

**BEFORE THE NATIONAL GREEN TRIBUNAL
AT NEW DELHI
APPEAL NO. 21 OF 2021**

IN THE MATTER OF:

Dr. Bharat Jhunjhunwala & Anr... .. Appellants

Versus

Union of India & Ors... .. Respondents

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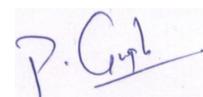
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REJOINDER TO THE REPLY FILED BY THE RESPONDENT NO. 1 & 3

It is most respectfully submitted:

1. That the Appellants herein are filing a combined rejoinder to the reply filed by the MoEF&CC, Respondent No. 1, and M/s THDC India Ltd., Respondent No. 3 in the matter. At the outset, the Appellants deny each and every statement, allegation, averment and contention made by the Respondents in their reply affidavit which is contrary to or inconsistent with what is stated in the Appeal. The Appellants pray that nothing should be deemed to be admitted by the Appellants by virtue of not having been specifically denied herein.
2. That the Hon'ble Tribunal vide order dated 08.10.2021 directed the Respondents to file response to the contentions raised in the Appeal and to the MoEF&CC to file an expert opinion of EAC for River Valley and Hydro-Electric Projects. The Respondents were required to respond to the following issues raised in the appeal which are reiterated herein:
 - a. Whether the EAC was right in appraising the project as a "continuing or ongoing project" considering that project proponent has introduced changes in the project design and parameters resulting to change in scope of the project? The issue required to be dealt with by the EAC was to examine

whether there have been any changes in the original proposal considering that any change in the environmental parameters whether major or minor constitutes change in scope.

(Ground A at page 39 of the Appeal)

- b. Whether the MoEFCC/EAC was right in exempting the project from public hearing in view of the Notification of 18.03.2021 on the basis that the project was 50% physically constructed? What is the basis for reaching to the conclusion that the physical construction of the project is more than 50%? ***(Ground B at page 46 of the Appeal)***
- c. Whether the EAC took note of the fact that the Rapid Draft EIA report failed to address negative environmental impacts of the project and the environmental costs of the said impacts was also not included in the CBA which were also highlighted by the Appellant No. 1 in his representation to the EAC dated 26.07.2020 and to the project proponent dated 17.08.2020? Also, whether a Rapid Draft EIA based on one season baseline data can be accepted for granting EC to a River Valley project of Category A. ***(Ground C and Ground D at page 51 and 62 respectively)***
- d. Whether public consultation which implies considering written responses and representations from the concerned and affected people was held and the Rapid Draft EIA report was made public for receiving objections/suggestions from the public for appraisal of the project for fresh EC? Whether exemption from “public hearing” constitutes “public consultation” too? ***(Ground E at page 65 of the Appeal)***
- e. Whether the project has been appraised by the EAC as a peaking station as reflected in the EAC minutes of

27.07.2021 whereas the same is a 'Run of the River Project' as clearly mentioned by the project proponent in the PIB meeting held in 2007? **(Ground F at Page 69 of the appeal)**

f. Whether the EAC considered that there has been considerable changes in the project area since the conception of the project in 2007 and whether the project stands economically and environmentally viable considering the change in circumstances? **(Ground G at page 71 of the Appeal)**

g. Whether the Respondent No. 3 can simply brush aside the representation of the Appellants dated 17.08.2020 whereas being a public authority and a government agency it is obligatory upon the Respondent No.3 to consider the representations made by the public in view of the Public Trust Doctrine? **(Ground E at page 66-69 of the Appeal)**

3. That the Appellants have filed a comprehensive appeal challenging the Environment Clearance dated 21.08.2021 on the abovementioned grounds. The Appellants for the purposes of the present rejoinder would like to reiterate the submissions/contentions raised in the Appeal. The Appellants have also filed an additional affidavit on 30.03.2022 placing on record the representation made by the Appellants to the Expert Appraisal Committee on 10.11.2021 regarding suggesting an alternative option that would significantly reduce the environmental and social impact of the Vishnugad Pipalkoti Hydro-electric Project without significantly impacting the other attributes of the Project. The Appellants would like to rely on the additional affidavit and the same may be read as part and parcel of the present rejoinder.

4. That the MoEFCC/EAC has given a casual reply and has failed to deal with the issues raised in the Appeal. The appellants in the present rejoinder are rebutting to the limited and specific response made by the EAC/MoEFCC in the following paras:
5. That the EAC in para 3 at page 37 of its reply has stated that there are no major environmental parameters such as submergence area, FRL, the height of the dam above river bed etc. and that there is no material change in the environmental related parameters. It is submitted that the Hydro Power Project is not limited to only parameters such as submergence or FRL or height of the dam and consists of various components such as Head race tunnels/channels, Surge shaft/surge chambers, Pressure shaft/Penstock, Underground and surface power house, Tailrace channel or tailrace tunnel and any changes in the design of the said components would result into environmental changes at the ground level. The question before the EAC was not to determine whether the change in design or project parameters is major or minor but to examine if there has been any change introduced in the original proposal. Further, the Appellants have relied upon various judgments which establishes that even changes in equipment, machinery or size of a particular component also results into change in scope of the project. The EAC at para 3 has stated that there is 'no material change in the environment related parameters of the project'. However, the appellants have reiterated the Table mentioned at page 39 of the Appeal to establish that even change in the sizes of the various components of the project would lead to increase in the potential environmental impacts.

Item	2006 DPR (Annexure A-13)	2021 EAC Minutes (Annexure A-12)	Change	
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DIVERSION TUNNEL				
Length	490	559 m (494 m tunnel and 65 m cut & cover)	+69m	Increased length and dia will involve more tunnelling, blasting, etc. More destabilization of the mountains.
Diameter	10	10.5 m, Circular	+0.5m	Increased length and dia involved more tunnelling, blasting, etc. More destabilization of the mountains.
Gates	10m*10m	4 m * 10.5 m, Vertical lift fixed wheel	+58sqm	
Invert level at entry	1228	1224 m	-4m	
Height	15 m	24 m	+9 m	
Length	46 m	40 m	-6 m	
Height	6 m	7.5 m	+1.5 m	
Top EL.	1228	EL 1222.5 m	-5.5	
DIVERSION DAM				
Length	89.3	98.85 m (NOF 31.85 m, OF 67 m)	+9.55 m	Increased length involves more use of steel and cement leading to more air pollution.
SPILLING ARRANGEMENT				
A. Sluices:				
Nos.	4	5	+1	
Design Flood	8004	10840 m ³ /sec	+2836 m	
Size of sluice	6.6*15	7.8 m (W) * 16 m (H)	+25.8	
B. Diversion Cum Spillway Tunnel	10	Diameter 10.5 (φ) , circular	+0.5 m	Increased diameter involves more tunnelling,

				blasting, etc. More destabilization of the mountains.
Length	490	100 m	-390 m	
Design Discharge	1074	1578 m ³ /sec	+504	
Gate	2+1, 4.1 m * 10 m	2+1 no., 4 m * 10.5 (Vertical lift fixed wheel gate)	+1sqm (4.1x10>4x10.5)	
DESILTING CHAMBER				
Size	350*16m*20.6 m	390 m (L) * 16 m (W) * 21.25 m (H)	+17240	Increased area involves more blasting, etc. More destabilization of the mountains. Retention of water for a longer time will lead to greater deterioration of quality and greater settling of sediments leading to greater change in water quality.
Gates	2.5*2.85	3 nos. 1.8 m*2.12 m (Vertical lift slide gate)	-3.309	
HEAD RACE TUNNEL				
Diameter	8.8 horse shoe	8.8 m Circular	shape change	
Velocity	3.56	3.76 m/sec	+0.2	
Bed slope (average)	1.208	1:121 (upstream of Maina River) 1:321 (Downstream of Maina River)	-0.087	
No. of adits	4	2	-2	

UPSTREAM SURGESHAFT				
Height (from HRT invert)	130	154 m	+24 m	Increased height dia involves more tunnelling, blasting, etc. More destabilization of the mountains.
Top EL	1305	1309 m	+4 m	
Orifice level	1185	1165 m	-20 m	
Tunnel invert	1175	EL 1155 m	-20 m	
Maximum surge level	1304	1307.42 m	+3.42 m	
Minimum surge level	1196.3	1209.24 m	+12.94 m	
PRESSURE SHAFT				
Length of each PS	351/36.7	466.4 m/51 m	-0.41893466	
POWER HOUSE				
Size of P/H cavern	127*20.3*50	146 m * 20.3 m * 48 m	+13357.4	Increased size involves more tunnelling, blasting, etc. More destabilization of the mountains.
Size of Transformer cavern	112*16*24.5	140.3 m*15 m * 25.5 m	+9760.75	Increased size involves more tunnelling, blasting, etc. More destabilization of the mountains.
Service bay level	1041	EL 1036 m	-5	
D/S SURGE TANK				
Size	120*12*27	150 m (L) * 13 m (W) * 27 m (H)	+13770	Increased size involves more tunnelling, blasting, etc. More destabilization of the mountains.
Minimum surge level	1026.5	1022.37 m	-4.13	

TAIL RACE TUNNEL				
a) Size	8.8	9.1 m ϕ , (circular)	+0.3	Increased size involves more tunnelling, blasting, etc. More destabilization of the mountains.
d) Min. TWL	1027.2	1028.2 m (with 10% load)	+1	
e) TRT invert level	1025	EL 1020.6 (at Outlet) crest level of weir at outlet is 1027 m.	-4.4	
SWITCHYARD				
e) No. of bays in the switchyard	8	7 bays	-1	
d) Size of potyard	40*60m	40m * 84m	+960	

It is important to note that every single change in any feature or aspect of the project which was not in the original plan will constitute Change in Scope. The MoEFCC/EAC has itself admitted that it has examined the 'revised project details as submitted by the project proponent' (para 2). It further states that 'design changes generally happens during the implementation of the project' (para 3). It further goes on to state that 'the project parameters of the current proposal cannot be compared with the DPR of 2006 (para 6) whereas till date the project proposal has been appraised and has obtained extension of validity on the basis of DPR of 2006 and that there is no subsequent DPR of the project which is apparent from para 1.6 at page 1-4 of the present Rapid Draft EIA report prepared by WAPCOS on the basis of which the present EC has been granted. It is pertinent to note that the project parameters, project design, project planning, capital expenditure etc. is part of the DPR

which is the most crucial document and the sole basis of a Hydro Power Project. If the project has undergone any changes or there are deviations in the project design from the DPR, the same would constitute Change in Scope, which would require a fresh DPR and EIA. The MoEFCC/EAC has admitted to the fact that there has been changes since the conception of the project yet it did not stipulate the requirement of fresh appraisal as is mandatory under the EIA Notification, 2006 in which case the project could not have been appraised as “ongoing or a continuing project”.

6. The EAC at para 3 has stated that it had exempted the project from public hearing. ‘In view of the actual progress being more than 50% **as reported by the PP** vide email dated 15th April, 2021’. It is submitted that the EAC has itself admitted that the decision to exempt the project from the mandatory requirement of public hearing was made completely on the basis of submissions made by the project proponent and there was no independent site visit or verification conducted to see the actual construction of the project at ground level. It is pertinent to note that the notification of 18.01.2021 of the MoEF&CC applies to project which are more than 50% physically constructed. Thus, to examine the actual construction or progress of the project it was obligatory upon the EAC to assess the ground situation by undertaking a site visit. However, the EAC instead of applying its mind relied upon the misleading information provided by the project proponent and did not even bother to verify the correctness of the claim made by the project proponent. In a number of judgments, the Hon’ble courts have strictly observed that the statements made by the project proponents during the appraisal of project for EC cannot be accepted as a gospel truth and the Government agencies are bound

to apply their mind and have their own mechanism to verify the truth.

The Hon'ble High Court of Himachal Pradesh in the matter of Him Parivesh Environment Protection Society v State of Himachal Pradesh, CWP No 586 of 2010, judgment dated 4th May, 2012 has stated,

“Para 14....If without any verification, the bald statement of the Project Proponent is to be accepted then it will be impossible to implement the environmental laws. The word of the Project Proponent can never be accepted as the gospel truth and the concerned Departments must have the mechanism and even more importantly must have the guts and the spirit to verify the truth.

Para 31..... We again must reiterate that the MoEF should not have accepted the word of the Company at its face value without verifying the same. All that we can say is that all the Government Bodies which are supposed to act like watch dogs to ensure that the environment and ecology is protected, miserably failed to perform their duties

Para 65If we go through the record of the public hearing, it is apparent that the public was not informed about the pros and cons of the Project. In this behalf, we may submit that the Pollution Control Board, the MoEF and the EAC must play a more pro-active role than what is being done at present. Sitting in the Green Bench, we have heard hundreds of matters and we are constrained to observe that in almost all, if not all, cases the word of the project proponent is accepted to be the gospel truth. Obviously, the project proponent and/or the consultants who prepare the project reports will paint a rosy picture about the

project and will gloss over and in fact hide the ill effects of the project. This is where the role of the Pollution Control Board and the MoEF starts. Why should we wait for NGO's or local inhabitants to come to Court to question the validity of the project. They do not have the wherewithal, the finances, the capability or the knowledge to oppose the report. We are of the considered view that the duty of the Pollution Control Board and the Officers of the Board or the MoEF is to verify the facts stated by the Project Proponent.”

Similarly, **the Hon'ble NGT in the matter of Sandeep Desai & Ors vs State Of Goa & Ors, Application No. 47 of 2012(T), decided on 23.11.2012**, has observed,

“9....Considered together, the documents would make it crystal clear that the statement with regards to distance from wildlife Sanctuary/National Park as mentioned in the Communication dated 17th May, 2007 by the MoEF, while granting EC are not in keeping with the fact situation. The EC Order reads vide paragraph 4 thereof as under :-

"Based on the information submitted by you, the Ministry of Environment & Forests accords EC for the above project as per Notification dated 14th September, 2006 Subject to Following conditions /"

10.... Thus, the information submitted by the project proponent was accepted as a gospel truth by the MoEF. The MoEF on its part did not verify the correctness of the information given by the Respondent no. 6”

The EAC in its reply has repeatedly stated that the project has attained a considerable progress with respect to civil and hydro-mechanical work, electro mechanical work etc. (para 3 of the reply).

However, the EAC minutes of 29th July 2020 (Annexure A-6 at page 131 of the Appeal) based on which the project was appraised for EC shows that the civil and Hydro Mechanical works were only 25% and Electro Mechanical works were only 28% in June, 2020 which means that the major percentage of work at ground level is still to be undertaken. It is also important to note that while the Appellants in Table 1, 2 and 3 at pages 47-50 of the Appeal have provided a detailed analysis to show that the actual progress of the project was only 15% and cannot be claimed to be more than 50%, the EAC however, has failed to provide any analysis or assessment of the project construction status to rebut the contention of the Appellants. It is submitted that the EAC has without applying its mind has exempted the project from 'public hearing' and 'public consultation' in the garb of the Notification of 18.03.2021 which does not apply to the present project.

7. That the EAC in para 5 of the reply admits "that the proposal which was considered by the EAC for grant of Environmental Clearance was a ***fresh proposal with fresh data about environment parameters, project profile etc, mentioned in the EIA/EMP report and salient features of the project submitted by the project proponent***". By its own admission the EAC has established the fact that the proposal was accepted and appraised as a fresh proposal. Thus, there are severe shortcomings in the appraisal process which the appellants wish to point out. First, if the project was considered a fresh proposal, then the same must have fulfilled the mandatory requirement under the EIA process which is,

- (a) Scoping – Issuance of TOR's for preparation of comprehensive EIA report based on three season baseline data (Pre-monsoon, monsoon and winter (lean) season)). (As per the Standard TOR's

for EIA/EMP Report for River Valley Projects, Internal page 44 published by MoEF&CC dated April 2015)

(b) Public Consultation- including public hearing at the affected site and inviting written responses/representations from affected and concerned persons, on the basis of draft EIA report,

(c) Inclusion of the public consultation proceedings in the draft EIA report reflecting suggestions and objections from the public on the project proposal and preparing Final EIA Report after making appropriate changes in the EIA/EMP after addressing all material environmental concerns of the public,

(d) Appraisal- Detailed scrutiny by the EAC of all the documents which includes the EC application, Final EIA report, outcome of the public consultations including public hearing proceedings etc. on the basis of which the project is granted EC.

The Appellants wish to state that though the EAC has claimed that the project was appraised as a fresh proposal, however, it failed to appraise the project as per the mandatory requirement of the EIA Notification, 2006 as mentioned in the above para. It is submitted that the project was appraised on the basis of a Rapid Draft EIA report based on one season data, no public hearing and no public consultation was undertaken, the EAC minutes too does not reflect that the representations made by the Appellants through letters dated 26.07.2020 and 17.08.2020 were considered, there was no final EIA report since there was no public consultations held and the project was granted EC on the basis of a Rapid draft EIA report which failed to address the environmental impacts and the environmental costs of such impacts which were required to be evaluated as part of the Cost Benefit Analysis of the project. Secondly, the EAC admits to the fact that the project proponent

had presented fresh data about environment parameters which implies that changes have been introduced in the current project proposal and it cannot be compared with the DPR of 2006, this fact itself establishes that the current EC should not have been considered as part of the original EC and appraised afresh in light of the changes made in the parameters considering the existing environmental situations prevailing in the area. Copy of the Standard TOR's for EIA/EMP Report for River Valley Projects, Internal page 44 published by MoEF&CC dated April 2015 is annexed herewith as **Annexure A-1**.

8. The EAC in para 2 of the reply has stated that the TOR's were prescribed for studying the possible environmental impacts of the project such as loss of biodiversity, soil conservation, socio economic aspects etc. and that it has considered the negative environmental impacts of the project (Para 7 of the reply). It is submitted that the TOR's were not limited to just assessment of the environmental impacts of the project but were also prescribed for evaluating the environmental cost of such impacts. The Appellants have argued (Ground C and Ground D at page 51 and 62 of the Appeal) that neither the environmental impacts of the project such as deterioration in water quality, loss of aesthetic values, impact of blasting, soil erosion and impacts on aquatic biodiversity etc, was considered in the EIA nor there was a proper CBA done for evaluating the environmental costs, which was not only a specific condition in the TOR (condition no xii. At page 170) but was also brought to the notice of the EAC and THDC through representations dated 26.07.2020 and 17.08.2020 respectively. The EAC minutes of 29.07.2020 and 27.07.2021 does not reflect any observation or discussion on the representations of the Appellants

on CBA which clearly establishes that the same were never considered by the EAC. The EAC has not responded as to whether the CBA included the various factors and parameters which were clearly stipulated by the IIFM in pursuance of the judgment passed by the Hon'ble Tribunal in Appeal No. 5 of 2011 dated 14.12.2011. The EAC has failed to examine that the TOR's issued for the project have not been complied with in letter and spirit and the EIA and CBA undertaken in pursuance of the same did not serve the purpose mandated in the EIA Notification. The EAC has only done a lip-service which is also apparent from the casual response given to the crucial issues raised in the Appeal.

9. The EAC has not responded on the contention of the Appellants regarding the project considered as a "peaking station" or "Run of the River" project. The Appellants are reiterating the contentions made at Ground F at page 69 of the Appeal where it has been contended that the project proponent has misrepresented the project as a Peaking power station which would help reduce the peaking power shortage in the region whereas before the PIB meeting held in the year 2007 while approving the investment of project, the same was referred to as Run of the River project. The EAC approved the project assuming that the project would provide peaking power benefits which is not the case. However, the EAC has chosen not to respond to the given issue which shows that the EAC has not made any independent assessment to verify the claims of the project proponent and has left the issues unanswered in complete dereliction of its duties.

Response to the Reply of M/s THDC India Ltd, Respondent No.

3 herein:

10. That the Appellants are dealing with the response of the Respondent No. 3 in the following paras. The appellants wish to reiterate the submissions made in the Appeal and the following must be read in conjunction of the same.
11. That the Respondent No. 3 in para 4 have alleged that the Appellants are not “persons aggrieved” and do not have any locus standi to approach the Hon’ble Tribunal. It is submitted that the issue of aggrieved persons is already settled by the judgments laid down by the Hon’ble Tribunal and more specifically in the case of Vimal Bhai & Ors. V/s Union of India & Ors. Appeal 5 of 2011, decided on 14.12.2011, the Hon’ble Tribunal has considered the term “person aggrieved” while taking into account all the statutory provisions of the NGT Act i.e. the Preamble, Sections 14, 15, 18 and 20 of the NGT Act as well as the constitutional provisions i.e. Article 51-A and 48-A of the Constitution of India and clearly observed that the constitutional provisions require that the State shall endeavor to safeguard the environment and wildlife and also casts a fundamental duty on all the citizens to improve the natural environment including forest, lake, rivers etc. Once, the Constitution of India puts a fundamental duty on all the citizens for making an effort towards protection and improvement of the natural environment, any person can approach the Tribunal and agitate his grievances as to protection and improvement of the natural environment. It was clarified by the Hon’ble Tribunal that the term 'persons' as defined or the 'person aggrieved' as occurs under the NGT Act cannot be placed above every citizen as appears in Article 51-A of the Constitution of India and therefore, the Hon’ble Tribunal held that the term 'person aggrieved' in the environmental practice must be given liberal construction and

needs to be flexible. In view of the said interpretation by the Hon'ble Tribunal itself, it is clear that the appellants are very much the persons interested and aggrieved in the present case and therefore in pursuance of their rights have filed the present appeal under Section 16 of the NGT Act.

12. That in para 12-13 the Respondent No. 3 has stated that it was not bound to include the suggestions made by the Appellant No. 1 on CBA vide representation dated 17.08.2020. It is submitted that the said representation was made pursuance to the EAC meeting of 29.07.2020 wherein specific condition for environment cost benefit analysis was prescribed to be undertaken as part of the EIA studies. The representation of 17.08.2020 was directly made to the Respondent No. 3 by virtue of the fact that the Respondent is a public authority and is bound to consider the representations/suggestions made by the public. It is obligatory upon the public bodies to apply Public Trust Doctrine which empowers the public to question the decision of the government bodies and its agencies on the ineffective management of natural resources and casts duty upon them to consider the views and opinions of the public in its decision-making process. The Respondent No. 3 has admitted to the fact that it has simply brushed aside the suggestions made by the Appellant No. 1 in complete disregard of the Public Trust Doctrine and the constitutional provisions of Article 21, 48 A and 51 A(g).

13. That the Respondent No. 3 in para 14 has stated that it has achieved 53.05% physical progress based on the money spent of Rs 186133.63 crores and project cost of Rs 350870.92 crores. It has arrived at this figure by adding the amount of money spent on various items. It is submitted that money spent is not relevant for

assessing the progress on the ground. The Appellants reiterate the submissions made in Table 1 of the appeal (page 47 of the appeal) which shows that the physical progress of the project as per admissions by Respondent No. 3 is only 15.2 percent. Table 1 is reproduced below for ready reference of the Hon'ble Tribunal.

Table No. 1

Sl. No.	Work	Present status of the Project as per CEA July 2021 report. (Annexure A-16)	Analysis	Percent Completed
1.	Desilting chambers	3 De-silting Chambers benching 40% completed	-	40.0
2.	HRT-TBM Commissioned but no progress	Heading excavation of HRT by DBM has been completed 739m out of 960m. TBM has been commissioned During operation of TBM in the RBM zone, big boulders have been encountered, which has hampered TBM operation. To overcome this problem two Approach Adits are being constructed to reach the cutter head.	Length of Head Race Tunnel is 13.4 km. Of this (1) 739 m DBM; and nil HRT has been completed as TBM is hampered. Thus $739/13400 = 5.5\%$ is complete.	5.5
3.	Tail Race Tunnel	In TRT, heading excavation 443m out of 3070m completed.	Although this is only excavation, yet giving benefit of doubt we may consider $443/3070 = 14.4\%$ complete.	14.4
4.	Barrage	-	As per our information	0.0

			zero work is done. Silence in CEA Progress report confirms this.	
5.	Electro-mechanical works	Supply works of Rs 167.60 crore has been completed. Total Project cost is 4397 Crore.	The cost of Electro-mechanical works was 473.64 crores out of project cost of 2031.64 crore as per TEC (Annexure A-17). Pro-rata the cost of Electro-mechanical works will be 1024 crore at project cost of 4397 cr. Of this 167.60 crore or 16.3% is completed.	16.3
6.	Average			15.2

Without prejudice, the project cost according to “**Present status of the Project as per CEA July 2021 report**” (Annexure A-16) is **4397 crores**. The Respondent No.3 has calculated the figure of 53.05% by taking the expenditure of 186133.63 crores and dividing it by the “approved” project cost of 350870.92 crores and thus arriving at 53.05%. However, for the purpose of this Notification, the approved project cost is not relevant. A delay in the approval process cannot be the smokescreen behind which higher progress can be claimed. If at all, only the actual project cost can be relevant. What matters whether the progress on the ground of project as of the date of application of the Notification is more than

50% complete or not. Therefore, the actual project cost as admitted by the Respondent No.3 of INR 4397 crores should be the basis of assessing whether the project has achieved more than 50% progress on the ground and if the project cost of INR 4397 crores as admitted by the Respondent No. 3 is taken, then the admitted expenditure of 186133.63 translates to physical progress of only 42% on the ground.

14. The Respondent No. 3 in para 16 has admitted that there was no final EIA/EMP report and the project was appraised on the basis of Rapid Draft EIA/EMP report since no public comments/views/suggestions were included or considered for final EIA report as there was no public hearing. It is submitted that the EIA Notification, 2006 requires the project proponent to include the representations of the public and make changes in the draft EIA report and prepare the final report based on the outcome of the public consultation process. It is apparent from the reply of the Respondent No. 3 that under the pretext of exemption from public hearing, the project proponent also did not undertake any consideration of the written representations which were received from the affected and concerned people including the representation made by the Appellant No. 1 on 17.08.2020, as part of the mandatory Public consultation process. As per Clause III (vii) of the EIA Notification, 2006,

“(vii) After completion of the public consultation, ***the applicant shall address all the material environmental concerns expressed during this process, and make appropriate changes in the draft EIA and EMP.*** The final EIA report, so prepared, shall be submitted by the applicant to the concerned regulatory authority for appraisal.”

It is blatantly clear from the above mentioned that the project proponent in order to obtain EC has misled the authorities and the public and has repeatedly violated the mandatory and substantial provisions of the EIA Notification, 2006.

15. That the Respondent No. 3 in para 17 has stated that the environmental costs and benefits of the project have been prepared in accordance with the guidelines dated 01.08.2017 issued by the MoEF&CC. In response to the same, the Appellants would like to reiterate the submissions made at Ground D at page 63 of the appeal wherein the appellants have clarified that the said guidelines are specifically for forest diversion proposals requiring Forest Clearance and not for Environment Clearance proposals as the guidelines take into account only the forest-related costs and benefits and exclude non-forest related costs that are required to be considered for undertaking CBA under the EIA regulations. The fact that the Respondent No. 3 has relied upon the said guidelines for preparation of the CBA for its EC proposal shows that the same is highly deficient and does not incorporate those social costs which have been prescribed by the IIFM, placed at Annexure A-22 of the Appeal. The CBA of the project undertaken by the project proponent thus cannot be relied upon for evaluating the cost and benefits of the project for obtaining EC.

Grounds

16. The Appellants have dealt with the issue of change in scope at Ground A at page 39 of the Appeal and also at para 5 of the instant rejoinder. The same is reiterated herein and may be read as part and parcel of the response of the Respondent No.3 to Ground A.
17. The Appellants would like to reiterate the submissions made in Ground B at page 46 of the Appeal and also at para 13 of the

instant rejoinder. The same may be read as part and parcel of the response of the Respondent No.3 to Ground B.

18. That the Respondent No. 3 in reply to Ground C has submitted that “the so-called shortcomings highlighted in the REIA report outlined by the Appellants have been clearly addressed and dealt with in the first EIA Report of 2006 and 2009 CES report”. There are two aspects which emerge from the contention of the Respondent No. 3. First, whether the project has been treated as fresh proposal on the basis of the new Draft REIA report as stated by the MoEF&CC in its reply at para 5 “that the proposal which was considered by the EAC for grant of Environmental Clearance was a **fresh proposal with fresh data about environment parameters, project profile etc, mentioned in the EIA/EMP report and salient features of the project submitted by the project proponent**”. If yes, then the EIA report of 2006 and 2009 cannot be relied upon for grant of fresh EC of 26.08.2021. Also, the statement of the Respondent No. 1 becomes contrary to the statement made by the Respondent No. 3 which has stated that the DPR of 2006 also cannot be relied upon for there has been considerable progress (para 6 of the MoEF&CC reply). Thus, if the DPR of 2006 cannot be considered for grant of fresh EC then how could be the EIA of 2006 and 2009 be relied upon. It is submitted that the grant of EC which is under challenge before the Hon’ble Tribunal is based upon the consideration of the Draft REIA report and therefore the question before the Hon’ble Tribunal would be to see whether the Draft REIA report is deficient to address the environmental concerns of the project considering the present situation on the ground. Also, it is pertinent to mention here that the original EC was granted on the basis of 2006 EIA report.

However, the World Bank dissatisfied with the same, sought another EIA of the project which was conducted in the year 2009. The 2009 EIA report does not have any legal backing since the same was never part of the appraisal process and thus, cannot be relied upon for the purposes of the present appeal. Secondly, the Respondent No. 3 has claimed that the environmental costs incorporated in the cost benefit analysis submitted by the Appellant No.1 have been considered in the EIA of 2006 and again in EIA 2009, the main point of consideration is even if the presence of impacts is admitted in the two EIAs, there is no valuation of the said impacts. Even though some measures for mitigation of those impacts are suggested there is no assessment as to how much mitigation is expected to take place, what will be the residual impact and what is the economic value of that residual impact. Admission of the impacts in the EIA gives all the more reason to make an evaluation of the economic costs and benefits. With this preliminary the EIA admissions on the 5 impacts are as follows;

A. Soil Erosion: The 2006 EIA admits that soil erosion is likely to take place (Page 4-19) and recommends that slope stabilization is needed (Page 4-20). It also admits that the area is full of steep slopes which are a hazard for erosion (Page 4-23). In the 2009 EIA it is admitted that construction of roads triggers soil erosion (Page ES-19 and ES-20) and that grazing also adds to erosion (Page ES-22). There is no consideration of the erosion that may take place downstream of the project due to change of the river flow as the appellants have outlined in the Appeal. Hence there are two objections: (1) The impact on soil erosion due to change in the flow regime of the river has not been examined in either of

the EIA; (2) The valuation of the impact even after the mitigation measures has not been done.

B. Blasting: The 2006 EIA states that because of the noise there will be impact on wildlife (Page 4-12 and 4-28). However, it states that there is likely to be no impact on the human population because the settlements are more than one kilometre away (Page 4-19). There is no reference to the impact of blasting on houses and water sources which has been raised by the Appellants. The 2009 EIA admits that blasting operations will have impact on the communities living in the vicinity of the project (Para 7.5, Page 21). However, it does not give any mitigation measures for this and merely says that this cost is much less than the creation of job opportunities. Such prophetic assessments of costs and benefits are not acceptable. It was necessary to make an impact evaluation on the water resources and houses due to blasting which has not been done in either EIA.

C. Aquatic Biodiversity: The 2006 EIA admits that the project will have adverse impact on aquatic ecology (Page 4.22 and Page 4.32). It also says that extraction of gravel impacts aquatic life (Page 4.29). It admits that migration of fishes is affected due to the construction of barrage (Page 4.31). The 2009 EIA also admits the impact (Page ES-18). Both the EIA's even admit the impact due to the obstruction of migration of fishes. Both EIA's mention that fish hatcheries will be constructed but do not make an evaluation of the effectiveness of the hatcheries, the level of mitigation that will be made and the economic valuation of the residual impact on fisheries and aquatic biodiversity.

D. Water Quality: The 2006 EIA states that the dissolved oxygen contain will not be affected (Page 4-5). It sees no adverse impact on water quality although it admits that suspended solid load will increase (Page 4-6). It states that the BOD load is insignificant and there is no temperature stratification expected in the reservoir. It admits that the enrichment of nutrients will affect water quality but says that this is not important (Page 4-8). The 2009 EIA states that water quality is likely to be affected during the lean period of January and February (Page ES-18). The Water Quality is more than DO and BOD. The water of the Ganga acquires its self-purifying qualities due to the presence of bacteriophages that are absorbed in the sediments. This aspect is totally ignored.

E. Aesthetic Value. There is no valuation of the deterioration of aesthetic value of the river due to the construction of barrage and due to the change of the flow regime. The 2009 EIA says that planting of plantations will improve the aesthetic value of the area (Page ES-21). Thus, the importance of aesthetic value is admitted. However, the aesthetic value of the free flow of the river is neither admitted nor valued.

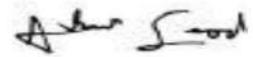
The conclusion is that the EIAs admit the negative impacts outlined above; and some mitigation measures are proposed. However, the effectiveness of the mitigation measures and the residual value of deterioration has not been valued.

Copy of the Chapter 4 of the EIA report 2006 is annexed herewith as **Annexure A-2**. The copy of the Executive summary of 2009 EIA report (CES) is annexed as R/3-8 at page 116-151 of the reply of Respondent No. 3.

19. The Appellants have dealt with the issue of cost benefit analysis at Ground D at page 62 of the Appeal and also at para 8 and 15 of the instant rejoinder. The same is reiterated herein and may be read as part and parcel of the response of the Respondent No.3 to Ground D.
20. That the Respondent No. 3 has failed to deal with the contention of the Appellants regarding not following the mandatory process of public consultation. The Respondent No. 3 has failed to draw a distinction between public hearing and public consultation and are required to examine the provisions of the EIA Notification, 2006 which they have purposely misinterpreted. The Appellants would like to reiterate the submissions made in Ground E at page 65 of the Appeal and para 6 of the instant rejoinder. The same may be read as part and parcel of the response of the Respondent No.3 to Ground E.
21. The Respondent No. 3 in reply to contention that whether it has misrepresented the project as a “peaking station” has attempted to ignore the contention as it has specifically not denied the submissions made by it before the PIB in 2007. The Appellants would like to reiterate the submissions made in Ground F at page 69 of the Appeal and para 9 of the instant rejoinder. The same may be read as part and parcel of the response of the Respondent No.3 to Ground F.
22. The Appellants would like to reiterate the submissions made in Ground G at page 71 of the Appeal. The same may be read as part and parcel of the response of the Respondent No.3 to Ground G.

23. In view of the aforesaid, it is humbly prayed that on the basis of the submissions made in the present rejoinder, directions prayed in the Appeal may be granted by the Hon'ble Tribunal.

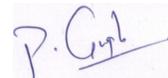
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Dated: 02.05.2022

**BEFORE THE NATIONAL GREEN TRIBUNAL
AT NEW DELHI
APPEAL NO. 21 OF 2021**

IN THE MATTER OF:

Dr. Bharat Jhunjhunwala & Anr... .. Appellants

Versus

Union of India & Ors... .. Respondents

AFFIDAVIT

I, Vimal Bhai S/o Smt. Mohini Devi, R/Flat No 2 First Floor, Chetram Colony, Sector 39, Surajkund, Faridabad, Haryana - 121009, aged about 59 years state on solemn affirmation as under:-

1. That I am the Appellant No.2 in the aforesaid matter and well conversant with the facts and record of the case, thus, I am competent to swear this affidavit.
2. That I have read over the contents of the Rejoinder and the same is true and correct and is drafted on my instruction.



Vimal
DEPONENT

VERIFICATION:-

Verified on this the 2 day of May 2022 that the contents of the above affidavit are true and correct. No part of it is false and nothing material has been concealed therefrom.

ATTESTED

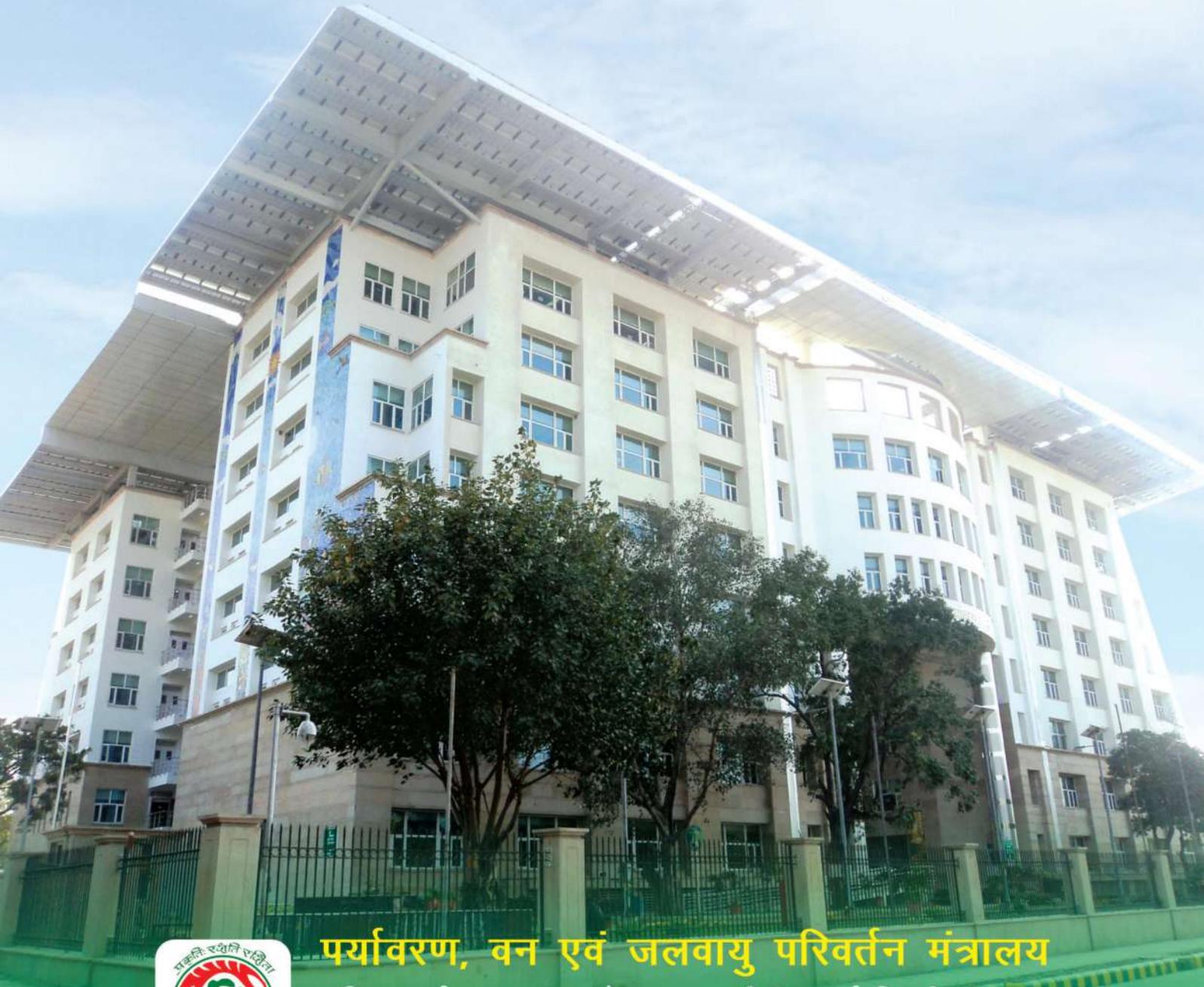
[Signature]
NOTARY PUBLIC DELHI

Vimal
DEPONENT

02 MAY 2022



**STANDARD TERMS OF REFERENCE [TOR] FOR
EIA / EMP REPORT FOR PROJECTS/
ACTIVITIES REQUIRING ENVIRONMENT
CLEARANCE UNDER EIA NOTIFICATION, 2006**



पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय

इंदिरा पर्यावरण भवन, जोर बाग, अलीगंज, नई दिल्ली-110003

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April, 2015

STANDARD TERMS OF REFERENCE [TOR]

FOR

EIA / EMP REPORT

FOR

PROJECTS / ACTIVITIES REQUIRING

ENVIRONMENT CLEARANCE

UNDER

EIA NOTIFICATION, 2006

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1(c):STANDARD TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR RIVER VALLEY PROJECTS AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

(1) Scope of EIA Study:

The EIA Report should identify the relevant environmental concerns and focus on potential impacts that may change due to the construction of proposed project. Based on the baseline data collected for three (3) seasons (Pre-monsoon, Monsoon and Winter seasons), the status of the existing environment in the area and capacity to bear the impact on this should be analysed. Based on this analysis, the mitigation measures for minimizing the impact shall be suggested in the EIA/EMP study.

(2) Details of the Project and Site

- General introduction about the proposed project.
- Details of Project and site giving L-Sections of all U/S and D/S Projects with all relevant maps and figures. Connect such information as to establish the total length of interference of Natural River and the committed unrestricted release from the site of Dam/Barrage into the main river.
- A map of boundary of the project site giving details of protected areas in the vicinity of 25 km of project location.
- Location details on a map of the project area with contours indicating main project features. The project layout shall be superimposed on a contour map of ground elevation showing main project features (viz. location of dam, Head works, main canal, branch canals, quarrying etc.) shall be depicted in a scaled map.
- Layout details and map of the project along with contours with project components clearly marked with proper scale maps of at least 1:50,000 scale and printed at least on A3 scale for clarity.
- Existence of National Park, Sanctuary, Biosphere Reserve etc. in the study area, if any, should be detailed and presented on a map with distinct distances from the project components.
- Drainage pattern and map of the river catchment up to the proposed project site.
- Delineation of critically degraded areas in the directly draining catchment on the basis of Silt Yield Index as per the methodology of Soil and Land use Survey of India.
- Soil characteristics and map of the project area.
- Geological and Seismo-tectonic details and maps of the area surrounding the proposed project site showing location of dam site and canal sites.
- Remote Sensing studies, interpretation of satellite imagery, topographic sheets along with ground verification shall be used to develop the land use/land cover pattern of the study using overlaying mapping techniques viz. Geographic Information System (GIS), False Color Composite (FCC) generated from satellite data of project area.

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- Land details including forests, private and other land.
- Demarcation of snow fed and rain fed areas for a realistic estimate of the water availability.

(3) Description of Environment and Baseline Data

To know the present status of environment in the area, baseline data with respect to environmental components air, water, noise, soil, land and biology & biodiversity (flora & fauna), wildlife, socioeconomic status etc. should be collected within 10 km radius of the main components of the project/site i.e. dam site and power house site. The air quality and noise are to be monitored at such locations which are environmentally & ecologically more sensitive in the study area. The baseline studies should be collected for 1 season (Preferably Monsoon season). Flora-Fauna in the catchment and command area should be documented. The study area should comprise of the following:

- Catchment area up to the dam/barrage site.
- Submergence Area.
- Project area or the direct impact area should comprise of area within 10 km radius of the main project components like dam, canals etc.
- Downstream upto 10 km from the tip of the reservoir.

(4) Details of the Methodology

The methodology followed for collection of base line data along with details of number of samples and their locations in the map should be included. Study area should be demarcated properly on the appropriate scale map. Sampling sites should be depicted on map for each parameter with proper legends. For Forest Classification, Champion and Seth (1968) methodology should be followed.

(5) Methodology for Collection of Biodiversity Data

- The number of sampling locations should be adequate to get a reasonable idea of the diversity and other attributes of flora and fauna. The guiding principles should be the size of the study area (larger area should have larger number of sampling locations) and inherent diversity at the location, as known from secondary sources (e.g. eastern Himalayan and low altitude sites should have a larger number of sampling locations owing to higher diversity).
- The entire area should be divided in grids of 5kmX5km preferably on a GIS domain. There after 25% of the grids should be randomly selected for sampling of which half should be in the directly affected area (grids including project components such as reservoir, dam, powerhouse, tunnel, canal etc.) and the remaining in the rest of the area (areas of influence in 10 km radius form project components). At such chosen location, the size and number of sampling units (e.g. quadrates in case of flora/transects in case of fauna) must be decided by species area curves and the details of the same (graphs and cumulative number of species in a tabulated form) should be provided in the EIA report. Some of the grids on the edges may not be completely overlapping with the study area boundaries. However these should be counted and considered for selecting 25% of the grids. The number of grids to be surveyed may come out as a decimal number (i.e. it has an integral and a fractional part) which should be rounded to the next whole number,

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- The conventional sampling is likely to miss the presence of rare, endangered and threatened (r.e.t.) species since they often occur in low densities and in case of faunal species are usually secretive in behaviour. Reaching the conclusion about the absence of such species in the study area based on such methodology is misleading. It is very important to document the status of such species owing to their high conservation value. Hence likely presence of such species should be ascertained from secondary sources by a proper literature survey for the said area including referring to field guides which are now available for many taxonomic groups in India. Even literature from studies/surveys in the larger landscapes which include the study area for the concerned project must be referred to, since most species from adjoining catchments is likely to be present in the catchments in question. In fact such literature from the entire state can be referred to. Once a listing of possible r.e.t. species from the said area is developed, species specific methodologies should be adopted to ascertain their presence in the study area which would be far more conclusive as compared to the conventional sampling. If the need be, modern methods like camera trapping can be resorted to, particularly for areas in the eastern Himalayas and for secretive/nocturnal species. A detailed listing of the literature referred to, for developing lists of r.e.t. species should be provided in the EIA reports.
- The R.E.T. species referred to in this point should include species listed in Schedule I and II of Wildlife (Protection) Act, 1972 and those listed in the red data books (BSI, ZSI and IUCN).

(6) Components of the EIA Study

Various aspects to be studied and provided in the EIA/EMP report are as follows:

A. Physical and Chemical Environment

Geological & Geophysical Aspects and Seismo- Tectonics:

- Physical geography, Topography, Regional Geological aspects and structure of the Catchment.
- Tectonics, seismicity and history of past earthquakes in the area. A site specific study of the earthquake parameters will be done. The results of the site specific earthquake design shall be sent for approval of the NCSDP (National Committee of Seismic Design Parameters, Central water Commission, New Delhi for large dams.
- Landslide zone or area prone to landslide existing in the study area should be examined.
- Presence of important economic mineral deposit, if any.
- Justification for location & execution of the project in relation to structural components (dam / barrage height).
- Impact of project on geological environment.

Meteorology, Air and Noise:

- Meteorology (viz. Temperature, Relative humidity, wind speed/direction etc.) to be collected from nearest IMD station.

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- Ambient Air Quality with parameters viz. Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM) i.e. suspended particulate materials < 10 microns, Sulphur dioxide (SO₂) and Oxides of Nitrogen (NO_X) in the study area at 5-6 Locations.
- Existing Noise Levels and traffic density in the study area at 5-6 Locations.

Soil Characteristics:

- Soil classification, physical parameters (viz., texture, Porosity, Bulk Density and water holding capacity) and chemical parameters (viz. pH, electrical conductivity, magnesium, calcium, total alkalinity, chlorides, sodium, potassium, organic carbon, available potassium, available phosphorus, SAR, nitrogen and salinity, etc.) at @ one sample/ha of command area.

Remote Sensing and GIS Studies:

- Generation of thematic maps viz. slope map, drainage map, soil map, land use and land cover map, etc. Based on these, thematic maps, an erosion intensity map should be prepared.
- New configuration map to be given in the EIA Report.

Water Quality

- History of the ground water table fluctuation in the study area.
- Water Quality for both surface water and ground water for [i] Physical parameters (pH, Temperature, Electrical Conductivity, TSS); [ii] Chemical parameters (Alkalinity, Hardness, BOD, COD, NO₃, PO₄, Cl, So₄, Na, K, Ca, Mg, Silica, Oil & grease, phenolic compounds, residual sodium carbonate); [iii] Bacteriological parameter (MPN, Total coliform); and [iv] Heavy Metals (Pb, As, Hg, Cd, Cr-6, Total Cr, Cu, Zn, Fe) at minimum 10 Locations, however, the sampling numbers should be increased depending on the command area.
- Delineation of sub and micro watersheds, their locations and extent based on the Soil and Land Use Survey of India (SLUSOI), Department of Agriculture, Government of India. Erosion levels in each micro-watershed and prioritization of micro-watershed through Silt Yield Index (SYI) method of SLUSOI.

B. Water Environment & Hydrology

- Hydro-Meteorology of the project viz. precipitation (snowfall, rainfall), temperature, relative humidity, etc. Hydro-meteorological studies in the catchment area should be established along-with real time telemetry and data acquisition system for inflows monitoring.
- Run off, discharge, water availability for the project, sedimentation rate, etc.
- Basin Characteristics.
- Catastrophic events like cloud bursts and flash floods, if any, should be documented.

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- For estimation of Sedimentation Rate, direct sampling of river flow is to be done during the EIA study. The study should be conducted for minimum one year. Actual silt flow rate to be expressed in ha-m km-2 year-1.
- Set-up a G&D monitoring station and a few rain gauge stations in the catchment area for collecting data during the investigation.
- Flow series, 10 daily with 90%, 75% and 50% dependable years discharges.
- Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.
- A site specific study on minimum environment flow should be carried out.

C. Biological Environment

Flora

- Characterization of forest types (as per Champion and Seth method) in the study area and extent of each forest type as per the Forest Working Plan.
- General vegetation profile and floral diversity covering all groups of flora including Bryophytes, Pteridophytes, Lichens and Orchids. A species wise list may be provided.
- Assessment of plant species with respect to dominance, density, frequency, abundance, diversity index, similarity index, importance value index [IVI], Shannon Weiner Index etc. of the species to be provided. Methodology used for calculating various diversity indices along with details of locations of quadrats, size of quadrats etc. to be reported within the study area in different ecosystems.
- Existence of National Park, Sanctuary, Biosphere Reserve etc in the study area, if any, should be detailed.
- Economically important species like medicinal plants, timber, fuel wood etc.
- Details of endemic species found in the project area.
- Flora under RET categories should be documented using International Union for the Conservation of Nature and Natural Resources (IUCN) criteria and Botanical Survey of India's Red Data list along with economic significance. Species diversity curve for RET species should be given.

Fauna

- Fauna study and inventorisation should be carried out for all groups of animals including reptiles and nocturnal animals in the study area. Their present status along with Schedule of the species.
- Information (authenticated) on Avi-fauna and wild life in the study area.
- Status of avifauna their resident/migratory/ passage migrants etc.

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- Documentation of butterflies, if any, found in the area.
- Details of endemic species found in the project area.
- RET species- voucher specimens should be collected along with GPS readings to facilitate rehabilitation. RET faunal species to be classified as per IUCN Red Data list and as per different schedule of Indian Wildlife (Protection) Act, 1972.
- Existence of barriers and corridors, if any, for wild animals.
- Compensatory afforestation to compensate the green belt area that will be removed, if any, as part of the proposed project development and loss of biodiversity.
- For categorization of sub-catchments into various erosion classes and for the consequent CAT plan, the entire catchment (Indian Portion) is to be considered and not only the directly the draining catchment.

D. Aquatic Ecology

- Documentation of aquatic fauna like macro-invertebrates, zooplankton, phytoplanktons, benthos etc.
- Fish and fisheries, their migration and breeding grounds.
- Fish diversity, composition and maximum length & weight of the measured populations to be studied for estimation of environmental flow.
- Conservation status of aquatic fauna.

E. Irrigation and Cropping Pattern

- Cropping pattern and Horticultural practices in the study area.
- Collection of primary data on agricultural activity, crop and their productivity and irrigation facilities component.
- Component of pressurized/drip irrigation and micro irrigation.
- Details of Conjunctive use of water for irrigation.

F. Socio-Economic

- Collection of Baseline data on human settlements, health status of the community and existing infrastructure facilities for social welfare including sources of livelihood, job opportunities and safety and security of workers and surrounding population.
- Collection of information with respect to social awareness about the developmental activity in the area and social welfare measures existing and proposed by project proponent.
- Collection of information on sensitive habitat of historical, cultural and religious and ecological importance.

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

- The Socio-economic survey/profile within 10 Km of the study area for Demographic profile; Economic Structure; Development Profile; Agricultural Practices; Infrastructure, education facilities; health and sanitation facilities; available communication network etc.
- Documentation of Demographic, Ethnographic, Economic structure and development profile of the area
- Information on Agricultural practices, Cultural and aesthetic sites, Infrastructure facilities etc
- Information on the dependence of the local people on minor forest produce and their cattle grazing rights in the forest land.
- List of all the Project Affected Families with their names, education, land holdings, other properties, occupation, source of income, land and other properties to be acquired, etc.
- In addition to Socio-economic aspects of the study area, a separate chapter on socio-cultural aspects based upon study on Ethnography of the area should be provided.

7. Impact Prediction and Mitigation Measures

The adverse impact due to the proposed project should be assessed and effective mitigation steps to abate these impacts should be described.

Air Environment

- Changes in ambient and ground level concentrations due to total emissions from point, line and area sources
- Effect on soils, material, vegetation and human health
- Impact of emissions from DG sets used for power during the construction, if any, on air environment.
- Pollution due to fuel combustions in equipments & vehicles
- Fugitive emissions from various sources.
- Impact on micro climate.

Water Environment

- Changes in surface & ground water quality.
- Steps to develop pisci-culture and recreational facilities.
- Changes in hydraulic regime and down stream flow.
- Water pollution due to disposal of sewage.
- Water pollution from labour colony/camps and washing equipment.

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Land Environment

- Adverse impact on land stability, catchment of soil erosion, reservoir sedimentation and spring flow (if any) [a] due to considerable road construction/widening activity [b] interference of reservoir with the inflowing streams [c] blasting for excavation of canals and some other structures
- Changes in land use/land cover and drainage pattern.
- Immigration of labour population.
- Quarrying operation and muck disposal.
- Changes in land quality including effects of waste disposal
- River bank and their stability
- Impact due to submergence.

Biological Environment

- Impact on forests, flora, fauna including wildlife, migratory avi-fauna, rare and endangered species, medicinal plants etc.
- Pressure on existing natural resources
- Deforestation and disturbance to wildlife, habitat fragmentation and wild animal's migratory corridors
- Compensatory afforestation-Identification of suitable native tree species for compensatory afforestation & green belt.
- Impact on fish migration and habitat degradation due to decreased flow of water
- Impact on breeding and nesting grounds of animals and fish

Socio-economic Aspects

- Impact on local community including demographic profile.
- Impact on socio-economic status.
- Impact on economic status.
- Impact on human health due to water / vector borne disease.
- Impact on increases traffic.
- Impact on Holy Places and Tourism.
- Impacts of blasting activity during project construction which generally destabilize the land mass and lead to landslides, damage to properties and drying up of natural springs and cause noise pollution, will be studied. Proper record shall be maintained of the base line information in the post project period.
- Positive as well as negative impacts likely to be accrued due to the project are to be listed.

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(8) Environment Impact Analysis

Environmental Impact Analysis due to the project on the above mentioned components should be carried out for construction and operation phases using qualitative or quantitative methods.

(9) Environment Management Plan (EMP)

Environmental Management Plan aimed at minimizing the negative impacts of the project should be given in detail. The mitigation measures are to be presented for all the likely adverse impacts on the environment. The following suggestive mitigating plans should be included:

- Catchment Area Treatment (CAT) Plan should be prepared micro-watershed wise. Identification of area for treatment based upon Remote Sensing & GIS methodology and Silt Yield Index (SYI) method of SLUSOI coupled with ground survey. Areas/watersheds falling under 'very severe' and 'severe' erosion categories are required to be treated. Both biological and engineering measures should be proposed in consultation with State Forest Department. Year-wise schedule of work and monetary allocation should be provided. CAT plan is to be completed prior to reservoir impoundment. Mitigations measures to check shifting cultivation in the catchment area with provision for alternative and better agricultural practices should be included.
- Command Area Development (CAD) Plan giving details of implementation schedule with a sample CAD plan.
- Compensatory Afforestation in lieu of the forest land required for the project needs to be proposed. Choice of plants should be made in consultation with State Forest Department including native and RET species, if any.
- Biodiversity and Wild Life Conservation & Management Plan for conservation and preservation of endemic, rare and endangered species of flora and fauna to be prepared in consultation with State Forest Department.
- Resettlement and Rehabilitation (R&R) Plan need to be prepared with due consultation with Project Affected Families (PAFs). The provision of the R&R plan should be according to the National Resettlement and Rehabilitation Policy (NRRP-2007) as well as State Resettlement and Rehabilitation Policy. Detailed budgetary estimates are to be provided. Resettlements sites should be identified.
- Plan for Green Belt Development along the periphery of reservoir, colonies, approach road, canals etc. to be prepared in consultation with the State Forest Department. Local plant species suitable for greenbelt development should be selected.
- Reservoir Rim Treatment Plan for stabilization of land slide/land slip zones if any, around the reservoir periphery to be prepared. Suitable engineering and biological measures for treatment of the identified slip zones to be provided with physical and financial schedule.
- Plan for Land Restoration and Landscaping of project sites.

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- Fisheries Conservation & Management Plan-Fish fauna inhabiting the affected stretch of river, a specific fisheries management plan should be prepared for river and reservoir.
- Muck Disposal Plan- suitable sites for dumping of excavated material should be identified in consultation with the State Pollution Control Board and Forest Department. All Muck disposal sites should be minimum 30 m away from the HFL of river. Plan for rehabilitation of muck disposal sites should also be given. The L- section/ cross section of muck disposal sites and approach roads to be given. Financial out lay for this may be given separately.
- Plan for Restoration of quarry sites and landscaping of colony areas, working areas, roads, etc.
- Study of Design Earthquake Parameters: A site specific study of earthquake parameters should be done. The results of the site specific earth quake design parameters should be approval by National Committee of Seismic Design Parameters, Central Water Commission (NCSDP), New Delhi.
- Dam Break Analysis and Disaster Management Plan: The outputs of Dam Break Model should be illustrated with appropriate graphs and maps clearly bringing out the impact of Dam break scenario. Provision for early warning systems should be provided.
- Water and Air Quality & Noise Management Plans to be implemented during construction and post-construction periods.
- Mitigating measures for impacts due to Blasting on the structures in the vicinity.
- Ground Water Management Plan.
- Public Health Delivery Plan including the provisions for drinking water facility for the local community.
- Labour Management Plan for their Health and Safety.
- Sanitation and Solid Waste Management Plan for domestic waste from colonies and labour camps etc.
- Local Area Development Plan to be formulated in consultation with the Revenue Officials and Village Panchayats. Local skill development schemes should be given. Details of various activities to be undertaken along with its financial out lay should be provided.
- Environmental safeguards during construction activities including Road Construction.
- Energy Conservation Measures.
- Environmental Monitoring Programme with physical & financial details covering all the aspects of EMP. A summary of cost estimate for all the plans, cost for implementing all Environmental Management Plans including the cost for implementing environmental monitoring programme should be given. Provision for an Environmental Management Cell should be made.

In the EMP, also include a sample CAD plan for a distributary outlet command. Such a plan is to show the alignment of irrigation and drainage channels. The components of the OFD works to be undertaken may be clearly mentioned along with a time schedule for their completion vis-à-vis the progress of irrigation development.

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1(c): STANDARD TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR HYDRO POWER PROJECTS AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

(1) Scope of EIA Studies

The EIA Report should identify the relevant environmental concerns and focus on potential impacts that may change due to the construction of proposed project. Based on the baseline data collected for three (3) seasons (Pre-monsoon, Monsoon and Winter seasons), the status of the existing environment in the area and capacity to bear the impact on this should be analysed. Based on this analysis, the mitigation measures for minimizing the impact shall be suggested in the EIA/EMP study.

(2) Details of the Project and Site

- General introduction about the proposed project.
- Details of project and site giving L-sections of all U/S and D/S projects of River with all relevant maps and figures. Connect such information as to establish the total length of interference of Natural River, the total length of tunneling of the river and the committed unrestricted release from the site of diversion into the main river.
- A map of boundary of the project site giving details of protected areas in the vicinity of project location.
- Location details on a map of the project area with contours indicating main project features. The project layout shall be superimposed on a contour map of ground elevation showing main project features (viz. location of dam, Head works, main canal, branch canals, quarrying etc.) shall be depicted in a scaled map.
- Layout details and map of the project along with contours with project components clearly marked with proper scale maps of at least a 1:50,000 scale and printed at least on A3 scale for clarity.
- Existence of National Park, Sanctuary, Biosphere Reserve etc. in the study area, if any, should be detailed and presented on a map with distinct distances from the project components.
- Drainage pattern and map of the river catchment up to the proposed project site.
- Delineation of critically degraded areas in the directly draining catchment on the basis of silt Yield Index as per the methodology of All India Soil and Land Use Survey of India.
- Soil characteristics and map of the project area.
- Geological and seismo-tectonic details and maps of the area surrounding the proposed project site showing location of dam site and powerhouse site.
- Remote Sensing studies, interpretation of satellite imagery, topographic sheets along with ground verification shall be used to develop the land use/land cover pattern of the study using overlaying

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mapping techniques viz. Geographic Information System (GIS), False Color composite (FCC) generated from satellite data of project area.

- Land details including forests, private and other land.
- Demarcation of snow fed and rain fed areas for a realistic estimate of the water availability.
- Different riverine habitats like rapids, pools, side pools and variations in the river substratum - bedrocks, rocks, boulders, sand/silt or clay etc. need to be covered under the study.

(3) Description of Environment and Baseline Data

To know the present status of environment in the area, baseline data with respect to environmental components air, water, noise, soil, land and biology & biodiversity (flora & fauna), wildlife, socio-economic status etc. should be collected with 10 km radius of the main components of the project/site i.e. dam site and power house site. The air quality and noise are to be monitored at such locations which are environmentally & ecologically more sensitive in the study area. The baseline studies should be collected for 3 seasons (Pre-Monsoon, Monsoon and Post Monsoon seasons). The study area should comprise of the following:

- Catchment area up-to the dam site.
- Submergence Area
- Project area or the direct impact area should comprise of area falling within 10 km radius from the periphery of reservoir, land coming under submergence and area downstream of dam upto the point where Tail Race Tunnel (TRT) meets the river.
- Downstream upto 10 km from tip of Tail Race Tunnel (TRT).

(4) Details of the Methodology

The methodology followed for collection of base line data along with details of number of samples and their locations in the map should be included. Study area should be demarcated properly on the appropriate scale map. Sampling sites should be depicted on map for each parameter with proper legends. For forest classification, Champion and Seth (1968) classification should be followed.

(5) Methodology for collection of Biodiversity Data

- The number of sampling locations should be adequate to get a reasonable idea of the diversity and other attributes of flora and fauna. The guiding principles should be the size of the study area (larger area should have larger number of sampling locations) and inherent diversity at the location, as known from secondary sources (e.g. eastern Himalayan and low altitude sites should have a larger number of sampling locations owing to higher diversity).
- The entire area should be divided in grids of 5km X 5km preferably on a GIS domain. There after 25% of the grids should be randomly selected for sampling of which half should be in the directly

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affected area (grids including project components such as reservoir, dam, powerhouse, tunnel, canal etc.) and the remaining in the rest of the area (areas of influence in 10 km radius from project components). At such chosen location, the size and number of sampling units (e.g. quadrats in case of flora/transects in case of fauna) must be decided by species area curves and the details of the same (graphs and cumulative number of species in a tabulated form) should be provided in the EIA report. Some of the grids on the edges may not be completely overlapping with the study area boundaries. However these should be counted and considered for selecting 25% of the grids. The number of grids to be surveyed may come out as a decimal number (i.e. it has an integral and a fractional part) which should be rounded to the next whole number.

- The conventional sampling is likely to miss the presence of rare, endangered and threatened (R.E.T.) species since they often occur in low densities and in case of faunal species are usually secretive in behaviour. Reaching the conclusion about the absence of such species in the study area based on such methodology is misleading. It is very important to document the status of such species owing to their high conservation value. Hence likely presence of such species should be ascertained from secondary sources by a proper literature survey for the said area including referring to field guides which are now available for many taxonomic groups in India. Even literature from studies/surveys in the larger landscapes which include the study area for the concerned project must be referred to since most species from adjoining catchments is likely to be present in the catchments in question. In fact such literature from the entire state can be referred to. Once a listing of possible R.E.T. species from the said area is developed, species specific methodologies should be adopted to ascertain their presence in the study area which would be far more conclusive as compared to the conventional sampling. If the need be, modern methods like camera trapping can be resorted to, particularly for areas in the eastern Himalayas and for secretive/nocturnal species. A detailed listing of the literature referred to, for developing lists of R.E.T. species should be provided in the EIA reports.
- The R.E.T. species referred to in this point should include species listed in Schedule I and II of Wildlife (Protection) Act, 1972 and those listed in the red data books (BSI, ZSI and IUCN).

(6) Components of the EIA Study

Various aspects to be studied and provided in the EIA/EMP report are as follows:

A. Physical and Chemical Environment

Geological & Geophysical Aspects and Seismo - Tectonics:

- Physical geography, Topography, Regional Geological aspects and structure of the Catchment.
- Tectonics, seismicity and history of past earthquakes in the area. A site specific study of the earthquake parameters will be done. The results of the site specific earthquake design shall be sent for approval of the NCSDP (National committee of Seismic Design Parameters, Central water commission, New Delhi for large dams.
- Landslide zone or area prone to landslide existing in the study area should be examined.

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- Presence of important economic mineral deposit, if any.
- Justification for location & execution of the project in relation to structural components (dam height).
- Impact of project on geological environment.

Meteorology, Air and Noise:

- Meteorology (viz. Temperature, Relative humidity, wind speed/direction etc.) to be collected from nearest IMD station.
- Ambient Air Quality with parameters viz. Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM) i.e. suspended particulate materials <10 microns, Sulphur Dioxide (SO₂) and Oxides of Nitrogen (NO_x) in the study area at 6 locations.
- Existing noise levels and traffic density in the study area at 6 locations.

Soil Characteristics

- Soil classification, physical parameters (viz., texture, porosity, bulk density and water holding capacity) and chemical parameters (viz. pH, electrical conductivity, magnesium, calcium, total alkalinity, chlorides, sodium, potassium, organic carbon, available potassium, available phosphorus, SAR, nitrogen and salinity, etc.) (6 locations).

Remote sensing and GIS Studies

- Generation of thematic maps viz., slope map, drainage map, soil map, land use and land cover map, etc. Based on these, thematic maps, an erosion intensity map should be prepared.

Water Quality

- History of the ground water table fluctuation in the study area.
- Water quality for both surface water and ground water for (i) Physical parameters (pH, temperature, electrical conductivity, TSS); (ii) Chemical parameters (Alkalinity, Hardness, BOD, COD, NO₂, PO₄, Cl, SO₄, Na, K, Ca, Mg, Silica, Oil & Grease, phenolic compounds, residual sodium carbonate); (iii) Bacteriological parameter (MPN, Total coliform) and (iv) Heavy Metals (Pb, As, Hg, Cd, Cr-6, total Cr, Cu, Zn, Fe) (6 locations).
- Delineation of sub and micro-watersheds, their locations and extent based on the All India Soil and Land Use Survey of India (AISLUS), Department of Agriculture, Government of India. Erosion levels in each micro-watershed and prioritization of micro-watershed through silt yield index (SYI) method of AISLUS.

B Water Environment & Hydrology

- Hydro-Meteorology of the project viz. precipitation (snowfall, rainfall), temperature, relative humidity, etc. Hydro-meteorological studies in the catchment area should be established along-with real time telemetry and data acquisition system for inflows monitoring.

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- Run off, discharge, water availability for the project, sedimentation rate, etc.
- Basin characteristics
- Catastrophic events like cloud bursts and flash floods, if any, should be documented.
- For estimation of Sedimentation Rate, direct sampling of river flow is to be done during the EIA study. The study should be conducted for minimum one year. Actual silt flow rate to be expressed in ha-m km² year⁻¹.
- Set up a G&D monitoring station and a few rain gauge stations in the catchment area for collecting data during the investigation.
- Flow series, 10 daily with 90%, 75% and 50% dependable years discharges.
- Information on the 10-daily flow basis for the 90 per cent dependable year the flow intercepted at the dam, the flow diverted to the power house and the spill comprising the environmental flow and additional flow towards downstream of the dam for the project may be given.
- The minimum environmental flow shall be 20% of the flow of four consecutive lean months of 90% dependable year, 30% of the average monsoon flow. The flow for remaining months shall be in between 20-30%, depending on the site specific requirements. A site specific study shall be carried out by an expert organization.
- Hydrological studies/data as approved by CWC shall be utilized in the preparation of EIA/EMP report. Actual hydrological annual yield may also be given in the report.
- Sedimentation data available with CWC may be used to find out the loss in storage over the years.
- A minimum of 1 km distance from the tip of the reservoir to the tail race tunnel should be maintained between upstream and downstream projects.

C. Biological Environment

Besides primary studies, review of secondary data/literature published for project area on flora & fauna including RET species shall be reported in EIA/EMP report.

Flora

- Characterization of forest types (as per Champion and Seth method) in the study area and extent of each forest type as per the Forest Working Plan.
- Documentation of all plant species i.e. Angiosperm, Gymnosperm, Pteridophytes, Bryophytes (all groups).
- General vegetation profile and floral diversity covering all groups of flora including lichens and orchids. A species wise list may be provided.
- Assessment of plant species with respect to dominance, density, frequency, abundance, diversity index, similarity index, importance value index (IVI), Shannon Weiner index etc. of the species to be provided. Methodology used for calculating various diversity indices along with details of locations of quadrates, size of quadrates etc. to be reported within the study area in different ecosystems.

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- Existence of National park, Sanctuary, Biosphere Reserve etc in the study area, if any, should be detailed.
- Economically important species like medicinal plants, timber, fuel wood etc.
- Details of endemic species found in the project area.
- Flora under RET categories should be documented using International Union for the Conservation of Nature and Natural Resources (IUCN) criteria and Botanical Survey of India's Red Data list along-with economic significance. Species diversity curve for RET species should be given.
- Cropping pattern and Horticultural Practices in the study area.

Fauna:

- Fauna study and inventorisation should be carried out for all groups of animals in the study area. Their present status alongwith Schedule of the species.
- Documentation of fauna plankton (phyto and zooplankton), periphyton, benthos and fish should be done and analysed.
- Information (authenticated) on Avi-fauna and wildlife in the study area.
- Status of avifauna their resident/ migratory/ passage migrants etc.
- Documentation of butterflies, if any, found in the area.
- Details of endemic species found in the project area.
- RET species-voucher specimens should be collected along-with GPS readings to facilitate rehabilitation. RET faunal species to be classified as per IUCN Red Data list and as per different schedule of Indian Wildlife (Protection) Act, 1972.
- Existence of barriers and corridors, if any, for wild animals.
- Compensatory afforestation to compensate the green belt area that will be removed, if any, as part of the proposed project development and loss of biodiversity.
- Collection of primary data on agricultural activity, crop and their productivity and irrigation facilities components.
- For categorization of sub-catchment into various erosion classes and for the consequent CAT plan, the entire catchment (Indian Portion) is to be considered and not only the directly the draining catchment.

D. Aquatic Ecology

- Documentation of aquatic fauna like macro-invertebrates, zooplankton, phytoplanktons, benthos etc.
- Fish and fisheries, their migration and breeding grounds.

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- Fish diversity composition and maximum length & weight of the measured populations to be studied for estimation of environmental flow.
- Conservation status of aquatic fauna.
- Sampling for aquatic ecology and fisheries and fisheries must be conducted during three seasons - Pre-monsoon (summer), monsoon and winter. Sizes (length & weight) of important fish species need to be collected and breeding and feeding grounds should also be identified along the project site or in vicinity.

E Socio-Economic

- Collection of baseline data on human settlements, health status of the community and existing infrastructure facilities for social welfare including sources of livelihood, job opportunities and safety and security of workers and surroundings population.
- Collection of information with respect to social awareness about the developmental activity in the area and social welfare measures existing and proposed by project proponent.
- Collection of information on sensitive habitat of historical, cultural and religious and ecological importance.
- The socio-economic survey/ profile within 10 km of the study area for demographic profile; Economic Structure; Developmental Profile; Agricultural Practices; Infrastructure, education facilities; health and sanitation facilities; available communication network etc.
- Documentation of demographic, Ethnographic, Economic Structure and development profile of the area.
- Information on Agricultural Practices, Cultural and aesthetic sites, Infrastructure facilities etc.
- Information on the dependence of the local people on minor forest produce and their cattle grazing rights in the forest land.
- List of all the Project Affected Families with their name, age, educational qualification, family size, sex, religion, caste, sources of income, land & house holdings, other properties, occupation, source of income, house/land to be acquired for the project and house/land left with the family, any other property, possession of cattle, type of house etc.
- Special attention has to be given to vulnerable groups like women, aged persons etc. and to any ethnic/indigenous groups that are getting affected by the project.

(7) Impact Prediction and Mitigation Measures

The adverse impact due to the proposed project should be assessed and effective mitigation steps to abate these impacts should be described.

Air Environment

- Changes in ambient and ground level concentrations due to total emissions from point, line and area sources.

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- Effect on soil, material, vegetation and human health.
- Impact of emissions from DG set used for power during the construction, if any, on air environment.
- Pollution due to fuel combustion in equipments and vehicles
- Fugitive emissions from various sources

Water Environment

- Changes in surface and ground water quality
- Steps to develop pisci-culture and recreational facilities
- Changes in hydraulic regime and downstream flow.
- Water pollution due to disposal of sewage
- Water pollution from labour colonies/ camps and washing equipment.

Land Environment

- Adverse impact on land stability, catchment of soil erosion, reservoir sedimentation and spring flow (if any) (a) due to considerable road construction / widening activity (b) interference of reservoir with the inflowing stream (c) blasting for commissioning of HRT, TRT and some other structures.
- Changes in land use / land cover and drainage pattern
- Immigration of labour population
- Quarrying operation and muck disposal
- Changes in land quality including effects of waste disposal
- River bank and their stability
- Impact due to submergence.

Biological Environment

- Impact on forests, flora, fauna including wildlife, migratory avi-fauna, rare and endangered species, medicinal plants etc.
- Pressure on existing natural resources
- Deforestation and disturbance to wildlife, habitat fragmentation and wild animal's migratory corridors
- Compensatory afforestation-identification of suitable native tree species for compensatory afforestation and green belt.
- Impact on fish migration and habitat degradation due to decreased flow of water
- Impact on breeding and nesting grounds of animals and fish.

Socio-economic aspects

- Impact on local community including demographic profile.
- Impact on socio-economic status

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- Impact on economic status.
- Impact on human health due to water / vector borne disease
- Impact on increase traffic
- Impact on Holy Places and Tourism
- Impacts of blasting activity during project construction which generally destabilize the land mass and leads to landslides, damage to properties and drying up of natural springs and cause noise population will be studies. Proper record shall be maintained of the baseline information in the post project period.
- Positive and negative impacts likely to be accrued due to the project are listed.

(8) Environmental Management Plans

1. Catchment Area Treatment (CAT) Plan should be prepared micro-watershed wise. Identification of free draining/ directly draining catchment based upon Remote Sensing and Geographical Information System (GIS) methodology and Sediment Yield Index (SYI) method of AISLUS, Deptt. of Agriculture, Govt. of India coupled with ground survey. Areas or watersheds falling under 'very severe' and 'severe' erosion categories should be provided and required to be treated. Both biological as well as engineering measures should be proposed in consultation with State Forest Department for areas requiring treatment. Year-wise schedule of work and monetary allocation should be provided. Mitigation measures to check shifting cultivation in the catchment area with provision for alternative and better agricultural practices should be included.
2. Compensatory Afforestation shall be prepared by the State Forest Department in lieu of the forest land proposed to be diverted for construction of the project as per the Forest (Conservation) Act, 1980. Choice of plants for afforestation should include native and RET species, if any. This will be a part of the forest clearance proposal.
3. Biodiversity and Wildlife Conservation and Management Plan for the conservation and preservation of rare, endangered or endemic floral/faunal species or some National Park/Sanctuary/ Biosphere Reserve or other protected area is going to get affected directly or indirectly by construction of the project, then suitable conservation measures should be prepared in consultation with the State Forest Department and with the physical and financial details. Suitable conservation techniques (in-situ/ ex-situ) will be proposed under the plan and the areas where such conservation is proposed will be marked on a project layout map.
4. Fisheries Conservation and Management Plan - a specific fisheries management measures should be prepared for river and reservoir. If the construction of fish ladder/ fish-way etc. is not feasible then measures for reservoir fisheries will be proposed. The plan will detail out the number of hatcheries, nurseries, rearing ponds etc. proposed under the plan with proper drawings. If any migratory fish species is getting affected then the migratory routes, time/season of upstream and downstream migration, spawning grounds etc will be discussed in details.

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5. Resettlement and Rehabilitation Plan needed to be prepared on the basis of findings of the socio-economic survey coupled with the outcome of public consultation held. The R&R package shall be prepared after consultation with the representatives of the project affected families and the State Government. Detailed budgetary estimates are to be provided. Resettlements site should be identified. The plan will also incorporate community development strategies.
6. Green Belt Development Plan along the periphery of the reservoir, approach roads around the colonies and other project components, local plant species must be suggested with physical and financial details. A layout map showing the proposed sites for developing the green belt should be prepared.
7. Reservoir Rim Treatment Plan for stabilization of land slide / land slip zones, if any, around the reservoir periphery is to be prepared based on detailed survey of geology of the reservoir rim area. Suitable engineering and biological measures for treatment of identified slip zones to be suggested with physical and financial schedule. Layout map showing the landslide/landslip zones shall be prepared and appended in the chapter.
8. Muck Disposal Plan suitable sites for dumping of excavated materials should be identified in consultation with State Pollution Control Board and State Forest Department. All muck disposal sites should be minimum 30 m away from the HFL of river. The quantity of muck to be generated and the quantity of muck proposed to be utilized shall be calculated in consultation with the project authorities. Details of each dumping site viz. area, capacity, total quantity of muck that can be dumped etc. should be worked out and discussed in the plan. Plan for rehabilitation of muck disposal sites should also be given. The L-section / cross section of muck disposal sites and approach roads should be given. The plan shall have physical and financial details of the measures proposed. Layout map showing the dumping sites vis-à-vis other project components will be prepared and appended in the chapter.
9. Restoration Plan for Quarry Sites and landscaping of colony areas, working areas, roads etc. Details of the coarse/fine aggregate/clay etc. required for construction of the project and the rock/clay quarries/river shoal sites identified for the project should be discussed along-with the Engineering and Biological measures proposed for their restoration with physical and financial details. Layout map showing quarry sites vis-à-vis other project components, should be prepared.
10. Study of Design Earthquake Parameters: A site specific study of earthquake parameters should be done. Results of the site specific earthquake design parameters should be approved by National Committee of Seismic Design Parameters, Central Water Commission (NCSDP), New Delhi.
11. Dam Break Analysis and Disaster Management Plan The outputs of dam break model should be illustrated with appropriate graphs and maps clearly bringing out the impact of Dam Break scenario. To identify inundation areas, population and structures likely to be affected due to catastrophic floods in the event of dam failure. DMP will be prepared with the help of Dam Break Analysis. Maximum water level that would be attained at various points on the downstream in case of dam break will be marked on a detailed contour map of the downstream area, to show the extent of inundation. The action plan will include Emergency Action and Management plan including measures like preventive action notification, warning procedure and action plan for co-ordination with various

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authorities.

12. Water, Air and Noise Management Plans to be implemented during construction and post-construction periods.
13. Public Health Delivery Plan including the provisions of drinking water supply for local population shall be in the EIA/EMP Report. Status of the existing medical facilities in the project area shall be discussed. Possibilities of strengthening of existing medical facilities, construction of new medical infrastructure etc. will be explored after assessing the need of the labour force and local populace.
14. Labour Management Plan for their Health and Safety.
15. Sanitation and Solid waste management plan for domestic waste from colonies and labour camps etc.
16. Local Area Development Plan to be formulated in consultation with the Revenue Officials and Village Panchayats. Appropriate schemes shall be prepared under EMP for the Local Area Development Plan with sufficient financial provisions.
17. Environmental safeguards during construction activities including Road Construction.
18. Energy Conservation Measures for the work force during construction with physical and financial details. Alternatives will be proposed for the labour force so that the exploitation of the natural resource (wood) for the domestic and commercial use is curbed.
19. Environmental Monitoring Programme to monitor the mitigatory measures implemented at the project site is required will be prepared. Provision for Environment Management Cell should be made. The plan will spell out the aspects required to be monitored, monitoring indicators/parameters with respect to each aspect and the agency responsible for the monitoring of that particular aspect throughout the project implementation.
20. A summary of Cost Estimates for all the plans, cost for implementing all the Environmental Management Plans.



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CHAPTER-4

PREDICTION OF IMPACTS

4.1 GENERAL

Based on the project details and the baseline environmental status, potential impacts as a result of the construction and operation of the proposed Vishnugad Pipalkoti hydroelectric project have been identified. This Chapter addresses the basic concepts and methodological approach for conducting a scientifically based analysis of the potential impacts likely to accrue as a result of the proposed project. The Environmental Impact Assessment (EIA) for quite a few disciplines are subjective in nature and cannot be quantified. Wherever possible, the impacts have been quantified and otherwise, qualitative assessment has been undertaken. This Chapter deals with the anticipated positive as well as negative impacts due to construction and operation of the proposed Vishnugad Pipalkoti hydroelectric project.

The impacts which have been covered in the present Chapter are categorized as below:

- Water Environment
- Climate and Weather Environment
- Land Environment
- Ecological Environment
- Demographic and Socio-Economic Environment

The impacts as referred above are described in the following sections. However, impacts on Demographic and Socio-economic environment have been described in Chapter-5.

4.2 WATER ENVIRONMENT

The various aspects covered under water environment are:

- Water resources
- Water quality
- Sediments

4.2.1 Water Resources

The river stretch downstream of the dam site upto the confluence point of tail race discharge will have reduced flow. The total length of the affected stretch of the river will be about 17 km. There are quite a few streams out-falling in this stretch i.e. between the dam site, and the tailrace discharge outfall. Thus, river will not be completely dry, in the intervening stretch. The reduction in flow or drying of the river in the intervening stretch is not likely to have any adverse impact on the downstream users. This is mainly because of the fact that there are no major settlements/ villages within the affected river stretch. Few settlements that are observed in the affected stretch do not use water from river Alaknanda. Thus, there are no users of water of river Alaknanda in the affected stretch. However, the reduction in flow could have an adverse impact on riverine ecology.

4.2.2 Water quality

a) Construction phase

The major sources of surface water pollution during project construction phase are as follows:

- Sewage from labour camps/colonies.
- Effluent from crushers.
- Effluents from other sources.

Sewage from labour camps

The project construction is likely to last for a period of about 5 years. The peak labour strength likely to be employed during project construction phase is about 2,000 workers and 600 technical staff. The employment opportunities in the area are limited. However, during project construction phase, some of the locals may get employment. It has been observed during construction phase of many of the projects, that contractors, who bring their own skilled labour, construct major works. It is only in the unskilled category, that locals get employment.

The construction phase, also leads to mushrooming of various allied activities to meet the demands of the immigrant labour population in the project area. As mentioned earlier, about 2,000 workers and 600 technical staff are likely to work in the project area during project construction phase. Normally, during construction phase, a large proportion of the labour population, migrate in the area with their families as well. Thus, in the proposed project, the increase in labour population shall be of the order of 8,200.

The domestic water requirements have been estimated as 70 lpcd. Thus, total water requirements work out to 0.57 mld. It is assumed that about 80% of the water supplied will be generated as sewage. Thus, total quantum of sewage generated is expected to be of the order of 0.46 mld. The BOD load contributed by domestic sources will be about 370 kg/day. Generally, labour population resides in 2 to 3 colonies. Considering the worst-case scenario for the purpose of assessment of impacts on water quality, it is assumed that all the sewage generated from various

labour camps/colonies outfalls at a common point. It is also assumed that the sewage is discharged without any treatment. For these conditions, the minimum flow required for dilution of sewage is of the order of 1.2 cumecs. Thus, even the minimum recorded flow in river Alaknanda is much higher than the flow required for dilution for disposal of untreated sewage.

Detailed DO modelling was done using Streeter Phelp's model. The equation used in the model is given as below:

$$D_t = \frac{K_1 L_A [10^{-K_1 t} - 10^{-K_2 t}]}{K_2 - K_1} + D_A 10^{-K_2 t}$$

- D_t = D.O. deficit downstream at time t.
 K_1 = deoxygeration rate (coff. Assumed)
 K_2 = reaeration rate (coff. Assumed)
 L_A = ultimate upstream BOD
 D_A = D.O. deficit upstream
 t = time of stream flow upstream to point at which D.O. level is to be estimated

The D.O. level in the river was taken as 8.0 mg/l. The minimum flow in the river Alaknanda was taken as 19 cumecs. The results of D.O. model are summarized in Table-4.1.

TABLE-4.1
Results of D.O. Modelling due to disposal of sewage from
labour camps in river Alaknanda

Distance from outfall (km)	D.O. (mg/l)
0.1	8.00
0.2	8.00
0.3	8.00
0.4	8.00
0.5	8.00
1.0	8.00

It can be observed from Table-4.1, that no impact is anticipated on river water quality, as a result of disposal of sewage from labour camps. This is mainly because of the fact that the organic loading as a result of disposal of untreated sewage from labour camps is much lower than the carrying capacity, even for the minimum 10 day daily observed for river Alaknanda at the dam site. Normally, during project construction phase, labour population is concentrated at 2 or 3 locations. Thus, in the proposed project too, sewage/BOD loading would outfall into the river Alaknanda through 2 or 3 drains, which means that impacts on DO level of river water quality would be even lesser than that estimated in this section. Even though no adverse impact is envisaged on water quality of river Alaknanda, adequate facilities for treatment of sewage generated from labour camps shall be commissioned.

Effluent from crushers

During construction phase, the contractor involved in construction activities will commission at least one crusher each at the dam site and the power project site. The total capacity of the two crushers is likely to be will be of the order of 120-150 tph. Water is required to wash the boulders and to lower the temperature of the crushing edge. About 0.1 m³ of water is required per tonne of material crushed. The effluent from the crusher would contain high suspended solids. About 12-15 m³/hr of waste water is expected to be generated from each crusher. The effluent, if disposed without treatment can lead to marginal increase in the turbidity levels in the receiving water bodies. The natural slope in the area is such that, the effluent from the crushers will ultimately find its way in river Alaknanda. This amounts to a discharge

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of 0.0033 to 0.0042 cumecs. Even the lowest flow in river Alaknanda is much higher than this flow. The effluent from crusher will have suspended solids level of 3000-4000 mg/l. On the other hand, suspended solids as observed at various sampling locations, during water quality monitoring studies was observed to about 5 mg/l. The level of suspended solids in the composite sample would increase by less than 1 mg/l. The increase in suspended is not expected to cause any significant adverse impacts.

To ameliorate the marginal impacts, it is proposed to commission adequate treatment facilities in the form of a settling tank to treat the effluent from each crusher. The settling tank will remove about 70% of the suspended solids. Thus, with the commissioning of settling tanks, the increase in suspended solid loading should be marginal, and is not expected to cause any adverse impact.

b) Operation phase

The major sources of water pollution during project operation phase include:

- Effluent from project colony.
- Impacts on reservoir water quality.
- Eutrophication risks.

Effluent from project colony

During project operation phase, due to absence of any large scale construction activities, cause and source of water pollution will be much different. Since, only a small number of O&M staff will reside in the area in a well designed colony which will have a Sewage Treatment Plant (STP) and other infrastructure facilities, the problems of water pollution due to disposal of sewage are not anticipated.

In the operation phase, about 250 families with a total population of about 1000 will be residing in the project colony. About 0.15 mld of sewage will be generated. The total BOD loading will be order of 45 kg/day. The BOD loading is insignificantly low to cause any adverse impact on water quality of river Alaknanda. It is proposed to provide biological treatment facilities including secondary treatment units for sewage so generated from the BOD load after treatment will reduce to 5 kg/day. Thus, with commissioning of sewage treatment facilities, even the marginal impacts on water quality of receiving water body as a result of disposal of sewage from project colony are anticipated.

Impacts on reservoir water quality

Stratification can limit the mixing of the water body, leading to depletion of D.O. levels. This can lead to reducing conditions in waters. Since, the depth in the proposed reservoir is not very high, the annual variation upto MDDL would prevent formation of any significant temperature stratification. Thus, no problems related to reservoir stratification are anticipated.

The flooding of previously forested and agricultural land in the submergence area will increase the availability of nutrients resulting from decomposition of vegetative matter. Enrichment of impounded water with organic and inorganic nutrients will be the main water quality problem immediately on commencement of the operation. However, this phenomenon is likely to last for a short duration of few years from the filling up of the reservoir. In a typical forest ecosystem in tropical condition, the above ground biomass ranges from 250 to 500 t/ha. The below ground root biomass

is of the order of 130 t/ha. The proposed project has sub-temperate climatic conditions, where the productivity levels are much lower. Also, the vegetation likely to come under reservoir submergence will be cleared before reservoir filling. Thus, any significant impact on reservoir water quality is not anticipated.

Eutrophication risks

Another significant impact, which can accrue in the reservoir, is the problem of eutrophication in the reservoir. This occurs mainly due to the disposal of nutrient rich effluents from the agricultural fields. However, within the catchment, the proportion of land under agriculture is quite low. About 70% of the total catchment is under snow. The total area under agriculture is around 10% of the total catchment area. The agro-chemical dosing is low in the area. Even in the post-project phase, use of fertilizers in the project catchment area is not expected to rise significantly. Considering the low fertilizer usage in the area, significant loading of nutrients is not anticipated. Thus, problems due to eutrophication are not anticipated in the proposed project.

4.3 CLIMATE AND AIR ENVIRONMENT

The various impacts covered under the above category are:

- Ambient air quality
- Noise.

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4.3.1 Ambient air quality

In a water resources project, air pollution occurs mainly during project construction phase. The major sources of air pollution during construction phase are:

- Pollution due to fuel combustion in various construction equipment.
- Fugitive emissions from crushers.
- Impacts due to vehicular movement

Pollution due to fuel combustion in various construction equipment

The operation of various construction equipment requires of combustion of fuel. Normally, diesel is used in such equipment. The major pollutant, which gets emitted as a result of diesel combustion, is SO₂. The SPM emissions are minimal due to low ash content.

The fuel utilisation rate of various equipment expected to be in operation during construction phase is given in Table-4.2. Ambient air quality modelling has been done using Gaussian Plume dispersion model. The modelling has been done for the worst scenario, considering the fact that all the construction equipment used are operating at a common point.

TABLE-4.2
Fuel consumption in operation of various mining equipment

S.No.	Equipment	Fuel consumption rate (lph)	No. of units	Total fuel consumption (lph)
1.	Comopressors	100	3	300
2.	Cranes	150	1	150
3.	DG Sets	150	2	300
4.	Concrete planners	50	5	250
5.	Batching plant	100	3	300
6.	Drilling machines	60	5	300
7.	Grouting & guniting equipment	60	5	300

Mathematical Modelling

The impact of emission of air pollutants has been predicted using Gaussian Plume Dispersion model. The model is a mathematical solution of three-dimensional advection-diffusion equation. The model has the following assumptions:

- Diffusion in downwind direction is insignificant compared with mean flow (advection dominates over diffusion).
- Wind speed is not a function of position.
- Diffusivities are not functions of position

The model requires the following inputs :

- Quantities of raw materials (including fuels).
- Fuel analysis (e.g. sulphur content).
- For exit gases:
 - Velocity
 - Temperature
 - Flow rate
 - Density
 - Specific heat
 - Heat emission rate
 - Emission rate of pollutant
- For Stack
 - internal diameter of exhaust
 - height from ground level
- Wind speed
- Ambient temperature
- Cloud cover
- Humidity

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The basic equation used in the ambient air quality modelling is given as below:

$$C(x) = \frac{Q}{2\pi u \sigma_y \sigma_z} \{ \exp (-1/2 (H/\sigma_z)^2) \}$$

where,

- C = concentration at a distance x from an effective source of height H
- Q = Uniform emission rate of pollutant
- $\sigma_y \sigma_z$ = standard deviation of plume concentration in horizontal & vertical directions
- u = mean wind speed
- H = effective height of release, i.e. sum of physical stack height and plume rise

The stability classes as classified through Pasquill Stability Classes was utilized to assess the stability class. For the modelling purpose stability class C was used. The maximum short-term increase in SO₂ was estimated as 0.15 µg/m³ at a distance of 200 m from the source when the wind velocity was between 19-24 km/hr. Thus, the increase in SO₂ level is insignificant. Similarly, maximum short-term increase in SPM level due to mining is expected at a distance of 2 km from the project site. The increase in concentration is expected to be of the order of 0.015 µg/m³, which is insignificant. Thus, increase in SPM and SO₂ is not expected to increase significantly due to combustion of fuel in various construction equipment. In the proposed project, no significant impact on ambient air quality is expected as a result of operation of various construction equipment.

Emissions from various crushers

The operation of the crusher during the construction phase is likely to generate fugitive emissions, which can move even upto 0.5 to 1 km in predominant wind direction. During construction phase, one crusher each is likely to be commissioned at the dam and power house sites. During crushing operations, fugitive emissions comprising of the suspended particulate will be generated. There could be marginal impacts to settlements close to the sites at which crushers are commissioned. However, based on past experience, adverse impacts on this account are not anticipated. However, during finalising the project layout, it should be ensured that the labour camps, colonies, etc. are located on the leeward side and outside the impact zone (about 1km) of the crushers.

Impacts due to vehicular movement

During construction phase, there will be increased vehicular movement for transportation of various construction materials to the project site. Large quantity of dust is likely to be entrained due to the movement of trucks and other heavy vehicles. However, such ground level emissions do not travel for long distances. Thus, no major adverse impacts are anticipated on this account.

4.3.2 Impacts on noise environment

In a water resource projects, the impacts on ambient noise levels are expected only during the project construction phase, due to earth moving machinery, etc. Likewise, noise due to quarrying, blasting, vehicular movement will have some adverse impact on the ambient noise levels in the area.

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Impacts due to operation of construction equipment

The noise level due to operation of various construction equipment is given in Table-4.3.

TABLE-4.3

Noise level due to operation of various construction equipment

Equipment	Noise level (dB(A))
Compressors	75-85
Cranes	82-85
DG Sets	80-90
Concrete placers	70-80
Batching plant	75-85
Drilling machines	85-95
Grouting, guniting equipment	80-90
Crushers	68-70
Pumps	68-70
Vibrators	69-81
Saws	74-81

Under the worst case scenario, considered for prediction of noise levels during construction phase, it has been assumed that all these equipment generate noise from a common point.

Noise modelling

The absorption of sound in the air is generally by molecular and viscous actions and is generally a complex phenomenon. In general, the sound pressure level decreases by 6 dB(A) for each doubling of the distance.

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The overall impact of noise due to various sources can be predicted using hemispherical model for sound wave propagation:

$$LPQ = LW + DIQ - 20 \log r - Ae - 8 \text{ dB(A)}$$

where,

LPQ- sound pressure level at a receiver located in the direction and distance 'r' from the source;

LW - sound pressure level of the source;

DIQ- directivity index of the source (for hemispherical radiation DI = 8 DB(A)).

r - distance of receiver from the source (m);

Ae - represents excess attenuation of the sound produced by factors such as;

- absorption in air;
- effect of rain, wind and fog;
- reflection and refraction at barriers and buildings;
- effect of the terrain, grass, shrubs, trees, etc., and
- effect of wind and temperature.

The absorption of sound in the air is generally by molecular and viscous actions and is a complex phenomenon. In general, the sound pressure level decreases by 6 dB(A) for each doubling of the distance.

The cumulative impact of various sources at a particular location is calculated by using the logarithmic absorption model as:

$$LP \text{ (Total)} = 10 \log (10^{LPQ1/10} + 10^{LPQ2/10} + \dots).$$

The increase in noise levels due to operation of various construction equipment are given in Table-4.4.

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TABLE-4.4**Increase in noise levels due to operation of various construction equipment**

Distance (m)	Ambient noise levels dB(A)	Noise levels due to construction activities dB(A)	Increase in ambient noise level due to construction activities dB(A)
100	35	76	41
200	35	70	35
500	35	62	27
1000	35	56	21
1500	35	52	17
2000	35	50.1	16.1
2500	35	48.2	13.2
3000	35	46.3	11.3

It would be worthwhile to mention here that in absence of the data on actual location of various construction equipment, all the equipment have been assumed to operate at a common point. This assumption leads to over-estimation of the increase in noise levels. Also, it is a known fact that there is a reduction in noise level as the sound wave passes through a barrier. Walls of the houses or other structures will attenuate at least 30 dB(A) of noise. Thus, no increase in noise levels are anticipated as a result of various activities, during the project construction phase.

Impacts due to increased vehicular movement

During construction phase, there will be significant increase in vehicular movement for transportation of construction material. At present, vehicular movement near the dam site is of the order of 10-15 trucks/hour. During construction phase, the increase in vehicular movement is expected to increase upto a maximum of 45 to 50 trucks/hour.

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As a part of EIA study, impact on noise level due to increased vehicular movement was studied using Federal Highway Administration model. The results of modelling are outlined in Table-4.5.

TABLE-4.5

Increase in noise levels due to increased vehicular movement

Distance (m)	Ambient noise level dB(A)	Noise levels due to increased vehicular movement dB(A)	Increase in ambient noise level due to increased vehicular movement dB(A)
10	40	72	32
20	40	67	27
50	40	61	21
100	40	57	17
200	40	52	12
500	40	47	7
1000	40	44	4

As mentioned earlier, there will be significant attenuation due to various factors, e.g. absorption by construction material, air absorption, atmospheric inhomogeneties, vegetal cover. Thus, no significant impacts on this account is anticipated.

Impacts on labour

The effect of high noise levels on the operating personnel, has to be considered as this may be particularly harmful. It is known that continuous exposures to high noise levels above 90 dB(A) affects the hearing acuity of the workers/operators and hence, should be avoided. To prevent these effects, it has been recommended by Occupational Safety and Health Administration (OSHA) that the exposure period of affected persons be limited as in Table 4.6.

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TABLE-4.6**Maximum Exposure Periods specified by OSHA**

Maximum equivalent continuous noise level dB(A)	Unprotected exposure period per day for hours and 5 days/week
90	8
95	4
100	2
105	1
110	0.5
115	0.25
120	No exposure permitted at or above this level

Noise generated due to drilling

The noise levels monitored at a 10 m distance from the source and operator's cabin is given in Table-4.7.

TABLE-4.7**Noise generated due to drilling**

Equipment	Noise level at source dB(A)
Standing idle (inside cabin)	70-72
Standing idle (10 m radius)	72-74
On load (inside cabin)	78-80
On load (10 m radius)	82-84

The noise levels during various construction activities have been compared to various standards prescribed by Occupational Safety and Health Administration (OSHA), which are being implemented in our country through rules framed under Factories Act. It can be observed (Refer Table-4.6) that for an 8 hour duration, equivalent noise level exposure should be less than 90 dB(A).

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The Director General of Mines Safety in its circular no. DG(Tech)/18 of 1975, has prescribed the noise level in mining operations for workers in 8 hour shift period with unprotected ear as 90 dB(A) or less. Similar norms can be considered for construction phase of the proposed project as well. The workers who are expected to be exposed to noise levels greater than 90 dB(A), should work in these areas upto 6 to 8 hours. In addition, they also need to be provided with ear plugs. Thus, increased noise levels due to drilling are not expected to adversely affect the workers operating the drill or involved in other mining activities closely.

Noise generated due to blasting

Noise generated by blasting is instantaneous in nature. Noise generated due to blasting is site specific and depends on type, quantity of explosives, dimension of drill hole, degree of compaction of explosives in the hole and rock. Noise levels generated due to blasting have been monitored at various sites and the results have been summarized in Table-4.8.

TABLE-4.8
Noise generation due to blasting

No. of holes	Total charge (kg)	Maximum charge/delay (kg)	Distance (m)	Noise level dB(A)
15	1500	100	250	76-85
17	1700	100	250	76-86
18	1800	100	250	74-85
19	1900	100	400	70-75
20	2000	100	100 check	76-80

It can be observed from Table-4.8, that noise level due to blasting operations are expected to be of the order of 75-86 dB(A). Since, the nearest settlement is atleast 1

km away, the incremental noise due to blasting is expected to be 50-60 dB(A). As the blasting is likely to last for 4 to 5 seconds depending on the charge, noise levels over this time would be instantaneous and short in duration. Considering attenuation due to various sources, even the instantaneous increase in noise level is not expected to be more than 60 dB(A). Hence, noise level due to blasting is not expected to cause any significant adverse impact.

Impacts due to ground vibrations

The explosive energy generated during blasting sets up a seismic wave within the surface, which may affect the structures and cause discomfort to human population. When an explosive charge is fired in a hole, stress waves traverse in various directions, causing the rock particles to oscillate. Blasting also generates ground vibrations and instantaneous noise. Various measures have been recommended to minimize the adverse impacts due to blasting :

- Proper design of blast hole to be developed.
- Use of noiseless trunk delays to minimize the noise due to air blast.
- Use of non-electric system of blasting for true bottom hole initiation.
- Use of muffling mats to arrest the dust and fly rock.

4.4 IMPACTS ON LAND ENVIRONMENT

The major impacts anticipated on land environment are as follows:

- Quarrying operations.
- Excavation of construction material from river bed.
- Operation of construction equipment.
- Soil erosion.
- Muck disposal.
- Impacts due to construction of roads.
- Acquisition of land

4.4.1 Quarrying operations

A project of this magnitude would require significant amount of excavation and use of construction material. The total quantity of muck likely to be generated from various construction activities is 1.5 Mm³. Apart of the of muck generated is poropsoed to be used as a construction material.

As a part of investigations for DPR preparation, three quarry sites have been selected. These are :

- Gulakoti quarry : 2 km downstream of dam site
- Patalganga quarry : 5 km downstream of dam site
- Birahi quarry : 5 km from power house site

Normally, in a hilly terrain, quarrying is normally done by cutting a face of the hill. A permanent scar is likely to be left, once quarrying activities are over. With the passage of time, the rock from the exposed face of the quarry under the action of wind and other erosional forces, get slowly weathered and after some time, they become a potential source of landslide. Thus, it is necessary to implement appropriate slope stabilization measures to prevent the possibility of soil erosion and landslides at the quarry sites. Various measures have been suggested as a part of Environmental Management Plan (EMP), which has been outlined in Chapter-6 of this Report.

4.4.2 Operation of construction equipment

During construction phase, various types of equipment will be brought to the site. These include crushers, batching plant, drillers, earth movers, rock bolters, etc. The

siting of these construction equipment would require significant amount of space. Similarly, space will be required for storing of various other construction equipment. In addition, land will also be temporarily acquired, i.e. for the duration of project construction for storage of quarried material before crushing, crushed material, cement, rubble, etc. Efforts must be made for proper siting of these facilities. Various criteria for selection of these sites would be:

- Proximity to the site of use.
- Sensitivity of forests in the nearby areas.
- Proximity from habitations.

The level or severity of impacts would vary with the distance of the settlement from the construction sites and intensity of construction activities. Most of the villages or settlements at various sites are located at least 1 km from the construction site. Considering the type of pollutant sources in the construction phase, the significant impact is anticipated.

4.4.3 Pollution from construction sites

The runoff from the construction sites will have a natural tendency to flow towards river Alaknanda or its tributaries. For some distance downstream of major construction sites, such as dam, power house, etc. there is a possibility of increased sediment levels which will lead to reduction in light penetration, which in turn could reduce the photosynthetic activity to some extent of the aquatic plants as it depends directly on sunlight. This change is likely to have an adverse impact on the primary biological productivity of the affected stretch of river Alaknanda. Since, river Alaknanda has significant flow, hence, impacts on this account are not expected to

be significant. However, runoff from construction sites, entering small streams would have significant adverse impacts on their water quality. The runoff would increase the turbidity levels with corresponding adverse impacts on photosynthetic action and biological productivity of these streams. The impacts on these streams and rivulets thus, could be significant. Adequate measures need to be implemented as a part of EMP to ameliorate this adverse impact to the extent possible.

4.4.4 Muck disposal

A project of this magnitude would generate significant amount of waste, as a result of tunneling operations, construction of roads, etc. About 1.5 Mm³ of muck is likely to be generated of which about 0.45 Mm³ would be used in construction of the various civil structures for the project. The balance (1.05 Mm³) shall have to be disposed at designated sites. An area of 12 ha has been earmarked for muck disposal.

Normally, muck is disposed in low lying` areas or depressions. Trees, if any, are cut before muck disposal, however, shrubs, grass or other types of undergrowth in the muck disposal at sites perish. The muck disposal sites in the proposed project are located close to river Alaknanda. If adequate protection measures are not undertaken, then the muck can roll in to the river. This can affect the river flow and aquatic ecology. Appropriate management measures need to be implemented for amelioration of adverse impacts, which have been outlined in Chapter-6 of this Report.

4.4.6 Construction of roads

The project construction would entail significant vehicular movement for transportation of large construction material, heavy construction equipment. New access roads would have to be constructed. A total of about 25.6 km of new road are proposed to be constructed. Some of the existing roads in the project area, would require widening.

The construction of roads can lead to the following impacts:

- The topography of the project area has steep slope which descends rapidly into narrow valleys. The conditions can give rise to erosion hazards due to net downhill movement of soil aggregates.
- Removal of trees on slopes and re-working of the slopes in the immediate vicinity of roads, can encourage landslides, erosion gullies, etc. With the removal of vegetal cover, erosive action of water gets pronounced and accelerates the process of soil erosion and formation of deep gullies. Consequently, the hill faces are bared of soil vegetative cover and enormous quantities of soil and rock can move down the rivers, and in some cases, the road itself may get washed out.
- Construction of new roads increases the accessibility of an hitherto undisturbed areas resulting in greater human interferences and subsequent adverse impacts on the ecosystem.
- Increased air pollution during construction phase.

Various management measures have been recommended for control of adverse impacts due to construction of roads and the same have been outlined in Chapter-6 of this Report.

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4.4.7 Acquisition of land

The total land to be acquired for the project is 120 ha. A part of this land is required for labour camps, quarry sites, muck disposal storage of construction material, siting of construction equipment, which will be required temporarily and returned once the construction phase is over. Permanent acquisition of land is required for dam axis, submergence area, project colony, etc. The details of land required for various project appurtenances is given in Table-4.9

TABLE-4.9

Details of land requirement for Vishnugad-Pipalkoti hydro electric project

Project Component	Area (ha)
Reservoir area	26.5
Working area	10.0
Dumping yard	12.0
Adits	5.0
Quarries	12.0
Colony	13.0
Workshop at dam	10.0
Power house working area	2.0
Potyard area	1.50
Approach road to quarries, dam site, etc.	38.0
Total	120.00

About 40 ha of private land is to be acquired and the balance, i.e. 80 ha is government or forest land. The Project Affected Families will get adequate compensation as per the National Policy on the Resettlement and Rehabilitation of the Project Affected Families-2003 (NPRR-2003). The details are given in Chapter-5 of this Report.

4.5 IMPACTS ON TERRESTRIAL ECOLOGY

Various impacts to be covered are listed as below:

- Impacts due to increased human interferences
- Acquisition of forest land
- Impacts on plants of ethno-botanical or medical importance
- Disturbance to wildlife
- Impacts due to increased accessibility

4.5.1 Impacts due to increased human interferences

The direct impact of construction activity of any water resource project in a Himalayan terrain is generally limited in the vicinity of the construction sites only. As mentioned earlier, technical staff, workers and other group of people are likely to congregate in the area during the project construction phase. It can be assumed that the technical staff will be of higher economic status and will live in a more urbanized habitat, and will not use wood as fuel, if adequate alternate sources of fuel are provided. However, workers and other population groups residing in the area may use fuel wood, if no alternate fuel is provided for whom alternate fuel could be provided.

About 2000 workers and 600 technical, i.e. 2600 is likely to congregate during construction phase. The increase in population is expected to be about 8200. the labour population is expected to use fuel wood, if adequate facilities to supply fuel are not provided. The details of fuel wood and tree requirements are given in Table-4.10.

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TABLE-4.10**Details of labour force and fuel wood requirement during construction phase**

Year	No. of labour	Total Population	Fuelwood requirement (m³/yr)	No. of trees to be cut every year
I	1000	3000	1370	550
II	1500	4500	2050	820
III	2000	6000	2740	1100
IV	2000	6000	2740	1100
V	2000	6000	2740	1100
Total			11,640	4670

To minimize the adverse impact, i.e. cutting of trees to meet fuel wood requirements, community kitchens have been recommended. These community kitchens shall use LPG or diesel as fuel. The details have been covered in Environmental Management Plan outlined in Chapter-6 of this Report.

The other major impact on the flora in and around the project area would be due to increased level of human interferences. The workers may also cut trees to meet their requirements for construction of houses and other needs. Thus, if proper measures are not undertaken, adverse impacts on terrestrial flora is anticipated. Since, labour camps are proposed to be constructed by the contractor alongwith necessary facilities, such impacts is not envisaged.

4.5.2 Acquisition of forest land

During project construction phase, land will be required for location of construction equipment, storage of construction material, muck disposal, widening of existing roads and construction of new project roads. A part of the land to be acquired is designated as forest land. The forests in and around the project area are quite

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degraded and tree density is not very high. As a part of field studies, the information on wood volume and tree density at various sampling sites was also estimated. The details are given in Tables-4.11.

TABLE-4.11

Wood loss (m³ha⁻¹) due to the Vishnugad- Pipalkoti hydroelectric project area

Site	Tree species	Wood loss (volume) m ³ . ha ⁻¹
S₁	Dam site/Submergence area	
	<i>Alnus nepalensis</i> (D. Don.)	39.54
	<i>Bauhinia variegata</i>	39.03
	<i>Celtis australis</i> (L.)	104.94
	<i>Lannea coromandelica</i> (Houttuyn)	61.55
	<i>Mallotus philippensis</i> (Lam.)	62.24
	<i>Phoenix humilis</i> (Royle)	7.11
	<i>Pinus roxburghii</i> (Sargent)	276.71
	<i>Sapium insigne</i> (Royle)	14.07
	<i>Toona ciliata</i> (Roemer)	186.25
	<i>Toona serrata</i> (Royle)	133.33
		Total
S₃	Power House site	
	<i>Aegle marmelos</i> (L.)	33.34
	<i>Alnus nepalensis</i> (D. Don.)	32.45
	<i>Celtis australis</i> (L.)	110.58
	<i>Ficus religiosa</i> (L.)	477.23
	<i>Lannea coromandelica</i>	44.71
	<i>Mallotus philippensis</i> (Lam.)	51.49
	<i>Pinus roxburghii</i> (Sargent)	276.49
	<i>Sapium insigne</i> (Royle)	9.89
	<i>Toona ciliata</i> (Roemer)	216.52
	<i>Toona serrata</i> (Royle)	137.71
		Total

NB: There is no wood loss at the sampling site S₂

As outlined in Table-4.11, the wood volume at various sampling sites ranges from 925 to 1390 m³/ha. The tree density at various sampling stations ranges from 570 to 640 per ha. Normally in a dense forest, about 1100 to 1200 trees per ha are

observed. Thus, forest in the area have moderate tree cover. No rare or endangered species are observed in the forest area to be acquired for the project.

4.5.3 Disturbance to wildlife

During construction phase, large number of machinery and construction labour will have to be mobilized. The operation of various construction equipment, and blasting is likely to generate noise. These activities can lead to some disturbance to wildlife population. Likewise, siting of construction equipment, godowns, stores, labour camps, etc. can lead to adverse impacts on fauna in the area. The forests in the area are under tremendous pressure due to increased interferences for this village. The dam and reservoir area is located mainly within the gorge portion, and no major wildlife is generally reported in the project area, hence no adverse impact on terrestrial fauna is anticipated.

Based on field observations and interactions with locals, etc. it can be concluded that no major fauna is observed in the project area. Hence, the impacts on terrestrial fauna are not expected to be significant. Likewise, area does not appear to be on the migratory routes of animals and therefore, the construction of the project will not affect migration of animals as well.

Stray animals, however, may some times drift to the construction site. It should be ensured through stringent anti-poaching surveillance that the stray animals are not killed. Detailed measures for the same have been suggested in Chapter-6, which outlines the Environmental Management Plan (EMP).

4.5.4 Impacts due to increased accessibility

During the project operation phase, the accessibility to the area will improve due to construction of roads, which in turn may increase human interferences leading to marginal adverse impacts on the terrestrial ecosystem. The increased accessibility to the area can lead to increased human interferences. Since significant wildlife population is not found in the project area, adverse impacts of such interferences are likely to be marginal. The mitigation measures to improve the terrestrial Ecology of the area is given in Chapter-6 of this Report.

4.6 IMPACTS ON AQUATIC ECOLOGY

a) Construction phase

The construction of the proposed Vishnugad-Pipalkoti hydroelectric would involve large scale extraction of different types of construction material from the river bed including boulders, stones, gravel, sand, etc. Extraction of gravel and sand causes considerable damage to fish stocks and other aquatic life by destabilizing the substratum, increasing the turbidity of water, silting of the channel bottom and modifying the flow which in turn may result in erosion of the river channel. These alterations upset the composition and balance of aquatic organisms. The material at the river sub-stratum like stones and pebbles often provide anchorage and home to the invertebrates who remain attached in a fast flowing stream. During fish spawning season, the fertilized eggs are laid amidst the gravel, where it is made sure, that eggs are not washed away in fast flowing stream. The eggs of almost all species are sticky in nature, which provide additional safety. The turbidity in excess of 100 ppm

brought by suspended solids chokes the gills of young fish. Fine solids in concentration greater than 25 mg/l, adversely affects the development of fish eggs and fish. During construction of a river valley project, huge quantity of debris is generated at various construction sites. The debris, if a separate area for dumping of the material is not marked, invariably would flow down the river during heavy precipitation. Such a condition can adversely affect the development of aquatic life. The inadequate system for dumping of debris can lead to many undesirable impacts. Hence, it is very much desirable that a suitable area is earmarked for the disposal of muck generation during the construction phase.

Impacts due to discharge of sewage from labour camp/colony

The proposed hydro-power project would envisage temporary and permanent residential areas to accommodate labour and staff engaged in the project. This would result in emergence of domestic waste water which is usually discharged into the river. Due to perennial nature of river Alaknanda, it maintains sufficient flow through out the year. The available flow is sufficient to dilute the sewage and as mentioned earlier, no adverse impacts on water quality are anticipated.

b) Operation phase

The completion of Vishnugad-Pipalkoti hydroelectric Project would bring about significant changes in the riverine ecology, as the river transforms from a fast-flowing water system to a quiescent lacustrine environment. Such an alteration of the habitat would bring changes in physical, chemical and biotic life. Amongst the biotic communities, certain species can survive the transitional phase and can adapt to the

changed riverain habitat. There are other species amongst the biotic communities, which, however, for varied reasons related to feeding and reproductive characteristics cannot acclimatize to the changed environment, and may disappear in the early years of impoundment of water. The micro-biotic organisms especially diatoms, blue-green and green algae before the operation of project, have their habitats beneath boulders, stones, fallen logs along the river, where depth is such that light penetration can take place. But with the damming of river, these organisms may perish as a result of increase in depth.

Amongst the aquatic animals, it is the fish life, which would be, most affected. The migratory fish species, e.g. trouts are likely to be adversely affected due to obstruction created by the proposed dam.

With the completion of dam, flow in the downstream stretch of the river would be reduced considerably more so during the lean period upto a stretch of 4 km downstream of dam site (upto confluence of river Maina). The most important changes, which can be expected, are:

- reduced flow rate
- reduction in availability of stano-thermal aquatic animals
- increase in population of euro-thermal species.

Unless the desired flow is maintained downstream of the dam, aquatic ecology in general and fisheries in particular would be affected. The mitigation measures for minimizing these impacts have been described in Chapter-6.

Impacts on migratory fish species

The obstruction created by the dam would hinder the migration of certain migratory species especially *Schizothorax* sp. This fish species undertakes annual migration for feeding and breeding. Finding their migratory path obstructed due to the dam, they are expected to congregate below the dam wall and will be indiscriminately caught by the poachers. This can lead to adverse impact on the migratory fish species. As a part of Environmental Management Plan, appropriate measures for amelioration of adverse impacts have been recommended.



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