 Asstt. Silt Analyst at Rs. 93	1,116
5 Gauge Readers at Rs. 70	4,200
5 Senior observers at Rs. 90	5,400
1 Dafadar at Rs. 33	396
5 Barkandazes at Rs. 33	1,980
7 Peons at Rs. 33	2,772
3 Laboratory Khalasis at Rs. 33	1,188
5 Chowkidars at Rs. 33	1,980
	1,10,616
3. Dearness allowance for officers	19,720
4. Dearness allowance for establishment	32,940
5. Travelling allowance for officers	20,000
6. Travelling allowance for establishment	13,000
7. Cost of Project Circle office debitable to Tapti	17,000
8. Establishment contingencies	10,000
Establishment per year	2,86,116
Total Establishment for 2 years	5,72,232

G. N. PANDIT,
Project Officer,
(Narbada & Tapti).

APPENDIX VI.

SABARMATI PROJECT REPORT

(I) *The Sabarmati River*

The Sabarmati river drains a catchment area of 1,723 square miles before entering the Dharoi Gorge. The catchment area above Ahmedabad is about 5,000 square miles. The maximum discharge of the river at Dharoi is about 3,00,000 cusecs, while at Ahmedabad it may be taken to be about 5,00,000 cusecs.

Two important tributaries, the Hathmati (hill catchment about 237 square miles) and the Khari (hill catchment about 100 square miles) meet the Sabarmati between Dharoi and Ahmedabad. Below Ahmedabad, the main stream of the Meshwa System consisting of Meshwa (hill catchment about 316 square miles), Migham (hill catchment about 157 square miles) and Vatrak (hill catchment about 450 square miles) joins the river.

The river is a source of considerable danger to the industrial town of Ahmedabad and villages lower down. Monsoon floods in the past have caused devastation, destroyed crops, carried away cattle, changed course of delta channels and filled up harbours with silt.

(II) *Works and Proposals in the Past*

In the past some very small dams and anicuts for storage and irrigation have been constructed on the tributaries of the river. No large works have been undertaken although proposals to harness the main channel of the Sabarmati river have been under contemplation as far back as the second half of the nineteenth century. A scheme was drawn up in 1904 by Bombay Engineers to construct a dam at Dharoi and three pick-up weirs at different places down the river up to Ahmedabad. The scheme was, however, dropped as it was not considered at the time sufficiently remunerative. Nothing tangible was done till 1935, when the Baroda Engineers started investigations and by 1942 produced a scheme, the details of which are available in two volumes. As the project could not proceed without the agreement of the several States having riparian rights and other interests in the waters of Sabarmati, the Baroda State referred it to the Bombay Government, who in turn sought the opinion of the Government of India. In addition, the Baroda Government wanted their project to be 'vetted' by the Central Waterways, Irrigation and Navigation Commission, and for that purpose a party of Engineers of the CWINC, headed by the Member for Irrigation, visited the area by air and land routes, and discussed the scheme with various interests informally and in conferences. All interests showed keenness to participate in a unified multipurpose development of the Sabarmati basin and not in piecemeal schemes and also wanted that the preparation of such a project be undertaken by the CWINC and that a special Division be opened under it for this purpose.

(III) *Proposals*

To implement the decisions arrived at in the conferences referred to in paragraph II, available data has been studied and proposals are drawn up for opening a Division to complete investigations for drawing up a scheme for unified multipurpose development of the entire Sabarmati basin.

A statement showing the rough details of the dam sites and possible irrigation areas is enclosed. The main work lies on the Sabarmati river itself, as there are possibilities for a dam at Dharoi, where the main stream debouches in the plains. The storage capacity of the reservoir formed by a dam of about 150 feet height at this site may be as much as 30,000 m.c. ft., which is expected in normal years to equal almost all the run-off from the catchment up to this point. The regulated discharge will be of the order of 500 cusecs yielding about 3,000 to 4,000 kW. of firm power, ensuring about 100 cusecs of constant flow for Ahmedabad water supply and making possible irrigation to the extent of about 1,00,000 acres with or without the help of pick-up weirs between Dharoi and Ahmedabad. Detailed investigations are necessary to find the exact location of the sites for pick-up weirs, the alignments for canals and location of the areas to be irrigated.

From a study of the form line sheets, possible sites for a dam on the Hathmati, a dam on Ghuvai, a pick-up weir on the Hathmati for the above two dams, a dam and pick-up weir on Meshwa, a dam on Vatrak and a dam on Majham (the main tributaries of the Sabarmati system) have been located very approximately and marked on the index map. The discharge available due to storage at these dams is likely to irrigate another 1,00,000 acres making a total of 2,00,000 acres irrigation over the entire basin . Taking an intensity of 40% the culturable commanded area should be about 5,00,000 acres. Possible location of the areas making up this figure are shown on the enclosed index map.

(IV) Estimate

An estimate is enclosed. Worked out in great detail, it provides for manning a Division with three Sub-Divisions for two years to complete the necessary investigations and to draw up a complete project for the unified multipurpose development of the entire Sabarmati basin.

The estimate amounts to Rs. 15,10,000. surveys of the reservoir and irrigation areas costing about Rs. 5,86,000 are proposed to be carried out through the Survey of India. All other investigations like the surveys for dam sites, canal alignment, soil surveys, discharge and silt obeservations and property surveys are proposed to be carried out independently by the CWINC. Geological surveys including core drilling are proposed to be carried out with the help of resident geologists and under the general advice of the Geological Survey of India. Meteorological surveys including fixing of new rain gauges and observatories for recording temperatures, humidity, wind velocity, etc. will be planned and carried out by the CWINC, under the guidance of the Meteorological Department.

Necessary provision has been made in the estimate for temporary buildings to accommodate the staff, for communications, for electric load surveys and for laboratory apparatus, etc. Necessary provision has also been made for the purchase of office equipment, scientific and ordinary tools and plant, and motor vehicles for transport in the difficult area.

M. D. MITHAL,

Director, Irrigation and Waterways,

C. W. I. N. C.

STATEMENT SHOWING PROPOSED DAM SITES AND POSSIBLE IRRIGATION AREA ON SABARMATI AND ITS TARIBUTARIES

Name of river or tributary	Site and Location	Dam or pick-up weir	Catchment area in sq. miles	Possible average annual runoff in million cu. ft.	Possible annual irrigation in acres	Area to be surveyed in acres for irrigation	Remarks
Sabarmati	Dharoi . . 72° 51′ E., 24° N.	Dam . .	1,723	15,000	..	..	
	Valasna . . 72° 47′ E., 23° 50′ W.	Pick-up weir .	..	..	60,000	150,000	
	Waghpur . 72° 47′ E., 23° 28′ N.	Do. . .	..	..	40,000	100,000	
	Ahmedabad . 72° 36′ E., 23° 2′ N.	Do. . .	..	..	..	..	100 cusecs will be reserved for Ahmedabad water supply.
Meshwa	Near Lachhai . 73° 10′ E., 23° 30′ N.	Dam . .	316	2,800	28,000	70,000	
Meshwa	Near Warwara. 73° 5′ E., 23° 30′ N.	Pick-up weir .					
Hathmati	Near Fatepur . 73° 10′ E., 23° 40′ N.	Dam . .	237	2,000	20,000	50,000	
Ghuvai	Near Khandial. 73° 5′ E., 23° 40′ N.	Dam .	192	1,600	16,000	40,000	
Hathmati	Near Himmat . Nagar. 72° 58′ E., 23° 36′ N.	Pick-up weir .					
Vatrak	Near Bhanipura 73° 22′ E., 23° 20′ N.	Dam . .	450	3,900	39,000	97,000	
Majham	Near Munsiwara. 73° 22′ E., 23° 17′ N.	Dam . .	157	1,300	13,000	34,000	
		TOTAL .	3,075	26,600	216,000	541,000 acres say 850 sq. miles.	

N. B.—Above the Dharoi dam site, there appear to be some sites for dams as indicated on the plan. These will need to be verified for the sake of negotiations amongst the various interests. The ultimate aim is, however, to concentrate on the Dharoi dam site.

Overall Estimate for Preliminary Surveys and Investigations for Possible Multipurpose Development of Sabarmati Basin

Abstract

Serial No.	Item	Estimated amount
		Rs.
1.	Survey through the Survey of India Staff under the direction of the C. W. I. N. C.	5,86,500
2.	Other river and land surveys to be carried out by the C. W. I. N. C. Staff	48,500
3.	Soil Surveys	17,000
4.	Temporary Buildings	10,000
5.	Discharge and Silt Observations	69,310
6.	Meteorological surveys	2,000
7.	Geological investigations and mineral surveys	1,87,960
8.	Communications	15,000
9.	Special T. & P. for laboratory apparatus for Soil Survey	11,000
10.	Electric load and property surveys	15,000
11.	Working of motor vehicles	30,000
12.	Establishment	2,84,886
13.	Tools and plant	1,63,083
14.	Contingencies and Sundries	69,767
	Grand Total	15,10,000

(Sd.) M. D. Mithal,
Director, Irrigation and Waterways.

DETAILS

Serial No.	Item		Estimated cost	Total
			Rs.	Rs.
1.	Survey through the Survey of India staff			
	(a) Survey of reservoir areas scale 4″= 1 mile . . . 100 sq. miles @ 320/- per sq. mile.		32,000	..
	(b) Contoured survey of Irrigation area scale 4″ = 1 mile. 850 sq. miles @ Rs. 650/- per sq. mile.		5,52,500	..
	(c) Rapid 2″ scale map of Dharoi Dam site . . .		2,000	5,86,500
2.	Other river and land surveys to be carried out by C.W.I.N.C. staff.			
	(a) Survey of dam site areas (scale 1/1000) contour interval 5′ to 10′, 10 sq. miles @ Rs. 2,600 per sq. mile.		26,000	..
	(b) Longitudinal section of the river and its tributaries with cross-sections (500 miles @ Rs. 25 per mile).		12,500	..
	(c) Mapping shoals, sand bars, deep channels and installing guages.		5,000	..
	(d) Miscellaneous surveys such as canal alignment, special reservoir surveys, etc.		5,000	48,500
3.	Soil surveys			
	Work Charged establishment for one year.			
	4 Auger Mukadams @ Rs. 55 p.m. for one year =	2,640		
	16 Khalasies @ Rs. 45 p.m. for one year =	8,640		
	T. A. for work charged establishment . . =	720		
		12,000	12,000	
	Testing Water and soil samples, for one year . . .		5,000	17,000
4.	Temporary Buildings		10,000	10,000
5.	Discharge and silt observations.			
	(a) There will be four discharge sites on Sabarmati and 6 discharge sites on its tributaries.			
	Non-recurring expenditure per site on Sabarmati.			
	Current meter ½ per site	500		
	Boat large	800		
	Discharge rods	100		
	Ropes	300		
	Sounding rods	100		
		1,800		
	For 4 sites non-recurring expenditure	7,200		
	Recurring expenditure (for 2 years) per site on Sabarmati.			
	½ observer @ Rs. 150/- p.m. including dearness allowance and special pay for 1½ years	1,800		
	One boatman @ Rs. 60 p.m. for 1½ years . . .	1,080		
	4 khalasies @ Rs. 55 p.m. for 1½ years . . .	3,960		
		6,840		
	Recurring expenditure for 4 sites = 4 × 6840 . . .	27,360		
	Non-recurring expenditure per site on a tributary of Sabarmati			
	½ current meter	250		
	Boat small	400		
	Discharge rods and sounding rods	100		
	Ropes	100		
		850		

Details—Contd.

Serial No.	Item		Estimated cost	Total
			Rs.	Rs.
	Non-recurring expenditure for 6 sites = 6 × 850 . .	5,100		
	Recurring expenditure (for 2 years) per site on a tributary of Sabarmati.			
	½ observer @ Rs. 150 p.m. including dearness allowance and special pay for 2 years	1,800		
	One boatman @ Rs. 55 p.m. for 1 year	660		
	2 khalasies also suitable as boatsmen @ Rs. 50 p.m. for 1 year	1,200		
		3,660		
	Recurring expenditure for 6 sites on tributaries of Sabarmati = 6 × 3,660	21,960	61,620	
	(*b*) *Silt observations*			
	Equipment	4,000		
	Work charged establishment for 1½ years.			
	Laboratory Assistant @ Rs. 150 p.m. for 1½ years . .	2,700		
	1 Khalasi @ Rs. 55 p.m. for 1½ years	990		
		7,690	7,690	69,310
6.	Meteorological Surveys—			
	Rain guages, temperatures, humidity & wind velocity observations		2,000	2,000
7.	Geological investigations and mineral Surveys—			
	(*a*) Equipment (non-recurring)			
	2 diamond drills with equipment @ Rs. 30,000 each .	60,000		
	2 diamonds and spares for the above @ Rs. 20,000 each .	40,000		
	1 Calyx drill with equipment	20,000		
	Spares for the above	10,000		
	2 large boats for drills @ Rs. 1,000 each . . .	2,000		
	2 compressors @ Rs. 5,000 each	10,000		
		1,42,000	1,42,000	
	(*b*) Running expenses for one year			
	One Drill foreman @ Rs. 1,500 p.m. for one year .	18,000		
	One Resident Asstt. Geologist @ Rs. 350 p.m. for one year	4,200		
	2 Operators @ Rs. 120 p.m.	2,880		
	4 helpers @ Rs. 60 p.m.	2,880		
	Dearness allowance & T. A. of staff	10,000		
	Running expenses for engines for drills, etc. . .	8,000		
		45,960	45,960	187,960
8.	Communications—			
	Constructing and maintaining temporary roads to various dam sites and gauging stations.		15,000	15,000
9.	Special Tools and Plant for laboratory, apparatus for soil surveys		11,000	11,000
10.	Electric load and property Surveys		15,000	15,000
11.	Working of motor vehicles (for 2 years @ Rs. 15,000 per year) .		30,000	30,000
12.	*Establishment*			
	(*a*) Pay of Officers			
	1 Executive Engineer @ Rs. 760 p.m. for 2 years .	18,240		
	3 Asstt. Engineers @ Rs. 350 p.m. for 2 years . .	25,200		
	1 Soil Physicist @ Rs. 275 p.m. for one year . . .	3,300	46,740	
	(*b*) Pay of Establishment—			
	12 Supervisors @ Rs. 140 p.m. for 2 years . . .	40,320		

Details—Contd.

Serial No.	Item	Estimated cost	Total
	1 Accountant @ Rs. 200 p.m. for 2 years	4,800	
	1 Head Clerk @ Rs. 160 p.m. for 2 years	3,840	
	1 Sub-Assistant Surgeon @ Rs. 200 p.m. for 2 years	4,800	
	5 Clerks @ Rs. 80 p.m. for 2 years	9,600	
	3 Sub-Divisional Clerks @ Rs. 75 p.m. for 2 years	5,400	
	1 Accounts Clerk @ Rs. 100 p.m. for 2 years	2,400	
	1 Head Draftsman @ Rs. 300 p.m. for 2 years	7,200	
	1 Junior Draftsman @ Rs. 100 p.m. for 2 years	2,400	
	2 Tracers @ Rs. 60 p.m. for 2 years	2,880	
	1 Computor @ Rs. 60 p.m. for 2 years	1,440	
	1 Ferro Printer @ Rs. 60 p.m. for 2 years	1,440	
	1 Dispenser @ Rs. 80 p.m. for 2 years	1,920	
	1 Storekeeper @ Rs. 80 p.m. for 2 years	1,920	
	4 Daffadars @ Rs. 35 p.m. for 2 years	3,360	
	5 Barkandazes @ Rs. 30 p.m. for 2 years	3,600	
	2 Sub-overseers @ Rs. 60 p.m. for 2 years	2,880	
	9 Peons (3 for Division, 2 for each sub-division) for 2 years @ Rs. 30 p.m.	6,480	
	2 Peons (1 for Ass. Geologist, 1 for soil Physicist) for 1 year @ Rs. 30 p.m.	720	
	4 Peons for Officers (one for Ex. Engr. and 1 each for S.D.O's) for 2 years @ Rs. 30 p.m.	2,880	
	6 Chowkidars @ Rs. 30 p.m. for 2 years	4,320	
	1 Daftri @ Rs. 35 p.m. for 2 years	840	
	6 Dak Runners @ Rs. 30 p.m. for 2 years	4,320	
	12 Khallasies @ Rs. 30 p.m. for 2 years.	8,640	
	11 Gauge-readers @ Rs. 30 p.m. for 2 years	7,920	
	1 Laboratory Attendant @ Rs. 40 p.m. for 1½ years	720	
	2 Clerks for Asstt. Geologist and Soil Physicist for one year @ Rs. 40 p.m.	960	
	3 Clerks special pay for handling cash for 2 years @ Rs. 20 p.m.	1,440	
	Geologist staff for one year	2,000	
		1,41,440	1,41,440
(c)	Dearness allowance for officers		8,000
(d)	Dearness allowance for establishment		24,000
(e)	Travelling allowance for officers —		
	Executive Engineer (2 years)	7,200	
	Asstt. Engineers (2 years)	8,600	
	Asstt. Geologist (1 year)	1,800	
	Soil Physicist (1 year)	1,800	
		19,400	19,400
(f)	Travelling allowance for establishment—		
	Overseers (2 years)	21,600	
	Other Staff (2 years).	10,000	
	Geologists, Staff (1 year)	1,400	
		33,000	33,000

Details– Contd.

S. No.	Item		Estimated cost	Total
	(*g*) Establishment Contingencies—			
	Rent for divisional and Sub-Divisional offices for 2 years	7,000		
	Rent for Soil Physicist's office for 1 year	1,500		
	Rent for Asstt. Geologist's office for 1 year	1,500		
	Rent for Laboratory for 1½ years	2,300		
		12,300	12,300	2,84,880
13.	TOOLS AND PLANT—			
	(*a*) *Scientific instruments and drawing materials*—			
	5 No. Levelling instruments with stand @ Rs. 700 each		3,500	
	1 No. Theodolite with stand @ Rs. 1,000 each		1,000	
	5 No. Prismatic compasses with stand @ Rs. 160 each		800	
	5 No. Planetables with stand @ Rs. 100 each		500	
	14 No. Levelling staves @ Rs. 40 each		560	
	4 No. Scale boxes complete with scales and offsets @ Rs. 15 each		60	
	2 No. Planimeters @ Rs. 200 each		400	
	20 No. Tapes metallic 100 feet @ Rs. 30 each		600	
	20 No. Tapes metallic 50 ft. @ Rs. 20/- each		400	
	2 No. Instrument drawing boxes 1st size @ Rs. 300 each		600	
	4 No. Instrument drawing boxes 2nd size @ Rs. 200 each		800	
	6 No. Instrument drawing boxes 3rd size @ Rs. 100 each		600	
	2 No. parallel rulers @ Rs. 40 each		80	
	Set squares of sizes L. S.		100	
	7 No. Drawing boards @ Rs. 30 each		210	
	7 No. T. Squares @ Rs. 10 each		70	
	18 No. Measuring Chains 100 feet long with arrows @ Rs. 40 each		720	
	6 No. Measuring chains 66 feet long with arrows @ Rs. 30 each		180	
	2 No. French curve boxes @ Rs. 30 each		60	
	2 No. Straight edges brass @ Rs. 30 each		60	
	5 No. Rulers 2 feet fourfold @ Rs. 8 each		40	
	1 Slide rule @ Rs. 200 each		200	
	5 Colour boxes complete @ Rs. 50 each		250	
	12 No. China slabs for colours @ Rs. 3 each		36	
	2 No. Steel tapes @ Rs. 100 each		200	
	1 No. Apparatus for printing plans		300	
	2 No. proportional compasses @Rs. 30 each		60	
	2 No. Glasses magnifying @ Rs. 40 each		80	
	18 No. Poles surveying @ Rs. 15 each		270	
	24 No. Ranging rods @ Rs. 5 each		120	
	18 No. Umbrellas field @ Rs. 50 each		900	
	12 No. Chronographs @ Rs. 90 each		1,080	
	1 Camera @ Rs. 400 each		400	
	4 Binoculars @ Rs. 200 each		800	
			16,036	16,036
	(*b*) *Plants and Machinery*—			
	1 G.M.C. Truck @ Rs. 10,000 each		10,000	
	4 Weapon carriers @ Rs. 7,000 each		28,000	
	6 Jeeps with trailers @ Rs. 6,000 each		36,000	
			74,000	74,000

Details—Contd.

S. No.	Item	Estimated cost	Total
(c)	*Tools*—		
	6 No. Augers with extension pieces @ Rs. 100 each	600	
	6 No. axes carpenters @ Rs. 15 each	90	
	12 No. hammers of sizes @ Rs. 5 each	60	
	24 No. G. I. Buckets @ Rs. 4 each	96	
	24 No. axes country @ Rs. 8 each	192	
	12 No. hammers stone breaking @ Rs. 2 each	24	
	Pegs iron and nails L.S.	100	
	24 No. Pick axes @ Rs. 5 each	120	
	12 No. Plumbs brass @ Rs. 3 each	36	
	6 No. Saws Hand @ Rs. 8 each	48	
	1 No. stoncil plate figures @ Rs. 25 each	25	
	1 No. stencil plate letters @ Rs. 30 each	30	
	24 No. Fire buckets @ Rs. 4 each	96	
	4 No. Iron safes @ Rs. 400 each	1,600	
		3,117	3,117
(d)	*Camp equipment*—		
	12 No. chairs folding with arms @ Rs. 16 each	192	
	24 No. tables camp folding @ Rs. 35 each	840	
	12 No. Cotton durries @ Rs. 80 each	960	
	16 No. Yakdans (record boxes) @ Rs. 40 each	640	
	1 No. Swiss cottage double fly tent 14′ × 14′ @ Rs. 1,200	1,200	
	6 No. Swiss cottage double fly tents 12′ × 12′ @ Rs. 1,000	6,000	
	20 No. double fly tents 10′ × 10′ @ Rs. 700 each	14,000	
	20 No. tent double fly 8′ × 8′ @ Rs. 500 each	10,000	
	12 No. servants tents @ Rs. 600 each	7,200	
	12 No. shouldaries @ Rs. 600 each	7,200	
	6 No. necessary tents @ Rs. 150 each	900	
	7 Bath Boards wooden @ Rs. 5 each	35	
	7 Wash hand basins @ Rs. 4 each	28	
	7 Jugs @ Rs. 4 each	28	
	6 Cots folding @ Rs. 50 each	300	
	36 Country charpoys @ Rs. 9 each	324	
	4 Lamps petromax @ Rs. 50 each	200	
	24 Hurricane lanterns @ Rs. 5 each	120	
	7 Buckets G.I. @ Rs. 5 each	35	
	4 Boxes for petromax lanterns @ Rs. 5 each	20	
		50,222	50,222
(e)	*Office furniture*—		
	7 No. tables for officers @ Rs. 125 each	875	
	20 No. tables with two drawers, handles and locks @ Rs. 60 each	1,200	
	4 No. tables camp folding for clerks @ Rs. 35 each	140	
	48 No. Office cane chairs @ Rs. 15 each	720	
	6 No. easy cane chairs @ Rs. 30 each	180	
	16 No. Cupboards with shelves & Locks @ Rs. 100	1,600	
	26 No. record stands with shelves @ Rs. 35 each	910	
	5 Nos. Yakdans or boxes @ Rs. 40 each	200	

Details—Contd.

S. No.	Item	Estimated cost	Total
	7 No. Benches for peons @ Rs. 25 each	175	
	12 No. Teapoys @ Rs. 15 each	180	
	20 No. Hurricane lanterns @ Rs. 5 each	100	
	4 No. cupboards with six drawers 8" high each, 3' wide 4' long and 5' high for plans @ Rs. 125 each	500	
	12 No. Buckets G. I. @ Rs. 5 each	60	
	14 No. baskets waste paper @ Rs. 3 each	42	
	16 No. call bells @ Rs. 4 each	64	
	12 No. stools wooden @ Rs. 6 each	72	
	1 No. Typewriter portable @ Rs. 300	300	
	5 No. typewriters Remington rand @ Rs. 450 each	2,250	
	5 Nos. scales with weights 1 to 20 tolas @ Rs. 30 each	150	
	12 Nos. cash and stamps boxes steel @ Rs. 20 each	240	
	5 pigeon holes for despatch clerks @ Rs. 50 each	250	
	Miscellaneous petty items such as pen-knives, scissors, locks, inkstands, liveries of peons, etc.	1,500	
		11,708	11,708
	(f) R. & C. of T. & P.—	8,000	8,000
	ABSTRACT—		
	Scientific instruments and Drawing materials	16,036	
	Plants and Machinery	74,000	
	Tools	3,117	
	Camp equipage	50,222	
	Office furniture	11,708	
	R. & C. of T. & P.	8,000	
	TOTAL	1,63,083	1,63,083
14.	Contingencies and sundries	69,767	69,767

YEARLY DISTRIBUTION OF THE AMOUNT OF THE OVERALL ESTIMATE FOR SABARMATI INVESTIGATIONS

Serial No.	Item	Estimated amount	Probable 1948-49 6 months	Expenditure 1949-50	Expenditure 1950-51
		Rs.	Rs.	Rs.	Rs.
1	Surveys through the Survey of India staff under the direction of C.W. I.N.C.	5,86,500	42,000	3,22,500	2,22,000
2	Other river and land surveys to be carried out by C.W.I.N.C. staff.	48,500	6,000	28,500	1,400
3	Soil Surveys	17,000	..	17,000	..
4	Temporary Buildings	10,000	5,000	5,000	..
5	Discharge and Silt Observations	69,310	17,000	34,310	18,000
6	Meteorological Surveys	2,000	1,000	600	400
7	Geological investigations and Mineral surveys	1,87,960	25,000	1,62,960	..
8	Communications	15,000	10,000	5,000	..
9	Special T. & P. for Laboratory, Apparatus for soil Surveys	11,000	11,000	..	..
10	Electric load and property surveys	15,000	..	15,000	..
11	Working of motor vehicles	30,000	7,500	15,000	7,500
12	Establishment	2,84,880	70,000	1,44,880	70,000
13	T. & P.	1,63,083	40,000	1,13,083	10,000
14	Contingencies and Sundries	69,767	15,500	36,167	18,100
	TOTAL	15,10,000	2,50,000	9,00,000	3,60,000

(Sd) M.D. MITHAL,
Director, Irrigation and Waterways.

ESTIMATE FOR PRELIMINARY SURVEYS AND INVESTIGATIONS IN CONNECTION WITH PROJECTS FOR MULTIPURPOSE DEVELOPMENT OF THE SABARMATI BASIN PREPARED IN ACCORDANCE WITH THE INSTRUCTIONS OF THE *AD-HOC* COMMITTEE

ABSTRACT

I. WORKS		
1. Dams and Appurtenant works—		
A. preliminary Expenses		75,120
K. Buildings		10,000
2. Main Canal and Branches		1,44,900
3. Discharge and Silt Observations		33,400
4. Meteorological Observations		2,000
5. Mineral Surveys		5,000
6. Surveys for Pisciculture		1,000
7. Malaria Surveys		2,000
8. Electrical Load Surveys		10,000
9. Economic and Property Surveys		5,000
10. Communications		10,000
11. Special Tools and Plant		71,000
		3,69,420
2% contingencies		7,388
	Total Works	3,76,808
II. TOOLS AND PLANT		
Tools and Plant		1,41,000
2% contingencies		2,820
		1,43,820
III. ESTABLISHMENT		2,66,210
	GRAND TOTAL	7,86,838
	Say	7,87,000

(Sd.) M. D. MITHAL,
Director, Irrigation and Waterways.

DETAILS

I. WORKS—	
Dams and Appurtenant Works	
A. Preliminary Expenses	
1. Survey of the reservoir basins by Air photography and ground survey and plotting contours at 10 ft.—5ft. intervals on a scale of 4″=1 Mile.	
40 square miles @ 375/per sq. Mile.	15,000
2. Survey of the dam sites and weir sites by air photography and ground surveys and plotting on scale of 32″=1 Mile.	
1280 acres @ 4-0 per acre	5,120
3. Rapid 2″ map of Dharoi dam site	2,000
4. Geological Investigation for foundations of the dam sites and weir sites and of the reservoir basins by boring, core drilling, making drifts and tunnelling, etc. including testing.	
46 holes each of 50—2300 R. ft. @ 20/- per R. ft.	46,000
5. Soil analysis and burrow surveys for earthen dams including testing	5,000
6. Model experiments by the Indian Waterways Station Poona	2,000
	75,120
K. Buildings	
Temporary Buildings	10,000
II. Main Canals and Branches	
(*a*) Surveys of the commanded area for alignment of canals	
1,20,000 acres @ 1-2-0 per acre	1,35,000
(*b*) Miscellaneous Surveys	5,000
(*c*) Longitudinal Section of the river and its tributaries with cross sections 100 miles @ 25/- per mile.	2,500
(*d*) Soil Surveys, L.S.	2,400
	1,44,900
III. Discharge and Silt observations (Period October 1948 to May 1950=20 months). One boatman and four khallasies at each discharge site, cost of ropes, discharge rods, floats, gauges, silt samplers and laboratory equipment.	
4 sites at Rs. 5,000/- per site per year for 20 months.	33,400
IV. Meteorological observations, raingauges, temperature, humidity and wind velocity observations	2,000
V. Mineral Surveys	5,000
VI. Surveys for Pisciculture	1,000
VII. Malaria Surveys	2,000
VIII. Electrical Load Surveys	10,000
IX. Economic and Property surveys	5,000
X. Communications	10,000
XI. Special Tools and Plant, 1 Diamond drill complete with accessories @ Rs. 60,000 each	60,000
Testing apparatus and laboratory equipment for compressive strength of rocks, optimum moisture content, consolidation, etc.	11,000
	71,000
	3,69,420
2% contingencies	7,388
Total work	3,76,808
II. TOOLS AND PLANT	
1. Motor vehicles for survey parties. 7 vehicles @ 7000/- each	49,000
2. Working expenses for 15 months	22,000
3. Scientific instruments and drawing materials	30,000

4. Ordinary Tools and Plant	5,000
5. Camp equipage	15,000
6. Office Furniture	15,000
7. R. & C. of T. & P.	5,000
	1,41,000
2% contingencies	2,820
Total Tools and Plant	1,43,820

III. ESTABLISHMENT—

1. *Pay of Officers—*

Executive Engineer 1 No. @ 875/- p. m. for 15 months	13,125
Assistant Engineers 3 No. @ 560/- p.m. for 15 months	25,200
Asstt. Geologist 1 No. @ 500/: p.m. for 6 months	3,000
Drill Foreman 1 No. @ 1000/- p.m. for 6 months	6,000
	47,325

2. *Pay of Establishment—*

Accountant 1 No. @ 200/- p.m. for 15 months	3,000
Head Clerk 1 No. @ 180/- p.m. for 15 months	2,700
Senior Clerk 3 Nos. @ 150/- p.m. for 15 months	6,750
Storekeeper 1 No. @ 150/- p.m. for 15 months	2,250
Senior Draftsman 1 No. @ 200/- p.m. for 15 months	3,000
Junior Clerks 7 Nos. @ 93/- p.m. for 15 months	9,765
Junior Draftsman 1 No. @ 143/- p.m. for 15 months	2,145
Tracers 2 Nos. @ 104/- p.m. for 15 months	3,120
Sub-Assistant Surgeon @ 170/- p.m. for 15 months	2,550
Compounder 1 No. @ 50/- p.m. for 15 months	750
Overseers 12 Nos. @ 240/- p.m. for 15 months	43,200
Research Assistant 1 No. @ 240/- p.m. for 15 months	3,600
Laboratory Asstt. 1 No. @ 230/- p.m. for 15 months	3,450
Silt Analyst 1 No. @ 200/- p.m. for 15 months	3,000
Asstt. Silt Analyst 1 No. @ 93/- p.m. for 15 months	1,395
Gauge readers 5 Nos. @ 70/- p.m. for 15 months	5,250
Senior Observers 4 Nos. @ 90/- p.m. for 15 months	5,400
Daffadars 4 Nos. @ 33/- p.m. for 15 months	1,980
Barkandazes 5 Nos. @ 33/- p.m. for 15 months	2,475
Peons 13 Nos. @ 33/- p.m. for 15 months	6,435
Khallasies for overseers 12 Nos. @ 33/- p.m. for 15 months	5,940
Laboratory Khallasies 3 Nos. @ 33/- p.m. for 15 months	1,485
Chowkidars 5 Nos. @ 33/- p.m. for 15 months	2,475
Dak Runners 5 Nos. @ 33/- p.m. for 15 months	2,475
Ferro printer 1 No. @ 60/- p.m. for 15 months	900
Daftri 1 No. @ 33/- p.m. for 15 months	495
Special pay for 3 Clerks for handling cash for 15 months @ 20/- p.m.	900
	1,26,885
3. Dearness Allowance for Officers for 15 months	7,000
4. Dearness Allowance for establishment for 15 months	38,000
5. Travelling allowance for officers for 15 months	20,000
6. Travelling allowance for establishment for 15 months	15,000
7. Establishments contingencies (for 15 months).	12,000
Total Establishment	2,66,210

TOOLS AND PLANT

1. *Plant and Machinery*

Motor vehicles 7 No. @ 7,000/- each	49,000
Working expenses for 15 months	22,000
	71,000

2. *Scientific instrument and Drawing materials.*

Levels 12 Nos. @ 850/- each	10,200
Folding footrules 12 Nos. @ 7/- each	84
Plotting scales 12 Nos. @ 30/- each	360
Set Squares transparent 8" (45° and 60°), 12 pairs @ 15/- per pair	180
1st quality Drawing Instrument box 1 No. @ 160/- each	160
2nd quality Drawing instrument boxes 12 Nos. @ 62/8/ each	750
French curve set 1 No. @ 30/- each	30
Parallel rulers 5 Nos. @ 60/- each	300
Survey Umbrellas 4 Nos. @ 62/8 each	250
Theodolite 1 No. @ 2,800/- each	2,800
Levelling Staves 16 pairs @ 150/- per pair	2,400
One hundred feet chains 16 Nos. @ 40/- each	640
100 feet Metallic Tapes 20 Nos. @ 30/- each	600
50 feet Metallic Tapes 20 Nos. @ 24/- each	480
Plane-table with stand 5 Nos. @ 100/- each	500
Prismatic compasses 4½" dia. 4 Nos. @ 310 each	1,240
Ranging Rods 72 Nos. @ 5/- each	360
Large size stanley planimeter 1 No. @ 400/- each	400
Small size planimeter 1 No. @ 250/- each	250
Stop watches 5 Nos. @ 100/- each	500
Steel tapes 2 Nos. @ 70/- each	140
Drawing boards with T. Square 7 Nos. @ 50/- each	350
10 inch Slide rule 1 No. @ 50/- each	50
Clinometers 2 Nos. @ 150/- each	300
6 inch celluloid semicircular protractors 4 Nos. @ 5/- each	20
Abney levels in case with stand 2 Nos. @ 360/- each	720
36 inch straight edge 1 No. @ 72/- each	72
Proportional compasses 2 Nos. @ 30/- each	60
Current meters 4 Nos. @ 1,000/- each	4,000
Magnifying glasses 5 Nos. @ 16/- each	80
Blue print apparatus 1 No. @ 600/- each	600
Camera 1 No. @ 300/- each	300
Prismatic binoculars 2 Nos. @ 250/- each	500
66 feet measuring chains 5 Nos. @ 30/- each	150
Colour boxes complete 3 Nos. @ 50/- each	150
China Slabs for colours 12 Nos. @ 2/- each	24
Total	30,000

3. *Ordinary Tools and Plant*

Augers 20 Nos. @ 100/- each	2,000
Carpenters axes 6 Nos. @ 20/- each	120
Country axes 20 Nos. @ 8/- each	240
G. I. Buckets 24 Nos. @ 4/- each	96
Hammers of size 24 Nos. @ 6/- each	144
Stone breaking hammers 12 Nos. @ 3/- each	36

Copper ghadas for water 10 Nos. @ 15/- each	150
Iron pegs and nails L. S.	100
Pick axes 48 Nos. @ 6/- each	288
Brass Plumbs 24 Nos. @ 3/- each	72
Hand Saws 12 Nos. @ 8/- each	96
Stencil plate figures 1 No. @ 29/- each	29
Stencil plate letters 1 No. @ 30/- each	30
Fire buckets 48 No. @ 8/- each	384
Nail extractors 6 No. @ 10/8/- each	63
Phahorahs 48 No. 10/- each	480
Crowbars 24 No. @ 25/- each	600
Sundries	72
Total	5,000

4. *Camp Equipage*

Chairs folding 16 No. @ 12 each	192
Tables camp folding 16 No. @ 30/- each	480
Swiss cottage double fly tent 1 No. 12′ × 12′ @ 1,000/- each	1,000
Double fly tents 10 No. 10′ × 10′ @ 700 each	7,000
Shouldaries 12 No. @ 500/- each	6,000
Necessary tent 1 No. @ 100/- each	100
Country charpoys 24 No. @ 8/- each	192
Sundries	36
	15,000

5. *Office Furniture*

Officer's Writing tables 1 No. @ 170/- each	170
Writing tables 5′ × 3′ × 2½′ with oil cloth 6 No. @ 125/- each	750
Writing table with 2 drawers 25 No. @ 100/- each	2,500
Office chairs 50 No. @ 20/- each	1,000
Easy chairs 6 No. @ 35/- each	210
Cupboards 6′ × 4′ × 1½′ 16 No. @ 125/- each	2,000
Record stands 4′ × 3½′ × 1½′ 16 No. @ 40/- each	640
Steel trunks 16 No. @ 25/- each	400
Cupboard 4′ × 3′ × 1½′ 16 No. @ 60/- each	960
Benches with backs 5′ × 15″ × 18″ 7 No. @ 30/- each	21
Steel stamp boxes 6 No. @ 10/- each	6
Cotton floor carpets 5 No. @ 100/- each	
Teapoys 16 No. @ 20/ each	
Cupboards 4′ × 3′ × 5′ with 6 drawers each 8 high for plans 6 No. @ 150 each	
Waste paper baskets 14 No. @ 2/- each	
Call Bells 12 No. @ 4/- each	
Peon belts 13 No. @ 5/- each	
High Chairs for tracers 2 No. @ 20/- each	
Chamber pot 1 No. @ 5/- each	5
Locks 36 No. @ 3/- each	108
Brass pad locks 8 Nos. @ 15/- each	120
Pigeon holes for despatch clerks 5 No. @ 25 each	125
Scales and weights 5 No. @ 20/- each	100
Steel cash boxes 5 No. @ 25/ each	125
Portable typewriter 1 No. @ 300/- each	300
Standard typewriter 1 No. @ 450/- each	450

Hurricane Lanterns 24 No. @ 5/-each	120
Table Lamps 10 No. @ 25/- each	250
Cycles 2 No. @ 225/-each	450
Safes 4 No. @ 400/-each	1,600
Stools wooden 12 No. @ 6/- each	72
Sundries	374
Total	15,000
G. R. & C. of T. & P.	5,000

Yearly distribution of the amount of the foregoing estimate

	Year 1948-49	Year 1949-50
I. WORKS		
(*i*) *Preliminary Expenses*		
1. Survey of reservoir basin	7,500	7,500
2. Survey of Dam Site	5,120	..
3. Rapid 2" map of Dharoi dam site	2,000	..
4. Geological investigations	..	40,000
5. Soil analysis etc.	5,000	..
6. Model Experiments	..	2,000
(*ii*) *Buildings*		
Temporary Buildings	10,000	..
(*iii*) *Main Canals and Branches*		
1. Survey of the commanded area	67,500	67,500
2. Miscellaneous Surveys	..	5,000
3. Longitudinal Section of the river	2,500	..
4. Soil Surveys	2,400	..
(*iv*) *Discharge and silt observation*	20,000	13,400
(*v*) *Meteorological Observations*	2,000	..
(*vi*) *Mineral Surveys*	5,000	..
(*vii*) *Surveys for pisciculture*	..	1,000
(*viii*) *Malaria Surveys*	2,000	..
(*ix*) *Electric Load Surveys*	..	10,000
(*x*) *Economic and property Surveys*	2,500	2,500
(*xi*) *Communications*	10,000	..
(*xii*) *Special Tools and plant*	..	60,000
(*xiii*) *Testing Apparatus and laboratory equipment*	11,000	.
Contingencies	2,555	4,995
	1,57,075	2,19,895
II. TOOLS AND PLANT		
Tools and Plant	1,43,820	..
III. ESTABLISHMENT	1,33,105	1,33,105
GRAND TOTAL	4,34,000	3,53,000

(Sd.) M. D. MITHAL,
Director Irrigation and Waterways

APPENDIX VII

C. P. and Bastar Projects

Central Provinces and Berar together with Bastar State which has recently merged into this province are one of the richest provinces of India in minerals. There are vast deposits of coal, bauxite, iron, copper, manganese, limestone etc. etc. The quality of coal found, however, is rather inferior and on that account practically no industrial use of the mineral wealth of the tract has so far been attempted. Surveys for the prurpose of utilising the water resources of the area were undertaken about thirty years ago but the results were surprisingly disappointing. In the main it was brought out that in spite of the copious rainfall over the entire area the resources could not be utilised to produce cheap power or cater for much irrigation ! At the request of the C. P. Government a fresh survey was undertaken by the CWINC and it was discovered that potential for power exceeded one million kW. and water could also be made available for perennial irrigation of nearly a million acres of cultivated and cultivable land.

In Bastar State at the request of the State Ministry a similar survey was carried out. This State has about the richest iron ore deposits concentrated in two small areas one on either side of the river Indravati. The percentage of iron in the ores is believed to be from 68 to 70. Potential of power on the Indravati river was found to be nearly 3,00,000 kW. continuous. The plateau of Jugdalpore was similarly discovered to be in a very undeveloped state, only a small portion being utilised for cultivation while actually cultivation could be extended over a much larger level and fertile area.

The possibilities of development were discussed with the Government of C. P & Berar and their technical officers and at a conference held in April, 1947 it was decided to select 8 projects besides those on the Narbada and Tapti for investigations with a view to prepare the detailed development estimates. C. P. Government also desired that the work of investigations should be done by the CWINC. The sites selected for investigations are given in the accompanying list in which other details of the projects are also shown. Similarly the projects for Bastar State have also to be investigated by CWINC. Details of the projects in that area are also shown in the list. The estimate amounting to Rs. 71,17,140 has been prepared to cover the cost of necessary work involved in the surveys and investigations. It is proposed to set up a Circle with three divisions and requisite number of sub-divisions, subordinate and ministerial staff to man the work of investigations. As in other programmes of investigations, survey works of dam sites, reservoir areas, areas to be commanded for irrigation will be completed through the agency of the Survey of India Department. Hydrological surveys and Geological surveys will be done in close co-operation with the Indian Meteorological Department and Geological Survey of India respectively. Provision has also been made for surveys for malaria control, fish cluture, navigation, soil-conservation etc. Provision for the acquistion of necessary plant for geological and hydrological and other surveys has been adequately made. The work is estimated to take four years to complete. The principal feature of the 12 projects 8 in C. P. and Berar and 4 in Bastar state are shown in accompanying statement.

Index map showing dam sites etc. is enclosed.

K. M. Bhatia,
Project Officer,
C. W. I. N. C.

ROUGH DATA FOR DAM SITES

Sl. No.	Name of tributary	Name of Nearest village	Longitude and latitude of left bank at dam site	Names of states or provinces in which dam and water spread fall	Maps in which the dam & water spread falls	Approx. distance from head in miles	Catchment area in sq. miles	R. L. of top of proposed dam above M.S.L.	Approx. height of dam above bed of river in feet	Length of water spread at dam in thousand feet	Capacity in million ac. ft.	Submerged area in acres	Minimum power (Projects) itself kW.	Minimum power in connection with other (Projects) kW.	Irrigation Potential acres
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Pench River .	North of Alkata.	79°16'E 21°43' N	C. P.	55 0/5,1	122 miles on Kanhan river.	1,416·8	1,750	125	11·12	662	15,870	6,300	6,300	1,00,000
2	Wainganga river .	North of Khapa	80° E 22°23' N	C. P.	55N/15 & 64/B/3	100	1,377·28	1,450	75	8·745	·36	15,488	1,800	1,800	50,000
3	Penganga river	At Amti	77°22' E 19°53' N	C. P. & a little of Hyderabad.	56E/5,1 55H/4 55D/16	252	1,596·8	1,600	120	2·97	1·482	35,200	13,400	13,400	3,00,000
4	Wardha river	East of Morai	78°5'E 21°23' N	C. P.	55, K/3,7	70	1,726·72	1,150	116	6·765	0·533	24,000	4,370	4,370	75,000
5	Pairi river .	North of Nirai & Mohera	81°59' 30" E 20°41' N	C. P.	64H/14 & L/2. 64M/14	37	1,196·8	1,140	110	4·455	1·22	48,000	6,360	6,360	1,00,000
6	Jonk river .	East of Uprani	82°33'E 21°35' 30" N.	C. P.	64K/10 64/K/10 11·12	93	1,227·2	880	112	·746	1·22	50,000	5,000	5,000	1,00,000
7	Hasado . .	North of Lotlota	82°42' 30" E 22°28' 30" N.	C. P.	64 J/11,10 64 J/11	104	3,000	1,050	120	1·5	·893	16,448	6,520	6,520	3,00,000
8	Mahanadi .	At Satiara	81°28' E 20°33' 45" N	C. P. & Eastern States.	64 M/6 64 N/6 7,10 11	62	1,133	1,207	77	5·280	1·22	28,000	5,000	5,000	1,50,000
9	Indravati river tributary of Godavari	Chitrakote	81°43' E 19°12' N	Eastern States			5,000						27,000	27,000	Very little
10															
11		Barsur	81°24' E 19°12' N	Eastern States			7,347						32,500	65,000	Very little
		Bhopalpatnam.	80°18' E 18°47' N	C P. & Eastern States	65B/5 65 A/ 4,8 B/1,5,9.	102	16,312	450	160	5·280	8·75	1,54,000	87,680	1,28,000	Very little
12	Sabari .	Gumma	81°52' E 18°35' N	C. P. & Eastern States			2,744	800	100	1·980	2·4	64,000	14,400	22,000	6,90,000

C. P. & BASTAR PROJECTS

Overall estimate for the preliminary surveys and investigations on 12 projects in the Central Provinces and Bastar State. (4 in upper Mahanadi basin, 4 in middle Godavari basin, and 4 in Bastar State).

ABSTRACT

	Rs.
I. WORKS	
1. *Dams and Appurtenant Works*	
(A) Preliminary Expenses	6,80,000
(K) Buildings	1,50,000
2. Main canals and branches	10,60,000
3. Discharge observations	3,10,000
4. Silt Observations	1,37,200
5. Property Surveys	28,800
6. Meteorological Surveys	1,08,720
7. Geological Surveys	19,61,040
8. Communications	1,50,000
	45,85,760
2% Contingencies	92,000
TOTAL WORKS	46,77,760
II. TOOLS AND PLANT	4,46,000
III. ESTABLISHMENT	19,93,380
TOTAL	71,17,140
Distribution—	
1/3 debitable to upper Mahanadi basin	23,72,380
1/3 debitable to middle Godavari basin	23,72,380
1/3 debitable to Bastar State projects	23,72,380

Allotment required

1st year	2nd year	3rd year	4th year
16,52,000	20,65,000	17,00,000	17,00,000

DETAILS

I. WORKS

1. *Dam and Appurtenant Works*

(A) *Preliminary expenses*

(a) *Surveys to be carried out by Survey of India.*

Reservoir Surveys—

Pairi	75	sq. miles
Jonk	78	do.
Hasado	26	do.
Mahanadi	44	do.
Bhopalapatnam	241	do.
Sabari	100	do.
Chitrakot and Barsur	300	do.
Pench	25	do.
Wainganga	25	do.
Pongangs	55	do.
Wardha	38	do.
	1,007	do.

	Rs.
1,007 sq. miles @ 375/- per sq. mile	3,80,000
Surveys to be carried out by C.W.I.N.C.	
Longitudinal Sections and other miscellaneous surveys like canal alignment surveys, special reservior, surveys, pisciculture, etc.	
12 sites @ 25,000/- per site	3,00,000
	6,80,000
(K) *Buildings*—	
Temporary buildings—Lump Sum	1,50,000
2. *Main canals and branches*	
Survey of irrigation area.	
18,75,000 acres @ -/9/- per acre	10,60,000
3. *Discharge observations* (No. of sites—12) (one at each project site)	
Expenditure per site	(non-recurring)
1 current meter @ 1,200/-	1,200
1 large boat @1,000/-	1,000
1 small boat @ 500/-	500
1 set velocity rods @ 200/-	200
1 set sounding rods @ 100/-	100
Ropes, etc.	600
Chronometers	200
Rack & pinion arrangement	200
Anchors	1,000
(*b*) *Recurring*	5,000
1 gauge reader @ 75/- for 4 years	3,600
1 Boatman @ 60/- p.m. for 4 years	2,880
6 Khalasies @ 50/- for 4 years	14,400
	20,880
Total for one site	25,880
Total for 12 sites	3,10,000
4. *Silt observations*	
(*i*) Equipment non-recurring @ 1,000/- per site	12,000
(*ii*) 12 silt observers @ 100/- for 4 years	57,600
(*iii*) 16 Khalasies for 4 years @ 50/- p.m.	57,600
(*iv*) Miscellaneous on carriage and transport	10,000
	1,37,200
5. *Property Surveys.*—	
2 surveyors @ 100/- p.m. for 3 years	7,200
12 khalasies @ 50/ p.m. for 3 years	21,600
	28,800
6 *Meteorological Surveys.*	
(*a*) *Equipment non-recurring.*	
60 new rain gauges @ 500/- each	30,000
(*b*) *Recurring.*	
2 Meteorological Assistants @ 200/- for 4 years	19,200
2 Senior observers @ 120/- for 4 years	11,520
60 part-time observers @ 16/- for 4 years	48,000
Total Meteorological Surveys	1,08,720

	Rs.
7. *Geological Surveys.*	
(a) *Equipment non-recurring.*	
8 Diamond Drills @ 75,000/- each	6,00,000
Diamonds and other spares @ 40,000/- per set	3,20,000
2 calyx drills 5"-6" complete with equipment and spares	50,000
8 special boats for drills @ 2,000/- each	16,000
Testing apparatus	1,00,000
	10,86,000
(b) *Recurring expenditure.*	
(3 years operations are considered enough).	
1 Geologist @ 800/- p.m. for 3 years	28,800
2 Assistant Geologists @ 400/- for 3 years	28,800
1 Drill foreman @ 1,000/- for 3 years	36,000
3 Operators (1 per drill) @ 150/- for 3 years	43,200
48 helpers (6 per drill) @ 80/- for 3 years	1,38,240
Fuel and other expenditure @ 20,000/- p.m. for 30 months	6,00,000
	8,75,000
Total for Geological surveys	19,61,040
8. *Communications.*	
Lump Sum	1,50,000
Total of Works	45,85,760
2% Contingencies	92,000
GRAND TOTAL WORKS	46,77,760
II. TOOLS AND PLANT—	
(a) *Camp equipment.*	
12 tents 14'×14' @ 1,200/- each	14,400
20 tents 10'×10' @ 800/- each	14,000
30 shouldaries @ 600/- each	18,000
30 servants tents @ 500/- each	15,000
Camp furniture	7,200
	78,600
(b) *Other tools and plant.*	
(i) *Non-recurring.*	
15 3/4 ton weapon carrier trucks @ 7,000/- each.	1,05,000
6 jeeps with trailers @ 7,000/- each	42,000
12 outboard motor @ 1,000/- each	12,000
48 levelling instruments @ 1,000/- each	48,000
48 measuring chains @ 50/- each	2,400
48-100 ft. tapes @ 30/-each	1,440
48-50 ft. tapes @ 20/- each	960
8 Theodolites @ 2,000/- each	16,000
15 binoculars @ 300/- each	4,500
20 drawing boards @ 30/- each	600
20 plane tables @ 150/- each	3,000
12 Prismatic compasses @ 150/- each	1,800
4 planimeters @ 500/- each	2,000
36 drawing instruments boxes 2nd class @ 200/- each	7,200
Scales with off sets, French curves	1,000
	2,46,940

	Rs.
(ii) *Recurring expenditure.*	
Repairs and carriage of scientific instruments for 4 years	50,000
Running expenses for trucks and jeeps for 4 years	1,50,000
	2,00,000
Total (a) & (b) Tools and Plant	4,46,000

III. ESTABLISHMENT.

(Provision is for 4 years)

1 Superintending Engineer @ 1850/- p.m.	88,800
3 Executive Engineers @ 800/- p.m. each	1,15,500
6 Assistant Executive Engineers @ 600/- p.m. each	1,72,800
6 Assistant Engineers @ 500/- p.m. each	1,44,000
1 Superintendent @ 300/- p.m.	14,400
3 Head Clerks @ 200/- p.m. each	28,800
3 Accountants @ 200/- p.m. each	28,800
1 Stenographer @ 200/- p.m.	9,600
18 Upper Division Clerks including S.D.Cs. @ 100/- p.m. each	86,500
32 Lower Division Clerks @ 75/- p.m. each	1,15,000
3 Steno-typists @ 100/- p.m. each	14,400
1 Head Draftsman @ 300/- p.m.	14,400
8 Senior Draftsmen @ 160/- p.m. each	23,040
8 Draftsmen @ 100/- p.m. each	38,400
8 Tracers @ 75/- p.m. each	28,800
48 Overseers @ 150/- p.m. each	3,45,000
3 Sub-Assistant Surgeons @ 150/- p.m. each	21,600
6 Research Assistants @ 180/- p.m. each	51,900
6 Laboratory Assistants @ 125/- p.m. each	38,000
3 Compounders @ 75/- p.m. each	10,800
3 Ward boys @ 50/- p.m.	7,200
1 Jemadar @ 40/- p.m.	1,920
28 peons @ 30/- p.m.	40,500
50 Barkandazes @ 30/- p.m.	72,400
12 Daffadars @ 30/- p.m.	17,300
1 Daftri @ 40/- p.m.	1,920
TOTAL	11,93,380
Dearness allowance and increments @ 25 %	3,00,000
Travelling allowance	3,00,000
Establishment contingencies including office furniture ; typewriters etc.	2,00,000
Total Establishments	19,93,380

The 3rd May, 1948

(Sd:) K.M. BHATIA,
Project Officer, C.W.I.N.C.

Estimates for preliminary surveys and investigations in connection with projects for multipurpose development in C. P. and Bastar State prepared in accordance with the suggestions of the Ad-Hoc *Committee.*

ABSTRACT

		Rs.
I. WORKS—		
1. *Dams and Appurtenant Works*—		
(A) Preliminary expenses		5,24,000
(K) Buildings		1,00,000
2. Main canals and branches		7,59,375
3. Discharge observations		1,65,280
4. Silt observations		70,600
5. Property Surveys		28,800
6. Meteorological surveys		84,040
7. Geological Surveys		16,59,360
8. Communications		1,00,000
		35,01,455
	2% Contingencies	70,029
	TOTAL WORKS	35,71,484
II. TOOLS AND PLANT		4,27,380
III. ESTABLISHMENT		14,10,375
	TOTAL	54,09,239

Allocation.

1/2 of above debitable to 4 C.P. Projects on Pairi, Jonk, Hasado and Mahanadi rivers	27,04,620
1/2 of above debitable to 4 projects in Bastar State on Sabari and Indravati (3 projects) rivers	27,04,620

ALLOTMENT REQUIRED.

1st year	*2nd year*	*3rd year*
16 lacs	20·9 lacs	18 lacs

DETAILS

I. WORKS—

1. *Dams and Appurtenant Works*—

(A) *Preliminary expenses*—

(*a*) Surveys to be carried out by the Survey of India.

Reservoir surveys

Pairi	75	sq. miles.
Jonk	78	do.
Hasado	26	do.
Mahanadi	44	do.
Bhopalapatnam	241	do.
Sabari	100	do.
Chitrakot & Barasur	300	do. (Approx.)
	864	do.

864 sq. miles @ 375/- per sq. mile . . . Rs. 3,24,000

(*b*) *Surveys to be carried out by C.W.I.N.C.*

Longitudinal Sections and other miscellaneous surveys like canal alignment surveys, special reservoir surveys, pisciculture, etc.

8 sites @ 25,000/- per site . . . . . [2,00,000

[5,24,000

			Rs.
(K) *Buildings*—			
Temporary buildings Lump Sum			1,00,000
2. *Main Canals and Branches* —			
Survey of irrigation area.			
13,50,000 acres @ -/9/- per acre			7,59,375
3. *Discharge observations*—			
Number of sites—8 (one at each dam site)			
Expenditure per site			
(a) *Equipment non-recurring*—			
1 current meter @ 1200/-			1,200
1 large boat @ 1000/-			1,000
1 small boat @ 500/-			500
1 set velocity rods @ 200/-			200
1 set sounding rods @ 100/-			100
Ropes etc.			600
Chronometers			200
Rack and pinion arrangements			200
Anchors			1,000
			5,000
(b) *Recurring*—			
1 gauge reader @ 75/- for 3 years		2,700	
1 Boatman @ 60/- for 3 years		2,160	
6 Khalasies @ 50/- for 3 years		10,800	
		15,660	
Total for one site		20,660	
For 8 sites		1,65,280	
4. *Silt observations*—			
(i) Equipment non-recurring @ 1000/- per site			8,000
(ii) 8 Silt observers @ 100/- for 3 years			28,800
(iii) 16 khalasies @ 50/- for 3 years			28,800
(iv) Miscellaneous on Carriage & Transport			5,000
			70,600
5. *Property Surveys*—			
2 surveyors @ 100/- p.m. for 3 years			7,200
12 Khalasies @ 50/- p.m. for 3 years			21,600
			28,800
6. *Meteorological Surveys*—			
(a) *Equipment non-recurring*—			
50 new rain gauges @ 500/- each			25,000
(b) *Recurring*—			
2 Meteorological Assistants @ 200/- for 3 years			14,400
2 Senior Observers @ 120/- for 3 years			8,640
50 part-time observers @ 20/- for 3 years			36,000
			84,040

	Rs.
7. *Geological Surveys—*	
(a) *Equipment non-recurring—*	
8 Diamond Drills @ 75,000/- each	6,00,000
Diamonds and other spares @ 40,000/- per set	3,20,000
2 Calyx drills 5"-6" complete with equipment and spares	50,000
8 special boats for drills @ 2000/- each	16,000
Testing apparatus for rocks and rock material	1,00,000
	10,86,000
(b) *Recurring expenditure—*	
1 Geologist @ 800/- for 2 years	19,200
2 Assistant Geologists @ 400/- for 2 years	19,200
1 Drill Foreman @ 1000/- for 2 years	24,000
8 Operators (1 per drill) @150/- for 2 years	28,800
48 helpers (6 per drill) @ 80/- for 2 years	92,160
Fuel and other expenditure @ 20,000/- p.m. for 20 months	4,00,000
	5,83,360
Total for Geological surveys	16,69,360
8. *Communications*	
Lump sum	1,00,000
TOTAL OF WORKS	34,11,815
2 % Contingencies	70,236
GRAND TOTAL WORKS	34,82,055
TOOLS AND PLANT—	
(a) *Camp equipage—*	
8 tents 14'×14' @ 1200/- each	9,600
20 tents 10'×10' @ 800/- each	16,000
20 shouldaries @ 600/- each	12,000
20 servants tents @ 500/- each	10,000
Camp furniture	4,800
	52,400
(b) *Other tools and plant—*	
(i) *Non-recurring.*	
15 3/4 ton weapon carrier trucks @ 7,000/- each	1,05,000
6 jeeps with trailers @ 7,000/- each	42,000
8 outboard motors @ 1,000/- each	8,000
32 levelling instruments @ 1,000/- each	32,000
32 measuring chains @ 50/- each	1,600
32-100 ft. tapes @ 30/- each	960
32-50 ft. tapes @ 20/- each	640
6 Theodolites @ 2,000/- each	12,000
10 binoculars @ 300/- each	3,000
15 drawing boards @ 30/- each	450
15 plane tables @ 150/- each	2,250
12 Prismatic compasses @ 150/- each	1,800
3 Planimeters @ 500/- each	1,500
24 drawing instrument boxes 2nd class @ 200/- each	4,800
Scales with offsets, French curves, etc.	600
	2,16,600

(ii) *Recurring expenditure.*

Repairs and carriage of scientific instruments for 3 years	37,500
Running expenses for trucks and jeeps for 3 years	1,12,500
	1,50,000
Total (a) and (b) Tools and Plant	4,19,000
2 % Contingencies	8,380
Grand Total Tools and Plant	4,27,380

II. ESTABLISHMENT

(Provision for 3 years).

1 Superintending Engineer @ 1,850/- p.m.	66,600
2 Executive Engineers @ 800/- p.m.	57,600
4 Asstt. Executive Engineers @ 600/- p.m.	86,400
4 Asstt. Engineers @ 500/- p.m. each	72,000
1 Superintendent @ 300/- p.m.	9,600
2 Head Clerks @ 200/- p.m. each	14,400
2 Accountants @ 200/- p.m. each	14,400
1 Stenographer @ 200/- p.m. each	7,200
13 Upper Division clerks including S.D. Cs. @ 100/- p.m. each	46,800
23 Lower Division clerks @ 75/- p.m. each	62,100
2 Steno-typists @ 100/- p.m. each	7,200
1 Head Draftsman @ 300/- p.m.	9,600
2 Senior Draftsmen @ 100/- p.m. each	11,520
6 Draftsmen @ 100/- p.m. each	21,600
6 Tracers @ 75/- p.m. each	16,200
32 Overseers @ 150/- p.m. each	1,72,800
2 Sub-Asstt. Surgeons @ 150/- p.m. each	9,600
4 Research Asstt. @ 180/- p.m. each	25,920
4 Silt Analysts @ 180/- p.m. each	14,400
4 Laboratory Asstts. @ 125/- p.m. each	18,000
2 Compounders @ 75/- p.m. each	4,800
2 Ward boys @ 50/- p.m. each	3,600
1 Jemadar @ 40/- p.m.	1,440
21 peons @ 30/- p.m. each	22,680
44 Barkandazes @ 30/- p.m. each	47,520
10 Daffadars @ 30/- p.m. each	10,800
1 Daftri @ 40/- p.m.	1,440
	8,40,300
Dearness allowance @ 25%	2,10,075
Travelling allowance	1,80,000
Establishment contingencies including office furniture, typewriters, etc.	1,80,000
TOTAL ESTABLISHMENT	14,10,375

3-5-1948.

(Sd) K. M. BHATIA,

Project Officer, C. W. I. N. C.

APPENDIX VIII

REPORT

ASSAM PROJECTS REPORT

Assam, the easternmost Province of India, covers an area of 63,000 square miles and gets an annual precipitation of 286 million acre feet. It has tremendous water power potential and a vast scope for industrialisation from its mineral and forest wealths. It suffered a strategic strain during the last war and with partition has become still more important and therefore needs an industrial development all round.

The Province can roughly be divided into 2 main valleys, the Brahmaputra valley in the north and the Surma valley in the south. The waters of these rivers at present cause devastating floods, destroying crops, water logging lands and creating problems of soil erosion and denudation. At the instance of the Government of Assam, the Central Waterpower, Irrigation and Navigation Commission undertook a preliminary survey for multipurpose schemes to solve the above problems as well as to provide cheap power for industrialisation. The available data which is very meagre showed that 12 schemes, 3 in the Surma valley and 9 in the Brahmaputra valley could be mooted. Of these 4 schemes on the Barak and Someshwari rivers in the Surma valley and Dihang and Manas rivers in the Brahmaputra valley were entrusted for investigation to the Central Waterpower, Irrigation and Navigation Commission at a conference held by His Excellency the Governor of Assam in October 1947.

The Central Waterpower, Irrigation and Navigation Commission started investigations on these four schemes in January 1948, and two of the rivers Dihang and Barak have been inspected by an Engineer, Dihang having been inspected by a Geologist also. The inspection has shown that schemes on both the rivers are promising.

The four schemes are briefly described below in order of priority and their principal features are shown in the accompanying statement.

1. *Dihang*—It is the main tributary of the Brahmaputra and possesses 2 excellent storage sites within 13 miles of its debouch from the hills. A 500 feet dam will impound lake of 9·82 million acre feet and generate at least one million K. W. of continuous power. The scheme will provide for flood absorption by storing the supply of the main tributary at times of rain thereby releasing the capacity of Brahmaputra in the lower basin to absorb floods from other tributaries. The lake will be 70 miles long and help in opening up the tribal areas of Assam.

2. *Barak*—Barak rises in the hills of Manipur State, bifurcates into two estuaries the Surma and the Kusiyra, which both fall into the Meghna river. When Meghna is in floods, its back water effect interrupts drainage of the Surma Valley with the result that the plains of Catchar and Sylhet districts become almost one sheet of water. A storage scheme on this river would absorb floods thereby reclaiming the plains of Surma Valley from water-logging and will provide irrigation to the reclaimed areas as also generate about 2,90,000 K. W. of power, which can be used in industrial exploitation of the tremendous forest wealth of Manipur and Lushai hills. As these hills are of shalys formations, 3 alternate schemes as shown in the statement have to be investigated.

3. *Manas*—Manas is the largest tributary of the Brahmaputra at the western end of Assam. The river is snow *cum* rain fed and large icebergs are reported now and again to form artificial dams in the river and cause unexpected floods when any one of them gives way. A 400 feet high dam will solve this flood problem, generate 2,50,000 K. W. of continuous power and provide irrigation to the western areas of Assam. The Government of India have under consideration a project for a navigation canal between Ganges, Tista and Brahmaputra to provide water transport between Assam and West Bengal. The Manas project will shorten one of the links in the development of this canal as it will make Manas navigable throughout the year and the canal can be connected with Brahmaputra through Manas.

4. *Someshwari*—Someshwari river provides a site for power generation at the southern fringe of Gharo hills. The river has a catchment area of 803 square miles and a 340 ft. high dam will store the entire run-off. There are rich coal fields and purest limestone quarries near this site and the power generated is expected to help in the development of these industries.

To enable these 4 schemes to be put through, detailed investigations covering topographical surveys of reservoir areas, surveys for irrigation, hydrological surveys, meteorological observations, geological surveys, navigational surveys, soil conservation surveys and pisciculture surveys have to be undertaken. It is proposed to open up a Circle with 3 Divisions and 9 sub-divisions to carry out these investigations and complete them in a period of 3 years. Besides the civil staff, the geological staff and the meteorological staff have been provided and the total estimate for the investigations amounts to Rs. 50,00,000.

5. Index map showing dam sites, etc. is enclosed.

K. M. BHATIA,
Project Officer, C. W. I. N. C.

3-5-1948.

ROUGH DATA FOR DAM SITES IN ASSAM PROVINCE

S. No	Name of Tributary	Name of nearest village	Longitude and Latitude of left bank of dam site	Map in which dam and water spread fall	Approx. catchment area in sq. miles	Maximum water Level	Approx. height of F.T.L. over river level in feet	Approx. length of water spread at M.W.L. at dam site in miles	Submerged area in acres	Approx. length of dam in feet	Capacity in m.a.ft.	Average rain-fall for 11 years (Inches)	Run-off as per Inglis* formula (at 50%, M. a. ft.	Power potential K. W.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Dihang	Rengging	95°-14′-30″ E 28°-11′-30″ N	82/P.L.	89,600	1,000	470	68	60,000	1900	9·82	170·43	56·08	1,000,000
2	Manas	Matharguri	90°-56′-30″ E 26°-48′-30″ N	78/J.M. N.	11,300	1,000	400	34	64,700	1900	10·67	105·73	54·18 46·94	240,000
3	Someshwari	Masighat	90°-38′-30″ E 25°-13′-30″ N	78 K/S. E.	800	400	330	29	33,200	2000	4·75	125·14	31·86 4·85	65,000
4	(I) Barak	Sibapurikhal	93°-3′-0″ E 24°-32′-0″ N	83 H/N.W. N.E.S.W.S.E.	4,800	500	440	129	89,600	4000	16·00	82·10	2·67 17·9	290,000
4(II)	Barak	Bhubandhar	93°-12′-30″ E	83H/N.W.S. W									10·5	
4(III)A	Barak	Bhubandhar	24°-41′-0″ N 93°-6′-0″ E	83/N.W.S.W.	5,270	400	340	108	94,000	4000	15·15	82·10	19·5	225,000
4(III)B	Ahu	Tingmum	24°-41′-0″ N 93°-6′-0″ E	83 H/N.W.	5,270	300	240	88	58,300	4000	7·19	82·10	11·6 19·5	116,000
4(III)C	Irang & Tinjang	Gallon	24°-41′-30″ N 93°-15′-0″ E	83 H/S.W.	1,475	450	250	upto upper Dam 31	6,700	2000	0·74	82·10	11·6 5·44	21,000
			24°-30′-30″ N	N.W.	1,440	450	260	28	7,000	2000	0·93	82·10	3·22 5·3	21.000
													3·15	

*Inglis formula is given as R″-0- 85P″—12″.

Overall estimate for preliminary surveys and investigations for four projects in Assam

ABSTRACT

Period of investigation	3 years	
Detailed estimates as prepared and submitted to W. M. P. for 15 months operations—		
(Establishment provided for 12 to 14 months)	23·08	lacs
Deduct non-recurring cost	10·3	lacs
	12.78	lacs
Assume 3 times this cost for 3 years operations	38·4	lacs
Add non-recurring cost	10·3	lacs
Total .	48·7	lacs
Say .	50	lacs

3-5-1948.

(Sd.) K. M. BHATIA,

Project Officer, C. W. I. N. C.

Rough estimates of preliminary investigations of the Assam Projects for the years 1947-48 and 1948-49

ABSTRACT

	1947-48	1948-49
	Rs.	Rs.
1. Surveys by Survey of India Department	10,000	4,00,000
2. Surveys by C. W. I. N. C.	5,000	1,10,000
3. Discharge observations (4 sites)	2,500	30,000
4. Silt Observations	2,000	23,000
5. Property Surveys	..	10,000
6. Meteorological Surveys	..	40,000
7. Seismological Surveys	..	20,000
8. Geological investigations	..	8,00,000
9. Communications	..	25,000
10. Temporary buildings	..	25,000
11. Camp equipage	20,000	10,000
12. Tools and Plant	1,00,000	80,000
13. Establishment	40,000	2 40,000
14. Dearness allowance	16,000	96,000
15. Travelling allowance	12,000	72,000
16. Office contingencies	60,000	60,000
Total . .	2,67,500	20,41,000

NEW DELHI ;
18-11-47.

MAN SINGH,
Director of Waterways, C.W.I.N.C.

DETAILS

	Rs.	Rs
I. *Surveys to be carried by Survey of India Department under direction of the C.W.I.N.C.*		
(*a*) Gorge sites 25 sq. miles at 110/- per sq. mile	2,750	..
River survey 1,000 sq. miles at Rs. 44/- per sq. mile	44,000	..
Moving aircraft etc.	3,250	..
(*b*) *Surveys and map publications.*—		
Gorge sites 5,000 acres at Rs. 4/- per acre	20,000	..
River Survey 900 sq. miles at Rs. 160 per sq. mile	1,44,000	..
	1,64,000	..
(*c*) Contoured surveys of Assam projects flood plain in Assam for Irrigation and other protective measures, 3,48,000 acres at -/9/- per acre	1,96,000	4,10,000
II. *Survey to be carried out by or under direction of the C. W. I. N..C.*—		
(*a*) Longitudinal Sections of rivers and cross-sections, 650 miles at 150/- per mile	97,500	..
(*b*) Other miscellaneous surveys, *e.g.*, canal alignment, special reservoir surveys, etc.	17,500	115,000
III. *Discharge observations.*—		
Number of sites 4		
Expenditure per site. Equipment Non-recurring.—		
1 current meter at 1,200/-	1,200	
1 boat large at 1,000/-	1,000	
1 boat small @ 500/-	500	
Velocity rods	200	
Sounding rods	100	
Ropes, etc.	600	
Chronometers	200	
Recurring expenditure.—	3,800	
(*Provision is made for 12 months*)		
1 supervisor @ 150/- p. m.	1,800	
1 Boatman @ 40/- p. m.	480	
4 Khalasis (also suitable as Boatmen) @ 30/- p. m.	1,440	
T. A., etc.	605	
	4,325	
4 Sites equipment @ 3,800 per site	15,200	
4 Sites recurring expenditure @ 4,325 per site	17,300	32,500
IV. *Silt observations at the above 4 sites.*—		
One silt observer and one analyst are proposed to be employed for taking observations at each site.		
(*i*) *Equipment non-recurring.*—		
Apparatus, 4 sets	4,000	4,000
(*ii*) *Recurring expenditure.*—		
(*Provision is made for 12 months*)		
4 silt observers @ 100/- p. m. each	4,800	
4 silt analysts @ 100/- p. m. each	4,800	
Khalasis (4 per observer and 2 per analysts) 24 @ 30/- p. m. each	8,640	
Dearness and Travelling allowance	2,760	21,000

		Rs.	
V.	*Property Surveys.*—		
	1 Supervisor for 12 months @ 110/- p. m.	1,320	
	4 Surveyors for 12 months @ 80/- p. m.	3,800	
	12 Khalasis for 12 months @ 30/- p. m.	4,320	
	Patwaris Lump Sum	560	
VI.	*Meteorological Surveys* (Rain gauges and Snow courses). It is proposed to instal 50 new gauge stations.		
	(*i*) *Equipment installation of gauges non-recurring*—		
	50 rain gauges (including temperature, 25,000 humidity and wind velocity at 25 places also some self recording gauges) average rate of say 500/- each.	25,000	
	Miscellaneous apparatus snow samples etc.	4,000	29,000
	(*ii*) *Recurring expenditure.*—		
	(*Provision is made for 12 months*		
	1. Meteorological Assistant @ 200/-	2,400	
	1 Senior observer @ 120/- p. m.	1,440	
	16 Observers (part-time) @ 15/- p. m.	2,880	
	16 Retainers (part-time) @ 12/- p. m.	1,536	
	2 Snow surveyors @ 120/- p. m.	2,880	Say 40,000
		40,136	
VII.	*Seismological Surveys.*—		
	This will be taken up separately in consultation with the Director of Meteorological Surveys but a lump sum provision is made of Rs. 20,000/-		
VIII.	*Geological Investigations.*—		
	(*i*) *Equipment non-recurring*—		
	4 Diamond Drills with equipment complete @ 75,000/- each	3,00,000	
	Diamonds (and other spares) for the above @ 40,000/- each	1,60,000	
	1 Calyx Drill 5"—6" complete with equipment etc.	20,000	
	Spares for above	5,000	
	4 special boats for drills @ 2,000/- each	8,000	
	Testing apparatus for rocks and rock materials	47,000	5,40,000
	(*ii*) *Recurring expenditure.*—		
	1 Geologist @ 600/- p. m. for 15 months	9,000	
	2 Asstt. Geologists @ 300/- each for 15 months	9,000	
	1 Drill Foreman @ 1,000/- p. m. for 12 months	12,000	
	4 Operators (1 per drill) @ 140/- p. m. each for 12 months	6,720	
	24 Helpers (6 per drill) @ 80/- p, m. for 12 months	23,040	say
	Running expenses of 4 engines for drills for 10 months @ 5,000/- per drill	2,00,000	2,60,000
IX.	*Communications.*—		
	Lump Sum	25,000	5,000
	Temporary buildings.—		
	Lump Sum	25,000	25,000
XI.	*Camp equipage.*—		
	4 tents 14′×14′ @ 1,200/- each	4,800	
	12 tents 10′×10′ @ 800/- each	9,600	
	12 shouldaries @ 600/- each	7,200	
	12 servants tents @ 500/- each	6,000	
	Camp furniture	2,000	29,600
XII.	*Tools and plant.*—		
	(*i*) *Non-recurring*		
	13 trucks @ 7,000/- each	91,000	
	4 jeeps @ 7,000/- each	28,000	
	4 country boats @ 1,000/- each	4,000	
	4 Outboard motors @ 1,000/- each	4,000	

	Rs.	
8 Chronographs @ 100/- each	800	
24 levelling instruments @ 1,000/- each	24,000	
Measuring chains 24 @ 15/- each	360	
26—100′ tapes @ 30/- each	780	
30—50′ tapes @ 20/- each	600	
4 Theodolites @ 1,200/- each	4,800	
6 Binoculars @ 200/- each	1,700	
12 drawing instruments boxes 2nd class @ 200/- each	2,400	
Scales with offsets, French curves	500	
12 Drawing Boards @ 30 each	360	
	1,64,000	
(*ii*) *Recurring expenditure.*—		
Repairs	4,000	
Working of trucks	12,000	
XIII. *Establishment.*—		
(*Provision is made for 14 months*).		
3 Executive Engineers @ 600/- p. m. each	25,000	
9 Assistant Engineers S. D. Os. @ 350/p. m. each	44,100	
1 Superintendent @ 250/- p. m.	3,500	
3 Head Clerks @ 160/- p. m. each	6,720	
1 Stenographer @ 160/- p. m.	2,240	
3 Accountants @ 150/p. m. each	6,300	
3 Upper grade clerks @ 80/- p. m. each	3,360	
3 Accounts clerks @ 80/- p. m. each	3,360	
9 Sub-divisional clerks @ 80/ p. m. each	10,080	
3 Steno-typists @ 80/- p. m. each	3,360	
4 Lower grade clerks @ 55/ p. m. each	3,080	
3 Record keepers @ 55/- p. m. each	2,310	
6 Assistant Accounts clerks @ 55/- p m. each	4,620	
9 Assistant Sub-divisional clerks @ 55/- p. m. each	6,930	
3 Assistant Record keepers @ 55/- p. m. each	2,310	
2 Typists @ 55/- p. m. each	2,310	
3 Despatchers @ 55/- p. m. each	2,310	
1 Head draftsman @ 300/- p. m.	4,200	
3 Senior draftsmen @ 170/- p. m. each	7,140	
8 Draftsmen @ 100/- each	11,200	
3 Overseers (Headqaurters) @ 100/- p. m. each	4,200	
8 Tracers @ 60/- p. m. each	6,720	
36 Overseers @ 100/- p. m. each	50,400	
6 Research Assistants @ 160/- p. m. each	13,440	
5 Silt Analysts @ 100/- p. m. each	7,000	
3 Sub-Assistant Surgeons @ 100/- p. m each	4,200	
3 Compounders @ 40/- p. m. each	1,680	
3 Ward boys @ 30/- p. m. each	1,260	
1 Jemadar @ 35/- p. m. each	490	
27 Peons @ 30 /- p. m. each	11,340	
12 Dafadars @ 30/- p. m. each	5,040	
24 Barkandazes @ 30/- p. m. each	10,800	
1 Daftri @ 35/- p. m.	490	2,79,930
	Say	2,80,000
(*b*) Dearness and Travelling allowances.		
Lump Sum	1,96,000	1,96,000
XIV. *Contingencies.*—		
Lump Sum	1,20,000	1,20,000

Estimate for preliminary surveys and investigations in connection with the projects in Assam Province prepared in accordance with the instructio of the AD-HOC Committee.

ABSTRACT

1. Surveys by Survey of India	6,16,500
2. Surveys by C. W. I. N. C.	1,50,000
3. Discharge observations	57,760
4. Silt Observations	26,000
5. Property Survey	9,600
6. Meteorological Survey	60,800
7. Seismological Survey	25,000
8. Geological Survey	8,53,280
9. Communications Lump Sum	50,000
10. Buildings Lump Sum	50,000
11. Camp equipage	29,600
12. Tools and Plant	2,80,170
13. Establishment	8,65,000
Total	30,73,710

DETAILS

I. *Surveys to be carried out by Survey of India—*

(*i*) Air photography of gorge sites 1,25,000 acres (200 sq. miles) @ 25 per sq. mile	5,000
(*ii*) River survey. 5 mile strip for length of 2 lakes and reservoir up to its junction with Brahmaputra. 202 × 5 = 1,010	
Say 1,000 sq. miles @ Rs. 44 per sq. mile	44,000
(*iii*) Moving aircraft	5,000
(*b*) *Field Surveys and Publications.—*	
(*i*) Reservoir sites 20 sq. miles @ 375 per sq. mile	75,000
(*ii*) River area 1,000 sq. miles @ 375 per sq. mile	3,75,000
(*iii*) Irrigation potential on Manas 2,00,000 acres @ -/9/- per acre	1,12,500
	6,16,500

II. *Surveys to be carried out by C. W. I. N. C.—*

(*a*) Longitudinal sections of rivers 200 miles @ 150 per mile	30,000
(*b*) Other miscellaneous surveys like canal alignment, special reservoir, pisciculture, etc.	1,20,000
	1,50,000

II. *Discharge Observations—*

Number of sites 4 (2 for projects and 2 more for hydrological data for Barak and Someshwari)

(*a*) *Equipment expenditure non-recurring—*

1 Current meter @ 1,200	1,200
1 Boat large @ 1,000	1,000
1 Boat small @ 500	500
1 Set sounding rods @ 100	100
Ropes, etc.	600
Chronometers	200
Rack and Pinion arrangement	200
	4,000

(*b*) *Recurring*—

1 Gauge reader @ 75 for 2 years	1,800
1 boatman @ 60 for 2 years	1,440
6 Khalasis @ 50 for 2 years	7,200
	10,440
Total for one site	14,400
Total for 4 sites	57,760

IV. *Silt Observations*—

(*i*) Equipment non-recurring @ 1,000/- per site	4,000
(*ii*) 4 Silt observers and Analysts @ 100/- for 2 years	9,600
(*iii*) 8 Khalasis @ 50/- for 2 years	9,600
(*iv*) Miscellaneous on Carriage and Transport	2,800
	26,000

V. *Property Survey*—

1 Surveyor @ 100/- for 2 years	2,400
6 Khalasis @ 50/- for 2 years	7,200
	9,600

VI. *Meteorological Survey (rain gauges and snow courses)*—

(*i*) 50 more rain gagues as proposed to be installed (in Barak & Someshwari) giving one gauge for 4,000 sq. miles @ 500/-	25,000
Snow survey apparatus	7,500
(*ii*) *Recurring expenditure*—	
1 Meteorological Assistant @ 200/- for 2 years	4,800
1 Senior observer @ 120/- for 2 years	2,880
16 Observers @ 20/- for 2 years (part-time)	7,680
16 Retainers (part-time) @ 15/- for 2 years	5,760
2 Snow surveyors @ 150/- for 2 years	7,200
	60,820

VII. *Seismological Survey*—

Lump Sum	25,000

VIII. *Geological Survey*—

(*i*) *Equipment non-recurring*—

4 Diamond Drills @ 75,000/- each	3,00,000
Diamonds and other spares @ 40,000/- per set	1,60,000
1 Calyx drill 5"—6" completo with equipment and spares	25,000
4 Special boats for drills @ 2,000/- each	8,000
Testing apparatus for rocks and rock material	47,000
	5,40,000

(*ii*) *Recurring expenditure*—

1 Geologist @ 800/- for 2 years	19,200
1 Asstt. Geologist @ 400/- for 2 years	9,600
1 Drill Foreman @ 1,000/- for 2 years	24,000
4 Operators (1 per drill) @ 150/- for 2 years	14,400
24 Helpers (6 per drill) @ 80/- for two years	46,080
Fuel and other running expenses @ 10,000 p. m. per drill for 20 months	2,00,000
	3,13,280
Total	8,53,280

IX. *Communications*—	
Lump Sum	[50,000]
X. *Temporary buildings*—	
Lump Sum	50,000
XI. *Camp equipage*—	
4 tents 14′ × 14′ @ 1,200/- each	4,800
12 tents 10′ × 10′ @ 800/- each	9,600
12 shouldaries @ 600/- each	7,200
12 servants tents @ 500/- each	6,000
Camp furniture	2,000
	29,600
XII. *Tools and Plant*	
(*i*) *Non-recurring*—	
13 trucks @ 7,000/- each	91,000
4 jeeps @ 7,000/- each	28,000
4 outboard motors @ 2,000/- each	8,000
24 levelling instruments @ 1,000/- each	24,000
24 measuring chains @ 15/- each	360
24 metallic tapes @ 30/- each	720
4 Theodolites @ 2,000/- each	8,000
8 Binoculars @ 300/- each	2,400
18 Drawing boards @ 30/- each	540
18 drawing instruments 2nd size @ 200/- each	3,600
3 planimeters @ 500/- each	1,500
15 plane tables @ 150/- each	2,250
12 nos. Prismatic compasses @ 150/- each	1,800
Other miscellaneous drawing apparatus like set squares, scales, curves	8,000
	1,80,170
(*ii*) *Recurring expenditure*—	
Repairs and carriage of scientific instruments for 2 years	25,000
Running expenses for trucks and jeeps for 2 years	75,000
	1,00,000
Total	2,80,170
XIII. *Establishment*—	
(1) *Provision for 24 months*	
1 Superintending Engineer @ 1,850/- for 24 months	44,400
2 Executive Engineers @ 800/- p. m. each	38,400
6 Assistant Engineers @ 400/- p. m. each	57,600
1 Superintendent for Circle Office @ 300/- p. m.	7,200
1 Head Draftsman for Circle Office @ 300/- p. m.	7,200
1 Stenographer for Circle Office @ 200 p. m.	4,800
2 Head Clerks for Executive Engineers' Offices @ 200/- p. m. each	9,600
2 Accountants for Executive Engineers' Offices @ 200/- p. m. each	9,600
13 Upper grade clerks including Sub-divisional clerks @ 100/- each	31,200
2 Stenographers to Executive Engineers @ 100/- p. m. each	4,800
23 Lower grade clerks including record keepers and typists @ 75 p. m. each	41,400
6 Draftsmen @ 100/- p. m. each	14,400

6 Tracers @ 75/- p. m. each		10,800
24 Overseers @ 150/- p. m. each		86,400
4 Research Assistants @ 200/- p. m. each		19,200
4 Laboratory Assistants @ 75/- p. m. each		7,200
2 Sub-Assistant Surgeons @ 150/- p. m. each		7,200
3 Compounders @ 50/- p. m. each		3,600
2 Ward boys @ 50/- p. m. each		2,400
1 Steno to Geologist @ 100/- p. m.		2,400
1 Clerk to Geologist @ 75/- p. m.		1,800
3 Draftsmen @ 40/- p. m. each		2,880
1 Jemadar to S. E. @ 40/- p. m.		960
21 Peons (8 per Division = 16), Circle Office—3, Geologist and Assistant —2	@ 30/- p. m. each	15,120
36 Barkandazes @ 30/- p. m. each		25,920
10 dafadars @ 30/- p. m. each		7,200
		4,71,360
	Say	4,72,000
Dearness allowance @ 25 %		1,18,000
Travelling allowance		1,50,000
Establishment contingencies including office furniture, typewriters, etc.		1,25,000
	Total Establishment	8,65,000

(Sd.) K. M. BHATIA,

Project Officer, C.W.I.N.C.

3-5-1948

APPENDIX IX

Coorg Project Report

The province of Coorg is a small centrally administered area in South India, west of Mysore State. The total area is 1,582 square miles and population of less than 2,00,000. It receives an annual rainfall of about 125". A number of schemes for irrigation and hydro-electric generation were projected by the provincial engineers in the past, but all of them were shelved for one reason or another. A small province like Coorg cannot take up independently investigations, preparation, and execution of such large scale projects for the development of its water and power resources.

C. W. I. N. C. was, therefore, approached by the Chief Commissioner of Coorg to take up the investigations of the feasible projects in the province, and also to take up the question of renovation of existing irrigation and fish culture tanks. Director, Irrigation and Assistant Director toured Coorg in October last, and inspected most of the sites . As a result of the inspection, the three projects—Herangi, Barapole and Lakshmantirtha, were considered suitable for investigations. Main features of these projects are given below (See Index Map).

Herangi Project—This project was first conceived in 1877 on representation of an influential zamindar of the place who drew attention to the possibility of utilising the Herangi river as a source of irrigation. A scheme prepared in 1899 for an anicut across Herangi near Herur village was later on abandoned as it was considered unremunerative. Similar attempts at reviving the project were also unsuccessful and the scheme was later on shelved. In order to make it a paying project, a dam with possibility of hydel energy along with irrigation is envisaged. A suitable site near the boundary of Herangi and Halgunda villages in the narrow gorge has now been located and is considered suitable for about 100′ high dam. It would be affording irrigation to about 7,000 acres and generate about 1,800 kW. of continuous power.

Barapole Project—This project envisages two dams about 100′—150′ high, one each on Konganahole and Kokatahole, the two tributaries of the Barapole river, and through pipes leading the discharge about 4 miles away, so that a head of about 1,500′ is available for power. The total power available from these two dams is estimated to be about 47,700 kW. of firm power. The power can be utilised in Madras Presidency for the adjoining districts of Malabar and South Kanara which are in need of it. It will also give impetus to new industries being started in Coorg province itself.

Lakshmantirtha Project—This project originally prepared in 1941 consists in having an anicut across Lakshmantirtha river just below its confluence with Ramtirthahole. The anicut will supplement water required to irrigate about 3,000 acres in Coorg province. The execution of the project was however objected to by the Mysore Government as in their view it would have had detrimental effect on the existing irrigation lower down the river in Mysore territory. To speed up agreement it is proposed to hold a meeting of the engineering representatives of the C.W.I.N.C., Madras Government and Mysore Government to go into the question whether it would be possible to allow the construction of an anicut, or it would be necessary to provide storage at the site. Survey and investigation work will have to be done for either project.

An overall estimate of Rs. 6,64,700 has been framed to carry out the surveys and investigations work on all the three projects and to put up proposals for renovation of irrigation tanks. Surveys of the reservoir areas and dam sites provided in the estimate are proposed to be carried out by the Survey of India Department, whereas the surveys for the irrigation areas would be done by the C.W.I.N.C. staff. Property surveys, electric load surveys and mineral surveys have also been included in the estimate. Geological investigations, including boring and drilling in the abutments and foundation, are proposed to be carried out in conjunction with the Geological Department and have been adequately provided for in the estimate. Fixing of new rain gauges, temperature and humidity recording stations shall be set up and read by the Meteorological Department. Discharge and silt observations are porposed to be recorded regularly and have been provided for in the estimate. To carry out these investigations it is proposed to open one division with three sub-divisions along with the requisite staff for two years, the time which it is estimated the work will take to complete. Necessary provision for this has been made in the estimate. Provision has also been made for the purchase of necessary office equipment, scientific and ordinary tools and plant, and motor vehicles, etc. It is also proposed to house the entire staff in temporary buildings for the duration of the investigations.

M. D. Mithal,
Director, Irrigation and Waterways,
C. W. I. N. C.

Overall estimate for preliminary surveys and investigations of Irrigation and Hydel Projects in the Coorg Province.

ABSTRACT

	Rs.
I. WORKS	2,11,260
II. TOOLS AND PLANT	1,14,240
III. ESTABLISHMENT	3,39,240
Total	664,740

DETAILS

WORKS—

(*i*) *Dams and Appurtenant Works*

Preliminary Expenses :—

1. Survey of the reservoir basin by air photography and ground survey and plotting contours @10'—5' intervals on a scale of 4" = 1 mile		
10 sq. miles @ Rs. 375/- per sq. mile		3,750
2. Survey of the Dam sites and weir site by air photography and ground surveys and plotting on a scale of 32" = 1 mile		
1,280 acres @ Rs. 4/- per acre		5,120
3. Geological investigations of foundations of the dams and weir sites including boring, core drilling, drifts, etc.		
Kokatahole dam	15 Nos.	
Konganahole dam	15 Nos.	
Herangi dam	15 Nos.	
Lakshmantirtha weir	5 Nos.	
	50 Nos.	
50 Nos. each of 50'-2500 ft.@ Rs. 20/- per foot		50,000
Soil Analysis for earthen dam etc.		2,000
(*ii*) *Buildings* :		
Temporary Buildings		5,000
(*iii*) *Main Canals and Branches* :		
1. Surveys of the commanded areas for alignment of canals :		
Herangi	7,000 acres	
Lakshmantirtha	3,000 acres	
	10,000 acres	
10,000 acres @ 1/2/- per acre		11,250
2. Miscellaneous surveys		4,000
3. Longitudinal section of the rivers and its tributaries 40 miles @ Rs. 25/ per mile		1,000
(*iv*) *Discharge and Silt observations.*		
One boatman and 4 Khalasis at each discharge site, cost of ropes, discharge rods, floats, etc. included. 3 sites @ Rs. 5,000/- per site per year for 2 years.		30,000
(*v*) *Meteorological Observations.*		
Raingauges, temperature, humidity, etc. observations	L.S.	2,000
(*vi*) *Mineral Surveys*	L.S.	2,000
(*vii*) *Electric load surveys*	L.S.	10,000
(*viii*) *Economic and Property surveys*	L.S.	5,000
(*ix*) *Communications*	L.S.	5,000
(*x*) *Special tools and plant.*		
1. Diamond drill complete with accessories @ Rs. 60,000 each.		60,000
Testing apparatus and laboratory equipment		11,000
		2,07,120
20% contingencies		4,140
		2,11,260
Total Works		2,11,260

II. TOOLS AND PLANT

1. Motor vehicles for survey parties 6 Vehicles @ Rs. 7,000 each		Rs.
Maintenance for 2 years		20,000
2. Scientific instruments etc.		10,000
3. Ordinary tools and plant		5,000
4. Camp Equipage		15,000
5. Office furniture		15,000
6. R & C of T & P		5,000
		1,12,000
2% contingencies		2,240
		1,14,240
Total Tools and Plant		1,14,240

III. ESTABLISHMENT

1. *Pay of Officers*

Executive Engineer 1 No. @ Rs. 875/- p.m. for 2 years		21,000
Assistant Engineer 3 Nos. @ Rs. 560/- p.m. for 2 years		40,320
Assistant Geologist @ Rs. 500/- p.m. for 2 years		12,000
Drill foreman @ Rs. 1,000/- p. m. for 1 year		12,000
	Rs.	85,320

2. *Pay of Establishment.*

Supervisors 12 Nos. @ Rs. 240/- p.m. for 2 years		69,120
Accountant 1 No. @ Rs. 200/- p.m. for 2 years		4,800
Head Clerk 1 No. @ Rs. 180/- p.m. for 2 years		4,320
Clerks 8 Nos. @ Rs. 93/- p.m. for 2 years		17,856
Draftsmen 2 Nos. @ Rs. 200/- p.m. for 2 years		9,600
Tracers 2 Nos. @ Rs. 104/- p.m. for 2 years		4,992
Daffadar 1 No. @ Rs. 33/- p.m. for 2 years		792
Barakandaz 1 No. @ Rs. 33/- p.m. for 2 years		792
Peons 8 Nos. @ Rs. 33/- p.m. for 2 years		6,322
Khalasis 12 Nos. @ Rs. 33/- p.m. for 2 years		9,504
Dak runners 4 Nos. @ Rs. 33/- p.m. for 2 years		3,162
	Rs.	1,31,260
Dearness allowance for Officers for 2 years lump sum		10,000
Dearness allowance for establishment for 2 years lump sum		50,000
		60,000
T. A. for officers for 2 years lump sum		24,000
T. A. for establishment for 2 years lump sum		32,000
		56,000
	Rs.	3,32,580
2 % contingencies		6,660
Total Establishment	Rs.	3,39,240
		3,39,240
Grand Total	Rs.	6,64,740

M. D. MITHAL,
Director, Irrigation and Waterways,
C. W. I. N. C.

Estimate for preliminary surveys and investigations of Irrigation and Hydel Projects in the Province of Coorg, which was originally submitted to Government

ABSTRACT

I. WORKS	60,000
II. TOOLS AND PLANT	40,000
III. ESTABLISHMENT	1,24,000
Total	2,24,000

DETAILS

I. WORKS

	Rs.
Surveys	
Surveys of the Reservoir Area 6,000 acres @ Rs. 2 per acre	12,000
Irrigation Area, 10,000 acres @ as. 8 per acre	5,000
Property, Surveys, etc.	3,000
Exploration Work—Equipment and Staff—	
Drilling, boring etc. 4 sites @ Rs. 4,000 each	16,000
Staff and other geological surveys	4,000
Temporary Buildings, Gauge Readers' Huts etc.—	
S. D. O. quarters temporary (alternative tents) (3) at Rs. 2,500/-	7,500
Overseers' Huts (12) @ Rs. 750/-	9,000
Gauge Readers' Huts etc.	3,500
Total—Works	60,000

II. TOOLS AND PLANT

Furniture for Divisional and Sub-Division Offices	5,000
Camp furniture	2,000
Transport vehicle and its maintenance	15,000
Instrument Level Theodolite etc. for surveys	10,000
Current meters, boats etc. for discharge and other observations	8,000
Total—Tools and Plant	40,000

III. ESTABLISHMENT

(a) (1) *Pay of Officers*	
1 Executive Engineer for 12 months @ Rs. 900/- p.m.	10,800
3 Sub-Divisional Officers for 12 months @ Rs. 500/- p.m.	18,000
Total	28,800
(2) *Pay of Establishment*	
12 Supervisors for 12 months @ Rs. 150/- p.m.	21,600
1 Accountant for 12 months @ Rs. 200/- p.m.	2,400
1 Head clerk for 12 months @ Rs. 160/- p.m.	1,920
8 clerks for 12 months @ Rs. 80/- p.m.	7,680
2 Draftsmen for 12 months at Rs. 100/- p.m.	2,400
2 Tracers for 12 months at Rs. 60/- p.m.	1,440
1 Dafadar for 12 months at Rs. 30/- p.m.	360
2 Barkandazes for 12 months at Rs. 30/- p.m.	720
8 Peons for 12 months at Rs. 30/- p.m.	2,880
6 Dak runners for 12 months at Rs. 30/- p.m.	2,160
Total—Establishment	43,560

(3) Dearness Allowance of Officers —lump sum	4,000
(4) Dearness Allowance, other allowances of Establishment—lump sum . . .	20,000
Total	24,0000
(5) T. A. of Officers	8,400
(6) T. A. of Establishment	12,960
(*b*) Establishment Contingencies	6,280
Total—Establishment	1,24,000

M. D. MITHAL,

Director, Irrigation & Waterways,

C. W. I. N. C.

ESTIMATE AS PER INSTRUCTIONS OF *AD.HOC* COMMITTEE

Estimate for Preliminary Surveys and Investigations in connection with the Irrigation and Hydle Projects in Coorg Province, prepared in accordance with instructions of the Ad-Hoc *Committee.*

ABSTRACT

I. WORKS	2,02,460
II. TOOLS AND PLANT	79,500
III. ESTABLISHMENT	1,70,040
TOTAL	4,52,000

DETAILS

I. WORKS—

(i) *Dams and Appurtenant Works*

Preliminary Expenses

1. Surveys of the reservoir basins by air photography and ground survey and plotting contours at 10'—5' intervals on a scale of 4"=1 mile 10 sq. miles @ Rs. 375/- p.sq. mile		3,750
2. Surveys of the dam sites and weir sites by air photography and ground surveys and plotting on a scale of 32"=1 mile 1,280 acres @ Rs. 4/- per acre.		5,120
3. Geological investigations and foundations of the dam sites and weir sites and of the reservoir basins by boring, core-drilling, making drifts and tunnelling etc. including testing :		
Kokatahole dam	15 Nos.	
Konganahole dam	15 Nos.	
Herangi dam	15 Nos.	
Lakshmantirtha weir	5 Nos.	
	50 Nos.	
50 Nos. each of 50'=2,500'@ Rs. 20/- per foot.		50,000
4. Soil analysis and burrows surveys for earthen dams including testing L. S.		2,000
(ii) *Buildings*		
Temporary buildings		5,000
(iii) *Main Canals and Branches*		
(a) Survey of the Commanded areas for alignment of canals		
Herangi	7,000 acres	
Lakshman trtha	3,000 acres	
	10,000 acres	
10,000 acres @ Re. -/9/- per acre		5,525
(b) Miscellaneous Surveys		4,000
(iv) *Discharge and Silt Observations(2 years)*		
One boatman and four Khalasies at each discharge site, cost of ropes, discharge rods, boats, floats, gauge, silt sampler and laboratory equipment @ Rs. 5,000/- per site per year 3 sites for 2 years		30,000
(v) *Meteorological Observations, Rain Gauges, temperature, humidity etc., observations lump sum*		2,000
(vi) *Electrical Load Survey L. S.*		10,000
(vii) *Economic and property surveys L.S.*		5,000
(viii) *Communications L. S*		5,000
(ix) *Special Tools and Plant.*		
1 diamond drill complete with accessories @ Rs. 60,000/- each		60,000
Testing apparatus and laboratory and workshop equipment for testing of samples		11,000
Total		1,98,495
2% contingencies		3,975
Total Works	2,02,460	2,02,460

II. TOOLS AND PLANTS—

1. Motor vehicles for survey parties			25,000
Running expenses for 2 years			10,000
2. Scientific instruments			10,000
3. Ordinary tools and plant			3,000
4. Camp equipage			15,000
5. Office furniture			10,000
6. R & C. T. & P.			5,000
Total			78,000
2% contingencies			1,500
Total—Tools and Plant		79,500	79,500

III. ESTABLISHMENT—

1. *Pay of Officers*:

Asstt. Engineers 2 @ Rs. 560/- p.m. for two years		26,880
Asstt. Geologist 1 @ Rs. 500/- p.m. for one year		6,000
Drill Foreman 1 @ Rs 1,000/- p.m. for one year		12,000
Total		44,880
Carried forward		2,81,960

2. *Pay of Establishment*

Overseers 8 @ Rs. 240/- p.m. for 2 years	46,080	
Senior Clerks 2 @ Rs.150/- p.m. for two years	7,200	
Junior Clerks 2 @ Rs. 93/- p.m. for two years	4,464	
Dafadars 2 @ Rs. 33/- p.m. for two years	1,584	
Gauge Readers 3 @ Rs. 70/- p.m. for two years	5,040	
Peons 4 @ Rs. 33/- p.m. for two years	3,168	
Khalasis 8 @ Rs. 33/- p.m. for two years	6,336	
Chawkidars 2 @ Rs. 33/- p.m. for two years	1,584	
Dak Runners 2 @ Rs. 33/- p.m. for two years	1,584	
Total	77,040	
3. Dearness Allowance of officers	4,800	
4. Dearness Allowance of Establishment	20,000	
Total	24,800	
5. T. A. of Officers	8,000	
6. T. A. of Establishment	12,000	
Total	20,000	
Total	1,66,720	
Contingencies @ 2 %	3,320	
Total—Establishment	1,70,040	1,70,040
Grand Total		4,52,000
Estimate for Year	1948-49	1949-50
(Details as under)	2,20,000	2,32,000

Estimate for Preliminary investigations of Irrigation and Hydel Projects in Coorg Province of the year 1948-49 and 1949-50.

	1948-49	1949-50
I. WORKS—		
(i) *Dam and Appurtenant Works.*—		
Surveys and investigations		
1. Survey of basin reservoir	1,800	1,950
2. Survey of the dam site	2,560	2,560
3. Geological investigations	..	50,000
4. Soil analysis for earthen dam	1,000	1,000
(ii) *Buildings*—		
Temporary Buildings	5,000	..
(iii) *Main Canals and branches*—		
(a) Survey of the commanded area	5,625	..
(b) Miscellaneous Surveys	..	4,000
(iv) *Discharge and silt observations*	15,000	15,000
(v) *Meteorological observations*	2,000	..
(vi) *Electrical load survey*	5,000	5,000
(vii) *Economic and property surveys*	2,500	2,500
viii) *Communications*	2,500	2,500
ix) *Special tools and plant*	..	60,000
Testing samples, laboratory etc.	11,000	..
Contingencies	1.495	2,470
	35,480	1,46,980
. TOOLS AND PLANT	79,500 /	..
II. ESTABLISHMENT	85,020	85,020
Grand Total	2,20,000	2,32,000

(sd) M. D. MITHAL,
Director Irrigation & Waterways
C. W. I. N. C.