DAMODAR VALLEY CORPORATION

REPORT OF THE
COMMITTEE FOR THE AUGMENTATION
OF WATER RESOURCES OF DAMODAR VALLEY CORPORATION

VOLUME III

CALCUTTA
JUNE, 1960.

Report of the
Committee for the Augmentation
of Water Resources of Damodar Valley Corporation

VOLUME III

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NOTE DATED 23-12-59 FROM SHRI I.B. DE OF WEST BENGAL.

MINUTE OF DISSENT

Chapter XII of the Report contains the summary and recommendations of the Committee. These are mainly based on the conclusions drawn in the previous chapters of the Report. Before I deal with points on which I disagree with Shri Khungar and some other members of the Committee who have already signed the Report, I must express my deep appreciation of the pains taken by Shri Khungar to examine thoroughly the problems before the Committee inspite of the lack of data.

2. The important issues on which I differ from the recommendations of the Committee are stated below :

(a) Para 4.1 Khariff Irrigation

It has been stated that the requirement from storage will be 0.40 million acre feet, to cover 90% of the years and that in a year like 1957 when there had been little rainfall in October the requirement might go upto 0.70 million acre feet. As the average requirement of water for Khariff Irrigation has been estimated at 1.28 million acre feet, the average requirement from storage is likely to be much more than 0.40 million acre feet. This can be only verified after the water management plan has been revised on the basis of the findings of this Committee regarding water requirement for irrigation, navigation, industrial use etc. for the period from 1949-50 to 1958-59 both for the existing four dams and for five dams including the proposed Aiyar Dam.

(b) Para 4.4 Domestic supply below Durgapur

The requirement below Durgapur has been assessed as 'nil'. This, in my opinion, is not correct as although there will be regeneration, some supply may have to be given during dry season for the benefit of the rural population living on the banks of the river below Durgapur, who may have no other suitable source of supply to meet their domestic requirement. This supply need not be more than that obtaining in the river in the dry season before the construction of the dams. I fully realise the value of stored water but cannot ignore the requirement of the rural population living on the banks of the Damodar below Durgapur specially during the dry season when wells and ponds are likely to dry up.

(c) Para 4.5 Industrial and Domestic uses

The total requirement of water for industrial use has been assessed at 900 cusecs. Since Aiyar dam is primarily necessary for meeting the shortage of water required for industrial use, it would be better to accept the recommendation of the D.V.C. viz., 1030 cusecs. This will provide some margin for any possible expansion of industry in future.

(d) Para 4.6 Total requirement from storage

The total requirement from storage, as worked out, cannot be accepted. The requirement from storage for Kharif irrigation can only be determined properly after the water management plans as mentioned before are revised. The requirement

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from storage for industrial and domestic uses may also be re-calculated on the basis of my remarks against paras 4.4 and 4.5.

(c) Para 5.4 Safe discharging capacity of lower Damodar

It has been stated that it would be very desirable to keep the discharge at Durgapur below 2,00,000 cusecs as far as possible. Such a statement may or may not be correct as it has not yet been examined properly how far the decrease in the discharge at Durgapur from 250,000 cusecs to 200,000 cusecs or even lower would reduce the flood hazards of the lower valley of the Damodar.

(f) Para 5.5 Flood absorption capacity required

The total flood absorption capacity of 2.24 million acre feet is based on certain assumptions.

The maximum possible flood storage at Aiyar site is only 0.57 million acre feet on the basis of the centre of the design storm being situated in the centre of the Aiyar dam catchment. This does not represent the worst condition as after the construction of the Aiyar dam the worst condition will be when the design storm will be centred in the centre of the catchment outside the Aiyar catchment. For such a storm, Aiyar dam will have little flood moderation effect so far as the lower valley is concerned. It will, therefore, be seen that 0.57 million acre feet flood storage at Aiyar dam will have very much reduced effect in the matter of ultimate flood control.

The flood control problem of the Damodar Valley has three broad aspects. These are :-

i) safety of the Damodar Left Embankment;

ii) prevention of flooding of the areas on the right bank of the Damodar; and

iii) prevention of flooding in the lower valley including the Trans-Damodar area.

As the reasonable adequacy of flood moderation will not be the same in regard to the above three aspects, I suggest that the matter should be further studied after collection of the required data. This study will indicate whether provision of any flood absorption capacity at the Aiyar dam site will be necessar or not.

Only 0.2 million acre feet can be stored by reduction of flood control capacity during September (0.1 million acre feet during the first fortnight and 0.1 million acre feet during the last fortnight). The water so available is proposed to be used for flushing. I am of opinion that it would not be advisable to encroach on the flood control capacity during September. I understand Mr. Komora, late Chief Engineer, D.V.C. was of opinion that the flood reserve should not be encroached even during the first fortnight of October.

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(g) Para 6.5 Area between Surekalna and Bakshi-Gaighata Khal

The usefulness of the proposed operation need be studied more thoroughly.

(h) Para 6.6 to 6.8 Regime of rivers

The conclusions drawn in these paragraphs are based on certain assumptions which are open to question and can only be accepted after these are verified by some field observations for two years at least.

(i) Para 6.9

Preliminary investigations for the proposed Ajoy Dam have not been completed yet. Hence, it would not be proper for the Committee to express any definite opinion regarding the feasibility of diversion of the waters of the Ajoy into the Damodar. I do not follow why the Committee presumed that 25,000 cusecs will be diverted from the Ajoy into the Damodar when the latter is already in flood.

The objects of the diversion of the waters of the Ajoy into the Damodar are :-

(i) flattening flood peaks of the Ajoy below the site of the proposed dam; and

(ii) meeting the shortage of water required for industrial and other uses in the D.V.C. area.

Both the objectives are important, and even if one can be met it may be worthwhile to undertake the proposed Ajoy Reservoir Project. Therefore, the investigations for the project should be started along with those of the Aiyar Dam. I feel there is no necessity for the Committee to recommend at this stage that provisional approval may be given to Aiyar Dam subject to its site being found suitable after proper investigations. Such approval can only be given when it is established beyond doubt that the lower valley of the Damodar will not be adversely affected by the construction of another dam on the Damodar system.

(j) Para 9.1 DVC's recommendations about storages at Aiyar

The Aiyar Dam is primarily required for meeting the shortage of water for industrial use. Additional capacity, if any, should for the present be reserved for the same purpose. Further studies are necessary to determine whether the provision of any flood absorption capacity at the Aiyar Dam site would be necessary or not. Prima facie it appears that the Aiyar Dam will not be of any use in reducing flood hazards in the lower valley.

(k) Para 10.5

" The Lower Damodar Conservancy Board " may be set up on the lines already recommended by the Lower Damodar Investigation Committee.

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(1) Para 11.1

The cost of acquisition of additional lands upto the top of the gates would be very heavy. It may, therefore, be considered whether it would not be advisable to remove all habitations lying between the existing acquisition levels and the top of the gates and have a legislation to prevent the re-erection of habitations within this zone. If this be possible, the lands proposed to be acquired may be used for cultivation only. Damage to such areas by extraordinary floods will not be frequent. Hence, the cost of acquisition of additional land will have to be weighed against the possible payment of compensation for occasional damage to cultivation by high floods. It would, however, be necessary to ensure that no loss of life occurs due to adoption of the above procedure.

3. To sum up :

(1) The investigations for the Aiyar and the Ajoy dams should be given equal priority and started simultaneously.

(2) Decision to construct the Aiyar dam should depend on the following :

(a) Completion of the investigations for both the dams and proper examination of the feasibility of diverting the waters of the Ajoy into the Damodar.

(b) Proper examination of the effect of reduction of upland water supply on rivers in the lower valley both for the existing four dams and for five dams including the Aiyar. This can only be done after collection of the data as indicated in my d.o. No.2741-C.I.(F) dated 12.11.59 to Shri Khungar, a copy of of which is enclosed.

(3) It is obvious that there can be no question of construction of the Aiyar dam if the further studies proposed to be made indicate the possibility of the rivers in the lower valley being affected adversely by the construction of an additional dam on the Damodar. Even if the proposed studies indicate under the existing conditions, i.e. with four dams, the rivers in the lower valley would be adversely affected without additional supply of upland water, it is to be considered seriously how best the potential created can be used to the best advantage of all the interests involved including the conservency of the river.

(4) The opinion of experts in river Engineering like Shri Joglekar, Adviser, Central Board of Irrigation & Power be obtained on the effect of reduction of upland water supply on the rivers in the lower valley.

Sd/- I. B. DE.
CHIEF ENGINEER, WEST BENGAL,
FLOODS AND FLOOD CONTROL
I. & W. DIRECTORATE.

23rd December, 1959.

IRRIGATION & WATERWAYS DIRECTORATE.

Shri I. B. Dey
Special Engineer
Floods & Flood Control.

D.O.No. 2741-C.I.(F)

Dated 12th November, 1959.

My dear Khungar,

In continuation of my telegram dated 10.11.59, I am sending herewith a copy of note dated 12.11.59 by Shri A. L. Das, Chief Engineer, I. & W. Directorate for your information.

I feel, I cannot accept the conclusions drawn in Chapter VI of the proposed report of the Committee.

As survey and investigations for the proposed Aiyar Dam will take at least 2 years, I think the water management plan may be revised on the basis of the findings of the present Committee, both for the existing four dams and for five dams including the Aiyar dam. The water management plan should be on ten-day basis and cover a number of years. This will enable us to determine what supply should actually be available for the flushing doses proposed to be provided.

I also think it necessary to have the observations and studies, as outlined in the statement accompanying the Chief Engineer's note, made at least during the next two years. This should enable us to eliminate most of the assumptions. The same will also help us to judge better the effects of construction of the Aiyar dam on the lower valley.

Yours sincerely,

Enclo: as stated.

Sd/- I.B. De.

Shri S.D. Khungar, ISE(Rtd.)
R 577
New Rjinder Nagar
New Delhi

Note on the effects of the additional Dam on the lower valley of Damodar.

Increasing demand for industry, it is seen, has raised the necessity for an additional dam. It is admitted that with the development of various facilities in the valley, this demand will increase and certainly something has to be done to meet the demand. But before storing further water of the basin higher up by construction of further dams, it is to be seen how such construction affects the river regime lower below as this is a very important issue and cannot be overlooked. It is not a sound proposal to control a river to such an extent as to cause its decay. The discharges from the Damodar ultimately passess into the Hooghly via Rupnarain. The Rupnarain and the Hooghly are the two life lines of Calcutta and their maintenance in efficient conditions is essential for the Port of Calcutta on which the very existence of Calcutta and the very economic life of West Bengal and its surrounding states depend.

The upland supply is essential for the maintenance of tidal rivers and Damodar is the main supplier of upland supply to Rupnarain and Hooghly. With the construction of 4 dams, the upland discharge has been reduced and with the construction of another dam, the position will be further worsened. Not much argument is necessary to prove this.

2. It has been estimated that there will be some trapping of silt in the dams but it has not been taken into consideration that the silt which will be trapped in the dam, would have been deposited even without dams in the Trans Damodar area in the pre-dam period. There is thus hardly any chance of silt load of the Damodar discharge reaching Rupnarain being reduced by dams higher up. To arrive at a correct appreciation of the problem, the same should be studied by silt observations at selected sites.

3. In one of the notes it has been said that the bed load is 15% of the suspended load. This assumption is open to question. The method of calculation of the total quantity of silt that will be deposited in the reservoir is based upon some assumptions which are difficult to accept without further study based on actual observations. The total silt content can be assumed at the most as 25% more than the silt content obtained by sampling at the surface. This is based on our experience and also corroborated by U.S.A. practice. Again to add another 33% over this 25% would certainly give an exaggerated figure.

4. While calculating the discharge reaching Rupnarain in post dam period it has been assumed that the Amta channel is closed. The scheme of closing Amta channel will take a fairly long time to mature. Till the scheme is implemented the discharge reaching Rupnarain will be less than what has been calculated and this reduction for a fairly long period may be detrimental to the river regime, so much so that the deterioration caused in the channel may not be fully removed.

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5. The present study is not based on water management plans covering a number of years on ten-day basis of the existing four dams and with the additional dam. This is necessary to determine the (a) availability of water; (b) requirement of storage and (c) release of controlled discharge reaching Rupnarain. The conclusion drawn on the basis of average figure of availability and storage would not be correct.

6. No investigations of the proposed Aiyar dam have so far been made and as these would take at least two years it will be wise to collect data as broadly indicated in the enclosed statement for two years. We would then be in a better position to give an opinion definitely on the effects of the Aiyar dam.

Sd/- A. L. Das
Chief Engineer, I & W Directorate.

PROPOSED OBSERVATIONS AND STUDIES TO DETERMINE THE EFFECTS OF AN ADDITIONAL DAM IN THE LOWER VALLEY.

1. Study of water management Plan on a ten-day basis covering a number of years with (1) Existing four dams and (2) with additional Aiyar Dam.

2. Silt observations for 4 months (Mid June to Mid October) once a day - one site across each stream above reservoirs.

-do- -do- one site below Maithon Reservoir and one below Panchet reservoir as close to the dams as possible where the river flow condition is normal.

-do- -do- one site below Durgapur.
-do- -do- one site on Mundeswari above tidal limit.

3. All observations as indicated under item 1 of pages 6-7 of the Report of the Lower Damodar Investigation Committee (Vol.I).

4. Determination of cubature of Rupnarayan at Kolaghat and Gopiganj; following studies and observation necessary for the purpose.

(i) Tidal gauge readings at 5 miles intervals starting from Bandar and finishing at Geonkhali (Gauge observations are now taken only at Bandar, Ranichak, Gopiganj, Dainan and Geonkhali).

The new gauges should have to be fixed in such a manner that there is on just downstream of the junction of Rupnarayan with any spill channel or tributary and that the distance between 2 consecutive gauges does not exceed 5 miles. (above 10 new tidal gauges are expected to be necessary) gauges to be read every hour from 6 A.M. to 6 P.M. Some special readings should be taken at more frequent intervals on some occasions).

(ii) One cross section every 2½ miles apart from Geonkhali to Dainan and every mile apart from Dainan to Bandur.

(iii) Discharge at Bandar (one observation every day).

(iv) One gauge on every spill channel or tributary fixed about 2 miles above its outfall into Rupnarayan and cross sections for these two miles every ½ miles apart (one or two discharge observations may be necessary for checking).

NOTE DATED 12-1-60 FROM SHRI S. MUKHERJEE,
CHIEF MINING ENGINEER, COAL BOARD.

Note of dissent on the report of the
Augmentation of Water Resources
Committee of Damodar Valley Corporation
Volume I.

In not agreeing to the conclusions arrived at in Chapters III and VII of the Committee for Augmentation of Water Resources of Damodar Valley Corporation, Volume I, I have to state that from all information available up-to-date the position with regard to reserves of high grade metallurgical coal in our country is far from satisfactory and it is incumbent on us to conserve every ounce of this variety of coal if we are to avoid its shortage in the foreseeable future. I would like to make it clear that this is the variety of coal which is required to feed the steel industry and other metallurgical processes. Underground stowing hydraulically with sand is the best method of conservation of the metallurgical coal resources at its source, as every ounce of sand is expected to produce about half an ounce of metallurgical coal and conserve such coal.

Regarding the annual replacement of sand in the Damodar river, widely divergent opinions had been expressed by different authorities, such as Mr. W. L. Voorduin's " Preliminary Memorandum of the Unified Development of Damodar River", Sri J. B. Auden's opinions on the silt contents of the Damodar, Mohanadi and Koshi rivers, Sri A. N. Khosla's formula, the observations made by Dr. N. K. Bose from 1945 to 1948 and the Damodar Valley Corporation's average estimates of the average annual bed load deposit of the Damodar river. On the basis of the figures of Mr. Voorduin the average annual amount of silt carried by upper Damodar works out to 14 million tons. Considering Khosla's formula, Sri J. B. Auden's opinions on the formula and the observations made by Dr. N. K. Bose from 1945 to 1948 and presuming that slope as well as other conditions of the Upper Damodar are more or less the same as those of the Barakar an annual silt deposit of 12.9 million tons may be expected in the Upper Damodar. The annual silt deposit in the Damodar was in the past, estimated at 25 million tons Fox and 11 million tons by Sri A.B. Dutt. The Damodar Valley Corporation, however, estimated the silt deposit (at both suspended and tractional) for Upper Damodar at 4.95 million tons. The D.V.C's basis of bed load forming 10% of the suspended load may, however, be on the low side. Authorities like Twenhofel estimated the tractional load for the European rivers as varying from 14 to 30 per cent of silt load and according to Sri J. B. Auden in the case of Damodar, which attains a very high velocity and flow during peak floods, the percentage of bed load is quite high. Thus it appears that the silt deposit of 4.95 million tons estimated by the D.V.C. seems an under estimate.

The estimate of average silt deposit per year thus varies from 4.95 million tons (D.V.C.) for the Upper Damodar to 25 million tons (Fox) for the entire Damodar. Theoretical calculations indicated an annual deposit of 9 to 14 million tons in the Upper Damodar. While taking an estimate of a very low figure in assuming that we take the annual average silt deposit of the Upper Damodar at 7 million tons it should be noted that the silt intensity depends to a large extent on the magnitude, frequency and duration of floods and the amount of deposition will vary widely depending on the magnitude of the floods.

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A part of the silt load may not be available for stowing purposes because fine silt and also fine grained sand may not be suitable for stowing. On the basis of silt gradation carried out by Sri A. K. Roy in the Damodar over a distance of 200 miles below Argada, sand particles above 0.211 m.m. were found to constitute between 77.1% and 83.76%. It may, therefore, be reasonable to assume that 20 per cent of the silt load that will be carried downstream may be too fine to be suitable for stowing purposes. Hence, the average annual sand deposit available for stowing from the Upper Damodar may be taken to be (7 million tons minus 20%) - 5.6 million tons.

Out of the total catchment (4190 sq. miles) of the Upper Damodar, the Konar Dam and the proposed Aiyar Dam will together command 2990 sq. miles, i.e. about 71% of the total. In appreciation of the fact that the siltation intensity of the upper reaches of the Damodar river is higher it may be reasonably assumed that the construction of the Aiyar Dam will reduce the expected replenishment by about 75%, to 1.4 million tons per annum. This would indicate that about 4.2 million tons, which would have been available above the Panchet Dam in the Jharia coalfield, will not be available on account of Aiyar and Konar Dams.

It should also be noted that the sand carried forward from the upper reaches to the area covering the Jharia coalfield depends to a great extent on the intensity of the floods as has been noted for the last few years. The intensity, magnitude and frequency of the floods in the river would be reduced to a considerable extent by the construction of the Aiyar dam, which would indicate that the capacity of carrying forward of the sand by the river will be greatly reduced.

I am, therefore, to emphasise that the replenishment of 5.6 million tons of sand per year in the Damodar river upto the Panchet Dam should be allowed to continue by not building further dams on the upstream side of the Jharia coalfield for the purpose of utilization of the sand for production and conservation metallurgical coal by the process of underground stowing of sand.

As regards the use of ash, cinder, washings from coal washeries for underground stowing it may be pointed out that these materials are not suitable for underground stowing under conditions applicable to coal seams in India because of their combustible matter-content and the Coal Board has already adopted a principle that not more than 20 to 25 per cent of such materials mixed with sand should be used for underground stowing.

As regards the use of materials other than sand, i.e. surface stratified rocks, it may be pointed out that this will make hydraulic stowing underground extremely expensive. It may also be pointed out that the cost of obtaining sand from other sources, i.e. from Sone river will be prohibitive under the present price structure of coal as it may run to figures of the order of Rs.15/- per ton of sand stowed. I would also point out that bringing of sand from the catchment area of the proposed Aiyar Dam in the Damodar river for a distance of about 37 miles from the eastern centre part of Jharia coalfield will be very expensive in capital and running expenditure. For example, a bi-cable ropeway with a maximum capacity of 1.5 million tons per year over a distance of 37 miles may cost Rs.5.18 crores at an estimated expenditure of Rs. 14 lakhs a mile, without considering the feasibility of and increased capital expenditure involved for such a ropeway running uphill and down-dale along the hilly country near the

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upper reaches of Damodar river. To repeat, the cost of transportation both capital and running over such a long distance will, therefore, be extremely high.

At present a number of installations are gathering sand from the stretch of the Damodar river adjacent to the Jharia coalfield. Other large installations are under construction and are also proposed, including sand gathering and transportation installations by the Coal Board which are proposed to transport very large quantities of sand to the coking coal collieries in the Jharia coalfield for purposes of stowing in coking coal collieries.

To conclude I am of the opinion that in extracting pillars underground, hydraulic sand stowing is the best method of conserving our meagre resources of high grade metallurgical coal. The replenishment, and therefore the availability of a large quantity of sand in the bed of the river Damodar near the Jharia coalfield from where it is expected to get almost all the supply of metallurgical coal, will be cut out by the construction of any dams on the upstream side (of the river Damodar) of the Jharia coalfield. Sand obtainable from other sources will be extremely expensive and prohibitive against the present price structure of coal. The use of other materials like ash, cinder, washing refuse from coal washeries will not be possible to any large extent because of the presence of a percentage of combustible-matter in them.

I would, therefore, stress with the utmost emphasis that no further dams should be built on the Damodar river on the upstream side of the Jharia coalfield.

Sd/- S. Mukherjee.
CHIEF MINING ENGINEER/ MEMBER,
COAL BOARD.

12th January, 1960.

NOTES OF DISCUSSION OF THE AWR COMMITTEE MEETING HELD ON 5TH MARCH, 1960 AT ANDERSON HOUSE, CALCUTTA.

Notes of discussion of the A.W.R. Committee meeting held on the 5th March 1960 at Anderson House, Calcutta .

P r e s e n t

Shri S. D. Khungar, ISE(Retd.)	...	Chairman.
" I. B. De, ISE(Retd.)	...	Member.
" S. Mukherjee	...	Member.
" B. Parthasarathy	...	Member.
" N. S. Iyengar	...	Member-Secretary.
" V. Nilakantan, Mg. Director Sindri Fertilizers	...	by invitation.

1) Note dated 23-12-59 by Shri I. B. De.

The gists of the points raised by Shri De and the conclusions of the Committee on each point are given below. Reference to the paragraphs is to paragraphs of the December 1959 Report of the Committee.

Para 4.1: Kharif irrigation.

The average requirement from storage is likely to be much more than 0.40 million acre feet

Conclusion: After discussion Shri De was convinced that 0.4 million acre feet was all right and agreed to drop this point.

Para 4.5: Domestic supply below Durgapur.

The requirement below Durgapur has been assessed as nil. A supply not more than that obtaining in the river in the dry season before the construction of the dams should be escaped below Durgapur.

Conclusion: It was agreed that 50 to 100 cusecs depending on the season may be escaped below Durgapur.

Para 4.6: Industrial and Domestic uses.

The total requirement of water for industrial use should be assessed as 1,030 cusecs.

Conclusion: It was agreed that in view of the rapidly increasing industrial uses, the requirement of water for industrial and domestic uses should be assessed at 1,000 cusecs instead of 900 cusecs previously adopted.

Para 4.8: Total requirement from storage.

This requirement should be re-calculated on the basis of revised requirements in paragraphs 4.5 and 4.6.•

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Conclusion: It was agreed that this should be done. The revised position would be as follows :

(i) Kharif irrigation	...	0.40	million ac-ft.
(ii) Rabi irrigation	...	0.11	" "
(iii) Navigation	...	0.20	" "
(iv) Domestic water supply below Durgapur	...	0.04	" "
(v) Industrial & Domestic uses	...	0.54	" "
Total:	...	1.29	" "
Allow 10% for losses in the river and difficulty in regulation of items (ii), (iii), (iv) & (v)	...	0.09	" "
Total:	...	1.38	" "
Reservoir capacity provided at present for purposes other than flood control	=	0.98	" "
Deduct Evaporation loss in the reservoirs	=	0.22	" "
Net reservoir capacity	=	0.76	" "
Additional capacity required	=	1.38	" "
minus		0.76	" "
		0.62	" "

against 0.52 million ac-ft. in the Dec.'59 Report.

Para 5.4: Safe discharging capacity of lower Damodar.

That it would be very desirable to keep the discharge at Durgapur below 200,000 cusecs as far as possible may or may not be correct as it has not been examined properly.

Conclusion: This point should be examined further when more field data is available.

Para 5.5 : Flood absorption capacity required.

(a) Flodd storage at Aiyar dam will have very much reduced effect in the matter of ultimate flood control.

Conclusion: It was agreed that the flood absorption capacity of 0.57 million ac-ft proposed to be provided at Aiyar dam may not be fully utilized in all storms. Aiyar dam will be effective in reducing the flood peaks.

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(b) Whether any flood absorption capacity should be provided or not at Aiyar should be examined after collection of the required field data.

Conclusion: It was agreed that the extent of flood absorption capacity to be provided at Aiyar damsite should be decided finally after the requisite field data is available. Meanwhile, investigation may proceed on the basis of a flood control capacity of 0.57 m. ac-ft. at Aiyar dam.

Para 5.8 : Flood absorption capacity required in September and October.

The Committee has recommended that 0.10 m. ac-ft. may be stored during the first fortnight and an additional 0.10 m. ac-ft. during the second fortnight of September by reduction of flood absorption capacity at the dams. It would be inadvisable to encroach on the flood control capacity during September.

As the time of discussion Shri De's attention was drawn to the Committee's recommendation about the proposed mechanism for giving flushing doses in the period upto 31st August, wherein it had been proposed to encroach to the extent of 0.10 m. ac-ft. and then release 0.20 m. ac-ft. and repeat this process as and when water was available. Shri De's view was that even then encroachment should not be permitted.

Conclusion : The matter was discussed at great length. It was pointed out to Shri De that if his contention was accepted, there would be practically no flushing of the rivers. The monsoon storage level at Maithon of 480 will not be normally attained till the end of August and should this level be lowered in September the level may not be made up at all. At Panchet Hill a flushing dose of 0.20 m. acre feet at the monsoon storage level will bring the reservoir below dead storage level. This will affect power generation. Further, the average capacity of the sluices will be about 30,000 cusecs against 50,000 cusecs necessary for effective flushing. This will mean that the number of effective flushing doses will be reduced from 8 to 2 before Aiyar dam is constructed and less than two after the construction of Aiyar, and should this be done the rivers will be killed. It was also pointed out to Shri De that the risk involved was little; but this calculated risk had to be taken in order to keep the rivers alive. While Shri De accepted the necessity of flushing doses to keep the rivers in good regime, he held the view that no encroachment should be permitted on the flood reserve during the monsoon. The other members did not agree with Shri De and felt strongly that flushing doses should be provided as recommended in December 1959 Report.

Para 6.5 : Area between Surekalna and Bakshi-Gaighata Khal.

The usefulness of giving 100,000 cusecs before end of August need to be studied more thoroughly.

Conclusion: It was agreed that this should be done. In fact, it had been only pointed out that release of 100,000 cusecs was possible and no positive recommendation that this should be done had been made.

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Para 6.9 : <u>The extent to which the water can be brought from Ajoy basin to Damodar basin, and its possible effect on the lower Damodar Valley</u>.

Preliminary investigations for the proposed Ajoy dam have not been completed yet. Hence, it would not be proper for the Committee to express any definite opinion regarding the feasibility of the diversion of the water of the Ajoy into the Damodar.

<u>Conclusion</u> : It was explained that what the Committee had stated was that the scheme of diversion of water from Ajoy to the Damodar Valley was technically feasible. The economics are still to be examined and field investigations completed. Final decision will be taken after the investigations are complete. Shri De was satisfied.

Para 9.5 : <u>Necessity of additional dams in DVC area</u>.

There is no necessity for the Committee to recommend at this stage that provisional approval may be given to construction of Aiyar dam, subject to its site being found suitable after proper investigations. Such approval can only be given when it is established beyond doubt that the lower Valley of the Damodar will not be adversely affected by the construction of another dam on the Damodar system.

<u>Conclusion</u> : It was agreed that the following changes should be made in the Report.

<u>Page 123</u> : Delete the sentence " Meanwhile, provisional approval may be given to the construction of Aiyar Dam subject to the suitability of site being approved by investigations. "

<u>Page 148</u> : Delete the sentence " Meanwhile provisional approval may be given to construction of Aiyar dam. "

Para 9.1 : <u>DVC's recommendations about storage at Aiyar</u>.

Further studies are necessary to determine whether the provision of any flood absorption capacity at Aiyar dam would be necesssary or not.

<u>Conclusion</u> : This has already been covered by paragraph 5.5.

Para 10.11 : <u>Setting up of Lower Damodar Conservancy Board</u>.

The Lower Damodar Conservancy Board may be set up on the lines already recommended by the Lower Damodar Investigation Committee.

<u>Conclusion</u> : It was explained that this recommendation had already been made in the December 1959 Report. Only it had been added that this Board should have executive power. Shri De was satisfied and agreed to withdraw this paragraph.

Cont'd.....p/16.

Para 11.1 : Acquisition of land upto top of gates at Maithon and Panchet dams.

The cost of acquisition of additional land upto top of gates would be very heavy. It may be considered whether it would not be possible to remove all habitations lying between the existing acquisition levels and the top of gates and have a legislation to prevent the re-erection of habitations within this zone. It would however be necessary to ensure that no loss of life occurs due to adoption of this procedure.

Conclusion : It was agreed that this suggestion may be examined and if found feasible, the area not only upto top of gates but also 5 ft. above top of gates as recommended in December 1959 Report should be covered.

2) Note dated 12-1-60 of Shri S. Mukherjee, Member.

This note was discussed and Shri Mukherjee was requested to quote authority for the various figures adopted by him in the note. He said that he was not in a position to give the authority then and there but would require about 15 days to do so. He promised to send a note by the 20th of March. Since he was proceeding on leave, he would authorise Shri U. N. Jha, Inspecting Officer, Dhanbad, to represent him at the next meeting of the Committee.

3) Discussion with Shri V. Nilakantan, Mg. Director, SFCL.

Shri Nilakantan raised the question of the maximum level to be attained at Sindri Pumphouse. It was explained to him that the construction of Aiyar dam had nothing to do with the raising of the water surface level at Sindri. In fact, if anything, it will help in reducing this level. The water surface level at Sindri was governed by the dam at Panchet Hill. Shri Nilakantan said that if that was the case, he had nothing to say against Aiyar dam, but he was much concerned about the levels to be attained at Sindri. Should a maximum level of 450 be attained at Sindri, not only will the lower pumphouse be submerged but the higher pumphouse, the filters and a portion of the Colony would be also affected. He also stated that both the pumphouses were working and it would not be possible to shut down either of the two pumphouses until a new pumphouse had been provided, should it be necessary to build a new one if no protection to existing ones was possible. He urged that until adequate protection had been given to the existing pumphouses and other works and/or new pumphouse built, the level at Sindri should not be allowed to go above El.437; otherwise, the work of Sindri Fertilizers will be seriously affected. It was suggested to him that it would be worthwhile getting the point examined jointly by representatives of DVC and the Sindri Fertilizers. The question as to who should bear the cost could be decided later. But something should be done urgently, so that flood absorption capacity at Panchet may be fully utilized.

D.O. NO. GC-10/59-60/ DATED 7-3-60 FROM
SHRI S. MUKHERJEE, CHIEF MINING ENGINEER, COAL BOARD ADDRESSED
TO SHRI U.N. JHA, INSPECTING OFFICER.

Sri S. Mukerjee
Chief Mining Engineer.

D.O. NO. GC-10/59-60/

COAL BOARD,
1, Council House Street,
Calcutta-1.
Dated the 7th March, 1960.

Sub:- Augmentation of Water Resources Committee
(Khungar Committee)

My dear Jha,

The last meeting of the above Committee was held last Saturday, the 5-3-60, but the deliberations were not concluded and a further meeting has been proposed to be called after the 20th March, 1960 (probably on the 21st or 22nd current).

As the Chairman has kindly agreed that I may go on leave from the 16th March 1960, I am directed to request you to attend these meetings on the dates that will be notified to you from the DVC's office.

I am forwarding herewith the Reports of the Committee in two volumes - Volume I (Report) and Volume II (Appendices and plates). I am also forwarding you the file on this subject which contains my note of dissent (pages 106-110/C) on the report of the Augmentation of Water Resources Committee of Damodar Valley Corporation - Volume I.

This note of dissent was also discussed during the meeting last Saturday and it was requested by the Committee that a note on the books from which the following figures have been collected giving the name of the authority, the author, the name of the book and the pages in which it occurs and if possible, quotation from the book and the figures referred to should be prepared and sent to Sri U. K. Ghosal, ICS, Secretary & General Manager, Damodar Valley Corporation, Anderson House, Alipore, Calcutta-27 by the 21st March, 1960. I would, therefore, request you to very kindly make out the note and send it to the above address and also attend the meeting of the Committee on whatever date it is fixed:

1) " On the basis of the figures of Mr. Voorduin the average annual amount of silt carried by Upper Damodar Works out to 14 million tons" (Page 106/C)

2) " Considering Khosla's formula, Sri J. B. Auden's opinions on the formula and the observations made by Dr. N. K. Bose from 1945 to 1948 and presuming that slope as well as other conditions of the Upper Damodar are more or less the same as those of the Barakar an annual silt deposit of 12.9 million tons may be expected in the Upper Damodar.(Pages 106-107/C).

Cont'd.....p/18.

3) " The Damodar Valley Corporation, however, estimated the silt deposit (both suspended and tractional) for Upper Damodar at 4.95 million tons. The DVC's basis of bed load forming 10% of the suspended load may, however, be on the too low side." (Page 107/C).

4) " While taking an estimate of a very low figure in assuming that we take the annual average silt deposit of the Upper Damodar at 7 million tons it should be noted that the silt intensity depends to a large extent....."(page 107/C).

5) " On the basis of silt gradation carried out by Sri A. K. Roy in the Damodar river of a distance of 300 miles below Argada, sand particles above 0.211 m.m. were found to constitute between 77.1 and 83.76%. (pages 107-108/C).

All the above figures were quoted from your comprehensive note on the availability of sand in the Damodar river in the vicinity of Jharia field.

Over and above the note to be submitted by 21-3-60, the Committee at its next meeting which is likely to be on the 28.3.60 would like to have for discussion a copy of the plan of the Jharia field showing the ropeway proposed to be installed by the Coal Board.

I shall be extremely grateful if you will kindly attend to the above and also attend the meeting of the Committee as will be notified to you.

Yours faithfully,

Enc:- As stated.

Sd/- S. Mukerjee.

To
Sri U. N. Jha,
Inspecting Officer
Circle No.3
Coal Board
Asansol.

Endt.No.GC-10/59/60/39842 Dated the 7th March, 1960.

Copy to Sri U. K. Ghosal, I.C.S., Secretary & General Manager, Damodar Valley Corporation, Anderson House, Alipore, Calcutta-27 with a request to let Sri U. N. Jha, Inspecting Officer, Circle No.3, Coal Board, Asansol know the date of the next meeting of the Augmentation of Water Resources Committee direct on receipt of the note from Sri U. N. Jha.

Sd/- S. Mukerjee.
Chief Mining Engineer, Coal Board.

SINDRI FERTILIZERS & CHEMICALS LTD.

REGISTERED OFFICE:
SINDRI P.O.
MANBHUM
BIHAR

REF.No. SECTT(G) 081.05

Dated, Sindri, the 7th/8th March 1960

My dear Ghoshal,

Further to my letter of even number dated the 25th February 1960 I send you herewith my record of what happened at the meeting of the A.W. R. Committee. I shall be grateful if you will confirm that this represents what actually took place.

Yours sincerely,

Sd: V. NILAKANTAN.

Shri U. K. Ghoshal, ICS.,
General Manager & Secretary
Damodar Valley Corporation,
Anderson House, Alipore
Calcutta

Enclo:

SINDRI FERTILIZERS & CHEMICALS LTD.

I attended the meeting of the Augmentation of Water Resources Committee held at 12.00 hrs. on 5-3-60 at Calcutta.

2. I explained to the Committee that Sindri's objection to the building of the Aiyar Dam was based on the impression gained at the earlier meetings that a direct consequence of the building of the Aiyar Dam would be to raise the storage level of the Panchet Reservoir to 450 at Sindri. The Chairman of the Committee and the Representatives of the DVC stated that this was not correct as the level of the Reservoir at Sindri depended entirely on the Panchet Dam and not on the construction or otherwise of the dams at the higher stages. I stated that if this was so we would have no objection to the building of the Aiyar or other Dams, but the question of the level of the reservoir at Sindri would remain to be solved. It was explained by the Representatives of the DVC that the top level of the reservoir at Panchet would be 445 and therefore, the level at Sindri could be expected to be at 450 when during floods it was found necessary to raise the level at Panchet to the maximum. I explained that we had had an assurance from the DVC earlier that the level at Sindri would not exceed 435 except in the event of some catastrophic flood. Raising of the level to 450 as a matter of operational control was entirely as different matter. The level of the Sindri Pump house was 442. We considered that the maximum safe level at which the Pumphouse can function was 437 and anything higher than this would result in serious difficulties in the maintenance of the Pumping station. A 450 level was quite unthinkable as this would, apart from submerging the Sindri Pumphouse, affect the Tasra Pumphouse which was built at 450. Also some of our acquired areas including the Sindri colony would be submerged. There would also be some difficulty with our Settling Tank bund since the toe of the bund was at 450 level.

3. The representatives of the DVC stated that the difficulties which would arise at Sindri had not been appreciated fully and they now understood the position that even for operational reasons the level at Sindri should not be raised beyond 435. They accepted the position that the Sindri Factory should not be put out of action on account of the level being raised beyond 435.

4. The Representatives of the DVC, however, pointed out that the question of protecting the installations at Sindri against the consequences of the water level being maintained at 450 should immediately be taken up since it could not be foreseen as to when it may be necessary to hold up the water to maximum level at Panchet. They suggested that a joint technical examination by Sindri and the DVC should be made immediately into this problem, which had arisen in consequence of the policy adopted by the DVC. I agreed with this view and stated that such a technical examination be taken up immediately. It was decided that I should address the DVC on this point.

Sd/- V. NILAKANTAN.
MANAGING DIRECTOR
SFCL. 7-3-60.

(True copy)

EXPRESS DELIVERY

Office of the Member-Secretary, Augmentation
of Water Resources Committee, DVC, P.O. Maithon Dam
Dist: Dhanbad.

No.SDK-308 March 16, 1960.

Shri V. Nilakantan
Mg. Director, Sindri Fertilizers & Chemicals (P) Ltd.
P.O. Sindri, Dist. Dhanbad.

Dear Sir,

Reference may please be made to your letter No. SECTT(G) 081.05 dated March 7/8, 1960 addressed to Shri U. K. Ghoshal, General Manager & Secretary, Damodar Valley Corporation, enclosing therewith your record of what happened at the meeting of the A.W.R. Committee held on the 5th March 1960. In this connection, reference may be made to our letter No. SDK-295 dated March 9, 1960 enclosing a copy of the notes of discussion of the A.W.R. Committee meeting held on 5-3-60. In para 3 of the notes of discussion, the Committee has recorded what happened during the discussion with you.

Yours faithfully,

Sd: N. S. Iyengar. 16.3.60.
Member-Secretary.

c.c. to: Shri S. Prasad, Deputy Secretary, DVC, Calcutta-27 with reference to his No.WS-230/59 Vol.II-2057 dt. 14-3-60.

(True copy)

From Shri I. B. De, M.I.E.,
35B, Bethune Row
Calcutta-6

To Shri U. K. Ghosal, I.C.S.,
General Manager,
Damodar Valley Corporation,
Anderson House, Alipore,
Calcutta-27.

No. 916-C.I.(F) dated 14th March, 1960.

Subject: Khungar Committee.

Sir,

The minute of dissent forwarded to you with my letter No.3095-C.I.(F) dated 23.12.59 was discussed at length in the meeting held at Calcutta on March 5, 1960. It appeared that it would not be possible to come to an agreement regarding some of the important points raised by me in my minute of dissent. As further discussion is not likely to be helpful, I would suggest that the minute of dissent already sent to you may form a part of the report.

Yours faithfully,

Sd: I. B. De. 14.3.60.

Memo No. 916/1-C.I.(F) dated 14.3.1960.

Copy forwarded to the Secretary to the Govt. of West Bengal, I. & W. Department for information.

Sd/- I. B. De.

NOTES OF DISCUSSION OF THE AWR COMMITTEE MEETING HELD ON 21-3-60 WITH ENCLOSURES.

(True copy)

Office of the Member-Secretary,
Augmentation of Water Resources Committee
P.O. Maithon Dam, Dist: Dhanbad.

No.SDK-320 May 7/10, 1960.

(1) Shri S. D. Khungar, ISE (Retd.),
R 577, New Rajinder Nagar, New Delhi-5.

(2) Shri I.B. De, ISE (Retd.)
35-B, Bethune Row, Calcutta-6.

(3) Shri U. N. Jha,
Inspecting Officer, Coal Board,
Asansol.

(4) Shri K. C. Madappa, IAS,
Deputy Secretary, Ministry of Commerce & Industry,
Govt. of India, New Delhi.

(5) Shri B. Parthasarathy,
Chief Engineer (Civil),
DVC, Maithon.

Subj:- Meeting of the A.W.R. Committee.

Dear Sir,

I am directed to enclose herewith notes of discussion of the A.W.R. Committee meeting held on the 21st and 22nd March, 1960 at Anderson House, Alipore, Calcutta.

A copy of letter dated 24-4-60 from Shri S.D. Khungar, Chairman of the Committee addressed to Shri U. K. Ghoshal, ICS, General Manager, DVC, is also enclosed. This may be treated as an annexure to the notes of discussion.

Yours faithfully,

Enclos: As above.

Sd: N. S. Iyengar.
Member-Secretary.

c.c. to: General Manager, DVC, Calcutta, with enclosures.

(TRUE COPY)

Q 3 Prem Nagar
Dayal Bagh
Agra

My dear Ghoshal, 24/4/60.

I enclose one copy of the notes of discussion of A.W.R.C. meeting held on 21 & 22 March 1960 as received from Iyengar and slightly modified by me.

We have suggested a slight change in the estimated cost of transport of sand from Aiyar to Jharia coalfields. This will be now Rs.2/- a ton against 1/- a ton given in our December report and the incidence per ton of steel (assuming that the whole cost of extra transportation is borne by Bokaro Steel Plant) will be 48 nP instead of 24 nP. This is still insignificant compared to the cost of steel. The important point that was missed by Mukherjee but fully appreciated by Jha is that the quantity of sand suitable for stowing in coal mines falls considerably short of requirements and it is only a question of time when the reserves will be exhausted and we have to fall back upon alternative materials. Even if the actual quantity of such sand intercepted by Aiyar Dam is somewhat higher than 1.2 million tons per annum worked out by us, the extra burden on steel will still be insignificant compared to its cost.

Regarding note of Shri De, the notes of discussion of the meeting on 5/3/60 already submitted correctly represent what was decided and no change is necessary. Necessity of Aiyar Dam has been accepted by De himself for providing water for industrial and domestic uses. Only he thinks that sufficient data is not available to justify some flood absorption at this stage. He has also agreed to investigations. It is true that we have recommended that if no extra flood absorption capacity is to be provided Aiyar should not be touched and other dam sites should be developed. It is possible however, that ~~no~~ on investigations, other sites may be found unsuitable and we may have to fall back on Aiyar even for industrial & domestic uses alone. Investigations for Aiyar, Ajoy and other dam sites on the Damodar must proceed simultaneously to avoid possible delay later on. Height of Aiyar Dam must be fixed provisionally to enable these investigations to proceed and obviously it is a better proposition to include also the height required for flood control. This will be more economical than if investigation is done by stages, first for industrial uses and later on for flood control and will also avoid delay in case flood control at Aiyar is to be provided finally.

If you have no objection, a copy of this letter may also go to all concerned along with the notes of discussion of the meeting held on 21 & 22 March, 1960.

With kind regards,

Yours faithfully,

Sd/- S. D. Khungar.

Notes of discussion of the A.W.R. Committee meeting held on 21st and 22nd March, 1960 at Anderson House, Calcutta.

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P r e s e n t.

Shri S.D. Khungar, ISE (Retd.)	...	Chairman.
Shri B. Parthasarathy	...	Member.
Shri N.S. Iyengar	...	Member-Secretary.
Shri U.N. Jha, Inspecting Officer, Coal Board	...	By invitation.

1) Note dated 12.1.60 of Shri S. Mukherjee, Member.

In the last meeting held on the 5th March 1960 Shri Mukherjee was requested to quote authority for the various figures adopted by him in his note of 12.1.60. As Shri Mukherjee was on leave, Shri U.N. Jha, Inspecting Officer, Coal Board, Asansol, furnished vide his letter No.12396 dated 18.3.60 the details of how the different figures quoted in Shri Mukherjee's note have been arrived at. A copy of this note is enclosed herewith. Shri Jha explained the computations in his note item by item. However, when he was requested to participate in the discussion to reconcile the figures of sand replenishment varying over a wide range, he pleaded his inability to do so as he was not a member of the Committee.

2) Note dated 23.12.59 by Shri I.B. De, Member.

Further to the notes of discussion held on 5.3.60 Shri I.B. De has sent his comments vide his letter No.941-C.I(F) dated 16.3.60. A copy of this is enclosed herewith. This could not be discussed with Shri I.B. De as he was not present in the meeting. He has explained his inability to attend the meeting in his letter No.916 C.I(F) dated 21.3.60 addressed to General Manager, DVC, and in his letter No.994-C.I.(F) dated 21.3.60 addressed to Shri N. S. Iyengar, Member-Secretary of the AWR Committee. Copies of these letters are attached herewith. However, Shri A.D. Khan, Secretary, Department of Irrigation & Waterways, Govt. of West Bengal, has informed Shri U. K. Ghoshal, General Manager & Secretary, in his D.O. No.1879-I dated 17.3.60 that Shri I.B. De has already been told that he continues to be a member of the Augmentation of Water Resources Committee even after he ceased to be the Chief Engineer, Floods. A copy of this D.O. is enclosed herewith.

The remaining members who attended the meeting viz., Shri S.D. Khungar, Shri B. Parthasarathy and Shri N.S. Iyengar, discussed the different items in the letter of Shri U. N. Jha and also in the comments of Shri I. B. De. These are as follows :-

A. Shri U.N. Jha's letter dated 18.3.60 re: Annual replenishment of sand.

(i) Estimate of 14 million tons of annual silt load in the upper Damodar.

In this estimate there are three item which need correction.

Cont'd.....p/26.

The first correction is average intensity of silt which is taken as 1/500 times the average flow. Subsequent to the preparation in 1945 of the report " Preliminary Memorandum on the Unified Development" by Mr. W. L. Voorduin, silt intensity has been measured at different places in the upper Valley. On the basis of the observations at Sudamdih near Sindri during the period 1949 to 1953, the intensity of the suspended silt is 1/1172. This has been used in the AWR Committee Report (page 17, Vol.I). The bed load is taken as 15% of the suspended silt. Also due to no observations being made at different depths, corrections are made on the basis of experiments at Hirakud and in U.S.A. as mentioned in pages 22-23 in the AWR Committee Report, Vol.I.

The second correction is for the runoff taken as 18.7 inches which corresponds to the Rhondia discharge data. The Committee has accepted the discharge data used in the Water Management Plans based on the reservoir data and the discharge measurements near the dams. This gives an annual runoff above Maithon and Panchet equal to 5.2 million acre feet which is equivalent to runoff of 14.6 inches.

The third correction is for the catchment area which is taken as 4,190 sq. miles. The sand winning operations of Jharia coalfield extend upto Sindri. The catchment area upto Sindri including the catchment areas of Gowai and Ijri is equal to 3,920 sq. miles, Deducting 385 sq. miles already controlled by Konar, the balance is 3,535 sq. miles.

(ii) Estimated annual silt load of 12.9 million tons.

In this estimate silt intensity observed in the Barakar catchment at Giridih and Kulti has been used. It is not necessary to use these data when we have observations in the Damodar catchment itself at Sudamdih near Sindri.

(iii) Estimate of 25 million tons.

This figure has been taken from Mr. J. B. Auden's paper. Details as to how this figure is arrived at are not available. Therefore, examination of the same is not possible.

(iv) Estimate of II million tons.

This has been taken from a paper by Shri A. B. Dutta. Details arrivingat this figure are not given. It is not, therefore, possible to examine the figure.

(v) Estimate of 4.95 million tons.

This is arrived at as follows :

Catchment area of Panchet excluding Konar .... 3,849 sq. miles.

Average annual runoff ... --- 14.6 inches.

$$= \frac{3849 \times 14.6}{12} \times 640$$

= 3 million acre feet.

Intensity of suspended silt = 1/1172.

Cont'd.....p/27.

Annual quantity of suspended silt $= \frac{3}{1172} \times 10^6 \times 4840 \times \frac{9}{25}$

$= 4.5$ million tons.

Add 10% bed load $= 0.45$ million tons.

Total $= 4.95$ million tons.

It may be noted that the AWR Committee has assumed 15% bed load. Also corrections have been made for not observing silt intensity at different levels.

(vi) Tractional load varies from 14 to 30%.

This has been taken from Mr. J. B. Auden's paper. As no details are given, the figures cannot be examined. The Committee has taken 15% of suspended load at bed load. 15% has been accepted by Punjab, C.W.P.C. etc.

(vii) Theoretical calculation of 9 to 14 million tons.

As regards 14 million tons, the details have been examined under Item (i) above, 9 million tons is worked out on the basis of dead storage capacity provided in the Preliminary Memorandum for the Damodar Branch. It should be noted that dead storage is provided not only from the considerations of silt deposition, but also from other considerations such as, minimum head for power generation etc. Therefore, computation of silt load should not be worked out on the basis of dead storage provided. For example, the dead storage provided by Mr. Voorduin for the Sonalpur site was 190,000 acre feet, whereas what is now provided at Panchet is 148.000 acre feet. Also the dead storage provided by Mr. Voorduin at Aiyar (Alignment 'A') was 260,000 acre feet, whereas what is proposed to be provided now at Aiyar for Alignment 'C' is only 170,000 acre feet. Therefore, the estimate of 9.3 million tons worked out on the basis of dead storage capacity and assuming 100 years to fill it cannot be accepted.

(viii) Silt gradation of Shri A. K. Roy.

Shri Jha has clarified that the silt gradation done by Shri A. K. Roy is for bed sand and not for suspended load. Therefore, the application of this data in Shri Mukherjee's note of 12.1.60 to estimate the annual deposit as 7 million tons - 20% = 5.6 million tons is not correct.

(ix) Percentage of silt load expected to be deposited behind the dams.

Shri Jha has suggested that the silt load carried away by the flood water below Panchet dam may be taken as 25% and that the remaining 75% would be trapped in the reservoir. In coming to this conclusion, he has assumed that 2/3 of the incoming water will have sufficient time and low velocity to deposit all its silt load, whereas about 1/3 of the flow will be released through the gates as they come. As against this assumption, what was observed during the 1959 monsoon season is as follows :-

Cont'd.....p/28

Total inflow into Panchet reservoir during the monsoon period.	...	5.5 million	ac-ft.
Held back in the live storage capacity between Els. 415 and 392.	...	0.26 "	"
Balance released during monsoon period	...	5.24 "	"
Temporarily held back in the flood reserve during flood control operations	...	1.05 "	"
Quantity of water released as it came	...	4.19 "	"

From the above, it will be seen that the quantity held back temporarily is equal to $\frac{1.05}{5.5}$

= 19% of the total inflow as against 67% assumed by Shri Jha.

Also the quantity of water released as it came = $\frac{4.19}{5.5}$

= 76% as against 33% assumed by Shri Jha.

As against the above figures, it may be mentioned that Shri Iyengar's paper published in the Irrigation & Power Seminar held at Hirakud, we have assumed that in an average about 1/3 of the flood reserve is expected to be used for temporary holding up of flood water about 5 times during the monsoon. This will give 1.468 million acre feet as against 1.05 million acre feet observed during the 1959 monsoon. For the above reasons the suggestion made by Shri Jha viz., 75% of the silt will deposit in Panchet is not acceptable.

(x) Average expected annual silt deposit in the Panchet reservoir.

The estimate of quantity deposited in the Panchet reservoir viz., 7 million tons - 25% cannot be accepted for the reasons mentioned in Item (ix) above.

(xi) Expected annual availability of 4.2 million tons of silt deposit after the construction of the Aiyar Dam.

Shri Jha has explained that the catchment area previously taken as 2,990 should have been 1,990 sq. miles. Making this correction, he has concluded that the construction of Aiyar dam will reduce the expected replenishment by 2.6 million tons. This cannot be accepted, because first the figure of 5.25 million tons arrived at under item (x) above, is not accepted and again the catchment area of Aiyar is 1,640 sq. miles as against 1,990 sq. miles mentioned in the note. The computations made in the Committee's report of December 1959 have been done in greater detail taking the silt intensity observation at Ramgarh near Aiyar into consideration. We do not see any reason to change those figures.

Cont'd.....p/29.

(xii) Estimated cost of sand transport from the Sone River.

The railway freight for transporting one ton for a distance of 170 miles from Dehri-on-Son to Jhoria coalfield is estimated as Rs.13.4. This gives an average rate of $\frac{13.4 \times 16}{170}$ = 1.26 anna per ton mile, which is more than the rate of -/1/- per ton mile assumed in the AWR Committee Report, page 108, Vol.I.

It is felt that the cost figure shown on page 108 of the Committee's report may be changed in view of the following :-

Capital cost per mile of the ropeway is at present Rs.14 lakhs as against the previous assumption of Rs.11 lakhs made by the 1957 Committee.

This increases the transportation cost from -/1/- per ton mile to 1.27 anna per ton mile. Also, the extra distance of transportation was previously estimated as 14 miles. It is explained by Shri Jha that the location where sand is required is nearabout Loyabad. The distance from the site of excavation of sand in Aiyar reservoir to Loyabad is about 37 miles, and the distance from the site of excavation of sand in Panchet reservoir to Loyabad is about 12 miles. The extra distance of transportation is, therefore, 37 - 12 = 25 miles. Therefore, the additional cost of transportation will be $\frac{1.27 \times 25}{16}$ = 1.96 say Rs.2/- per ton. Therefore, the extra cost of transporting 1.2 million tons of sand from Aiyar to Loyabad will be Rs.24 lakhs. In other words, the extra cost per ton of steel will be 48 nP. instead of 24 nP. shown in the December 1959 Report.

(xiii) Distance from the headwaters of the proposed Aiyar dam to the middle part of the Jharia coalfield.

The distance of 37 miles suggested by Shri Jha is accepted. However, in fixing the extra distance of transportation, the distance between the site of excavation at Panchet reservoir and the centre of Jharia coalfield should be deducted.

B. Comments of Shri I.B. De, Member, dated 16-3-60.

Para 4.1: Kharif irrigation.

0.40 million acre feet was decided after modifying the water management plans on the basis of the revised findings of the Committee.

Para 4.5: Domestic supply below Durgapur.

In the meeting held on 5-3-60 the release of 50 to 100 cusecs below Durgapur depending upon the season was agreed to by all present.

Cont'd.....p/30.

Para 5.5: Flood absorption capacity required.

Investigation of Aiyar Damsite has been recommended by the Committee. For the purpose of investigation, it is necessary to fix tentatively the height of dam. For this purpose, it was agreed that the flood control capacity may be taken as 0.57 million acre feet at Aiyar.

Para 5.8: Flood absorption capacity required in September and October.

No comments.

Para 6.9: The extent to which the water can be brought from Ajoy basin to Damodar basin, and its possible effect on the lower Damodar Valley.

No comments.

Para 11.1: Acquisition of land upto top of gates at Maithon and Panchet dams.

No comments.

Enclos: As above.

Maithon,
May 9, 1960.

Sd: N. S. Iyengar,
Member-Secretary.
10.5.60.

- C o p y -

No.12397

Asansol, the 18th March, 1960.

From:
V. N. Jha
Inspecting Officer
Coal Board, Circle No. 3.
Asansol

To
Shri U. K. Ghosal, I.C.S.
Secretary & General Manager
D.V.C.
Anderson House
Alipore
CALCUTTA-27.

Sub: Augmentation of Water Resources Committee:
Note of dissent submitted by Shri S. Mukherjee,
Chief Mining Engineer, Coal Board.

Dear Sir,

I invite reference to endorsement No. GC-10/59/60/39842 dated the 7th March, 1960 addressed to you by Shri S. Mukherjee, Chief Mining Engineer, Coal Board on the above subject. As desired by Shri Mukherjee, I am submitting below details of how the different figures of expected sand replenishment in the upper Damodar, given in Shri Mukherjee's note, have been arrived at :-

1) Estimate of 14 million tons of annual silt load in the upper Damodar (upto Panchet).

According to Mr. W. L. Voorduin (paragraph 98, page 29 of the "Preliminary Memorandum of the Unified Development of the Damodar River") the average silt content in the Damodar has been stated as 1/500 times the average flow. Again, according to him, (vide table 3, page 14 of the Preliminary Memorandum of the Unified Development of the Damodar River) the average run off for the monsoon period (from June to October) for the Damodar River was 18.7 inches for the years from 1933 to 1944. On the basis of these figures the average annual silt load carried in the upper Damodar is arrived at as follows :-

$$\frac{\text{Catchment in sq. ft. X average runoff in ft.}}{500 \times 25}$$

$$= \frac{4190 \times 1760 \times 1760 \times 9 \times 18.7}{500 \times 25 \times 12}$$

= 14.02 million tons.

Notes:- 25 cft. of silt has been taken as one ton. The catchment of upper Damodar has been taken as 4190 sq. miles as given for Sanolapur in Exhibit II of the aforesaid memorandum.

Cont'd.....p/32.

2) Estimated annual silt load of 12.9 million tons above the Panchet Dam.

According to the figures of Dr. N. K. Bose's research work (1949) as quoted by Dr. J. B. Auden, in his paper "Some Factors concerning transport of sediments by rivers" (published in the proceedings of the National Institute of Sciences of India, volume XVI (1950) the average intensity of silting from 194[illegible] to 1948 was found at Giridih and Kulti as 2.08 acre feet and 1.47 acre feet per sq. mile respectively. The nature of terrain and the slope of the upper Damodar being more or less similar to those of the Barakar the silt intensity for the upper Damodar may be taken as the mean of the above figures. In other words, the intensity of silting for the upper Damodar may be taken as $\frac{2.08 + 1.47}{2} = 1.78$ acre feet per sq. mile of catchment. Taking the catchment for the upper Damodar to be 4190 sq. miles (as given for Sonolapur in Mr. Voorduin's Memorandum) the annual average silt load for the upper Damodar is calculated as

$$\frac{1.78 \times 4190 \times 4840 \times 9}{25}$$

= 12.8 million tons (assuming 25 cft. of silt equivalent to one ton).

3) Estimate of 25 million tons of annual silt load for the entire Damodar.

In paragraph 4 of his paper " Some factors concerning transport of sediments by rivers" (published in the proceedings of the National Institute of Sciences of India, volume XVI (1950) Shri J. B. Auden has quoted Sir Ceryl Fox's estimate of "current" deposit brought down annually by floods as 25 million tons. The details of Sir Ceryl's estimate are not available with me.

4) Estimate of 11 million tons of annual sand replenishment.

This estimate has been made by Shri A. B. Dutta of G.S.I. in his paper "Sand Stowing" published in the proceedings of the National Institute of Sciences of India, volume XVI (1950). The details of this estimate are not given in the paper.

5) Estimate of 4.95 million tons of annual silt load made by the D.V.C. for the Upper Damodar.

In his d.o. letter No. DE-3/1/28-112 dated the 28th/29th May, 1956 addressed to the P.A. to the Chief Engineer, D.V.C., Shri N. S. Iyenger, the then Planning Engineer, has stated " It is expected that about 200,000 tons of bed load will be deposited annually in the reach of the river Barakar between 12 and 17½ river miles upstream of the Maithon dam; also it is expected that about 450,000 tons of bed load will be deposited in the stretch of the Damodar river between 15 and 20 river miles upstream of the Panchet Hill dam.

The above estimates corres-pond to about 10% of the total suspended silt load estimated on the basis of the actual silt observations done at Chirkunda corresponding to Maithon and at Sudamdih corresponding to Panchet Hill."

Cont'd.....p/33.

Thus, it may be seen that according to Shri Ayanger's estimate the bed load deposit, being only 10% of the suspended silt load, above the Panchet dam is 0.45 million tons. Therefore, the total silt load, including bed load, is, according to him, 4.95 million tons above Panchet.

6) Tractional load varies from 14 to 30% of suspended silt load.

This statement has been taken from Shri J. B. Auden's paper " Some factors concerning transport of sediments by rivers" (published in the proceedings of the National Institute of Sciences of India, volume XVI (1950). Relevant extract from this paper is quoted below :-

" The quantity of tractional or bed load moved by streams is known with less certainty than the suspended load. Twenhofel (1950, page 222) cites estimates in Europe of tractional as a percentage of bad load which vary from 14 to 30 per cent, whereas in some exceptional American rivers the tractional and suspended loads have been considered to be almost equal."

7) Theoretical calculation of 9 to 14 million tons of silt load in the upper Damodar.

As for the estimate of 14 million tons reference may kindly be made to item 1 above. This has been calculated on the basis of the average silt intensity, the average runoff during the monsoon period and the catchment. Theoretical calculation for the estimate of 9 million tons is shown below :-

According to the estimate of Mr. Voorduin (Preliminary Memorandum of Unified Development of the Damodar River) the life of the D.V.C. dams has been provided for 100 years. The total dead storage provided for the Panchet, Aiyar, Bokaro and Bermo dams on the upper Damodar comes to 537,000 acre feet (Exhibit II of the aforesaid Memorandum). Therefore, annual deposition of silt behind these dams was estimated at 5370 acre feet which works out to $\frac{5370 \times 4840 \times 9}{25}$ = 9.3 million tons. (Assuming 25 cft. of silt equal to one ton).

8) Silt gradation of Shri A. K. Roy.

There seems to be some confusion in regard to the figures of silt gradation given in Shri Mukherjee's note. This silt gradation was done by Shri A. K. Roy for bed sand and not for suspended load, and is, therefore, not applicable for the latter. According to this gradation almost 100% of the bed sand is suitable for stowing which is borne out in actual practice.

9) Percentage of silt load expected to be deposited behind the dams.

The figure of 20% given in Shri Mukherjee's note should be revised to 25% which is arrived at as follows :-

At the beginning of the monsoon all the upland river flow will be impounded and will thus have sufficient time to deposit its silt load in the reservoir. After the reservoir is full upto its live storage level, heavy floods

Cont'd.....p/34.

will be released by opening the gates. Thus it may be reasonably expected that two third of the incoming water will have sufficient time and low velocity to deposit all its silt load excepting perhaps very fine silt which may remain in suspension. In the case of late heavy floods which may ordinarily account for about one third of the entire flow, they will be released through the gates as they come and will thus carry with them a certain percentage of silt load, but not all, as tranctional load will deposit in the reservoir. Moreover, the incoming flood will push ahead a part of the impounded water already relieved of silt load, through the gates. Therefore, the silt load carried by such releases of flood water will be less than one third and may be taken as 25%.

10) Average expected annual silt deposit of 5.6 million tons in the Panchet reservoir.

Because of the correction from 20% to 25% suggested above in item 9, this figure should be revised to 5.25 million tons (7 million tons - 25%).

11) Expected annual availability of 4.2 million tons of silt deposit after the construction of the Aiyar dam.

Unfortunately there has been a slight mistake in the calculation of the above figure. The catchment of the Konar and proposed Aiyar dams has inadvertently been stated to be 2990 sq. miles in place of 1990 sq. miles. Therefore, the catchment of Konar and Aiyar dams will constitute only 47.5% of the total catchment of the upper dam. In appreciation of the fact that the intensity of the upper Damodar is higher it may be reasonably assumed that the construction of the Aiyar dam will, therefore, reduce the expected replenishment by 50% i.e. from 5.25 million tons to 2.6 million tons.

12) Estimated cost of sand transport from the Sone River.

The estimated cost of transport of sand from the Sone River, including the cost of excavation and loading, works out to Rs. 15/- per ton as follows :-

Dehri-on-Sone is about 170 miles from the middle of the Jharia Coalfield. Transport by an aerial ropeway over such a long distance being impracticable, sand can be transported only in railway wagons. On the basis of the concession rate, now allowed by the Railway Board to the Coal Board for sand transport from Bhojundih to Khas Ganeshpur at the rate of Rs.0-1-6 per mound, the railway freight alone from Dehri-on-Sone will amount to Rs.13.40 per ton. Adding the cost of excavation and loading the total will come to Rs.15/- per ton of sand at the pit head.

13) Distance from the head waters of the proposed Aiyar dam to the middle part of the Jharia Coalfield.

As sand is expected to collect near the tail end of the reservoir, the distance from the site of excavation to the site of proposed Aiyar dam will itself measure above 8 to 10 miles. Adding to it the distance from the proposed site of the Aiyar dam to the middle part of the Jharia Coalfield, say Loyabad the total distance for the ropeway will be 37 to 38 miles.

Yours faithfully,
Sd/- (U. N. Jha).

(TRUE COPY) No.941 - C.I. (F)

35B, Bethune Row,
Calcutta-6

March 16, 1960.

From:

Shri I. B. De, M.I.E.,

To

Shri N. S. Iyengar
Member-Secretary
A.W.R. Committee
P.O. Maithon Dam
Dist: Dhanbad

Sub: A.W.R. Committee.

Ref: Your letter No.SDK-295 dt. March 9, 1960.

Sir,

In continuation of my letter dated March 15, 1960 I am forwarding herewith my comments on the notes of discussions of the A.W.R. meeting held on the 5th March, 1960, sent with your letter under reference.

Yours faithfully,

Enclo: As noted.

Sd/- I.B. De. 16.3.60.

No.941/1-c.I(F)

Copy with a copy of the comments forwarded to the Secretary to the Government of West Bengal, Irrigation & Waterways Department, Writers' Buildings, Calcutta, for information.

Enclo: As noted.

Sd/- I. B. De.

No.941/2-C.I(F)

Copy forwarded to the General Manager, Damodar Valley Corporation, Anderson House, Alipore, Calcutta-27, for information.

Sd/- I. B. De.

Comments of Shri I. B. De on the notes of discussions of the A.W.R. Committee meeting held on March 5, 1960.

1) Note dated 23.12.59 by Shri I. B. De

Para 4.1: Kharif irrigation

I was not fully convinced that 0.40 million acre feet was alright. I, however, agreed to accept the figure of 0.40 million acre feet tentatively pending preparation of the modified water management plans on the basis of the revised findings of the Committee regarding water requirement for irrigation, navigation, industrial use etc.

Para 4.5: Domestic Supply below Durgapur

I suggested that the views of the Chief Engineer, Irrigation & Waterways, on this point might be obtained. The decision to escape 50 to 100 cusecs below Durgapur was only tentative.

Para 4.6: Industrial & Domestic use.

No comments.

Para 4.8: Total requirement from storage

My remarks against paras 4.1 and 4.5 above may please be seen.

Para 5.4: Safe discharging capacity of lower Damodar.

The views expressed by me in my note of dissent may please be seen.

Para 5.5: Flood absorption capacity required

I agreed to the investigations for the Aiyar dam site being started immediately along with those for the Ajoy dam site.

As far as I remember, I stated that the flood control problem of the Damodar Valley had three aspects as stated in detail in my note of dissent and that further studies after collection of the requisite data would indicate whether provision of any flood absorption capacity at the Aiyar dam site would be necessary or not. It would not be correct to say that I agreed to the investigations for the Aiyar dam being made on the basis of a flood control capacity of 0.57 million acre feet at Aiyar dam.

Para 5.8: Flood absorption capacity required in September & October

As stated I did agree that flushing doses were essential to keep the

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rivers in good regime but did not agree to encroach on flood reserve during the monsoon for the purpose. I questioned the efficacy of the flushing doses as recommended by the Committee for keeping the rivers in the lower valley in good regime.

Para 6.5: Area between Surekalna and Bakshi-Gaighata Khal.

No comments.

Para 6.9: The extent to which the water can be brought from Ajoy basin to Damodar basin, and its possible effect on the lower Damodar Valley.

The views expressed by me in my note of dissent which covers other points also may please be seen.

Para 9.5: Necessity of additional dams in D.V.C. area.

No comments.

Para 10.11: Setting up of the Lower Damodar Conservancy Board.

No comments.

Para 11.1: Acquisition of land upto top of gates at Maithon and Panchet dams.

As far as I remember, the Committee accepted my suggestion as given in my note of dissent concerning this item.

Sd/- (I. B. DE.)
16.3.60.

(COPY) D.O. No. 12396

Asansol, the 18th March, 1960.

Dear Shri Iyengar,

I enclose herewith a copy of my letter addressed to Shri U. K. Ghosal on the lines discussed with you in your office on the 16th instant. As I have been busy with other important works it has not been possible for me to go through your article. I am, therefore, retaining that volume with me and shall return it to you at Calcutta in your D.V.C. office when I shall be coming to attend the meeting.

I had a discussion with the Chairman and the Secretary of the Coal Board yesterday regarding my attending the meeting of the Khungar Committee as well as clarification of the points stated in Mr. Mukherjee's note. They have agreed that I should attend the meeting in the forenoon of the 21st, and the other meeting of the Coal Board has been accordingly adjusted. I hope discussion on the points raised from Mr. Mukherjee's note will be over by say 1 O' clock.

I should also like to inform you that Coal Board is likely to submit a further note supplementing that already submitted by Shri Mukherjee. The preparation of this note will take a few days more and will not be ready by the 22nd.

More when we meet at Calcutta.

Yours sincerely,

Sd/- U. N. Jha.

To
Shri N. S. Iyengar,
Manager,
DVC Reservoirs
P.O. Maithon Dam
DHANBAD.

(True Copy)

From: Shri I. B. De, ISE(Retd.),
35B, Bethune Row,
Calcutta-6.

To Shri N. S. Iyengar
Member-Secretary
A.W.R. Committee
P.O. Maithon Dam
Dist: Dhanbad

C/O: General Manager, DVC,
Anderson House, Alipore

No.994-C.I (F) dated March 21, 1960.

Ref:- Your letter No. SDK-303 dated March 15, 1960.

Dear Sir,

I have not received any instruction from the Govt. of West Bengal for attending the meeting of the A.W.R. Committee to be held at Calcutta on 21st and 22nd March, 1960. I am, accordingly, unable to attend the said meeting.

Yours faithfully,

Sd: I. B. De. 21.3.60.

No. /1(2)-C.I.(F) dated March 21, 1960.

Copy forwarded for information to :-

1. General Manager, Damodar Valley Corporation,
Anderson House, Alipore, Calcutta-27.

2. Secretary to the Govt. of West Bengal, I. & W. Deptt.

Sd: I. B. De.

(True copy)

Secretary,
Department of Irrigation & Waterways.
Government of West Bengal, Writers' Buildings, Calcutta, the 17th March, 1960.

D.O. No. 1879-I.

My dear Ghoshal,

Please refer to your d.o. No. WS-230/59-Vol.II-2071 dated the 14th March, 1960 Shri I. B. De has already been told that he continues to be a member of the Augmentation of Water Resources Committee even after he ceased to be the Chief Engineer, Floods. In the circumstances, the Government of West Bengal do not see the necessity of appointing another officer in his place.

Yours sincerely,

Sd: A. D. Khan.

Shri U. K. Ghoshal ICS.
General Manager & Secretary
Damodar Valley Corporation
Anderson House, Alipore
Calcutta-27.