EXECUTIVE SUMMARY

1. GENERAL

Dibang Multipurpose Project (3000 MW) is being conceived on River Dibang which originates from snow covered southern flank of the Himalayas close to Tibet border at an altitude of more than 5000 m. The river emerges from the hills and enters sloping plain area near Nizamghat (Emewu) in Arunachal Pradesh, from where river flows for a distance of 50 km to meet river Lohit. The total catchment area of Dibang up to the dam site is 11276 sq km which lies entirely in India.

MOEF has accorded clearance for pre-construction activities for Dibang Multipurpose Project as per the provisions of Environmental Impact Assessment (EIA) Notification, 2006 and approved the TOR for EIA. Some of the additional provisions stipulated in the approved TOR were required to be studied. Accordingly, an additional study was undertaken with respect to downstream impacts, Environmental Flow for sustenance of aquatic environment and for downstream uses, impact of flood moderation in the downstream etc. and the present report covers these aspects.

2. PROJECT DESCRIPTION

Dibang Multipurpose project is proposed across river Dibang, a major tributary of river Brahmaputra, near Munli village in Lower Dibang Valley district of Arunachal Pradesh. The entire project area is located in a highly mountainous and difficult terrain. The project envisages construction of a 288 m high concrete gravity dam across Dibang river. At Full Reservoir Level (EL 545 m) the reservoir storage is 3748.2 Mcum and reservoir surface area is 40.09 sq.km. The length of reservoir at FRL is 43 km. The layout plan of the project is presented as Figure 1.

3. WATER RESOURCES

The water availability series available in “Feasibility Report of Dibang Multipurpose Project CWC (2003)” has been modified and updated by CWC and Brahmaputra Board up to April 2003 and available in report of “Power Potential studies of Dibang Multipurpose Project and Cost Benefit Analysis for Optimisation of Project Parameters, Brahmaputra Board (Jan-2005)”. The Design Flood (PMF) worked out to be 26223 cumec.

4. WATER QUALITY

Water quality monitoring studies have been undertaken for various physico-chemical and bacteriological parameters at various locations. The pH level in the study area of Dibang Multipurpose project ranged from 7.5 to 7.6 at various samples sites covered as a part of the study. TDS level ranged from 82 to 92 mg/l which is well below the permissible limit of 500 mg/l specified for drinking water. The hardness level ranged from 32 to 37 mg/l indicating soft nature. The hardness level was well below the permissible limit of 200 mg/l specified for drinking water. The chlorides level ranged from 9 to 14 mg/l, which are well below the permissible limit of 200 mg/l, specified for meeting drinking water requirements. The sulphates level at various sampling stations ranged from 7 to 10 mg/l in various samples monitored as a part of the study. The sulphates were found to be well below the permissible limit of 200 mg/l specified for drinking water purposes. The concentration of various cations, e.g. sodium, potassium, calcium and magnesium was observed to be quite low which is also reflected by the low TDS level. Iron was found to be well below the permissible limit of 1 mg/l specified for drinking water purposes. The concentration of various heavy metals was found to be well below the permissible limits. Concentration of phenolic compounds and oil & grease as expected in a region with no major sources of water pollution from domestic or industrial sources was observed to be quite low.

The BOD values are well within the permissible limits, which indicates the absence of organic pollution loading. This is mainly due to the low population density and absence of industries in the area. The low COD values also indicate the absence of chemical pollution loading in the area. The marginal quantity of pollution load which enters river Dibang, gets diluted. The DO level ranged from 9.4 to 9.6 mg/l at various

sampling locations monitored as a part of the study. The DO levels were close to saturation limits in water, indicating the excellent quality of water in the study area. The Total Coliform level was nil at all the sampling sites, indicating the fact that pollution loading is well within the carrying capacity of river Dibang.

5. AQUATIC ECOLOGY

Aquatic ecology monitoring has been studied at various locations in the study area.

5.1 Periphytons and Phytoplanktons

Periphytons were represented by 24 members of the family of Bacillariophyceae, Chlorophyceae and Myxophyceae. The dominant taxa of periphyton were *Tabellaria fenestrata*, *Meridion circulare, Diatoma vulgaris*, *Synedra ulna*, *Cyclotella* and *Cymbella cistula*. However, only 16 members of phytoplanktons were represented by the family of Bacillariophyceae, Chlorophyceae and Myxophyceae. The dominant taxa of phytoplankton were *Tabellaria fenestrata*, *Cymbella cistula* and *Navicula radiosa*.

5.2 Zooplanktons

Zooplankton population in the torrential water current of the Dibang River was very low. Zooplanktons were represented by the taxa of Cladocera (01 Genus), Rotifera (03 Genera) and Copepoda (01 Genera). The important taxa of zooplankton were *Daphnia* (Cladocera), *Trichocera*, *Keratella* and *Asplanchana* (Rotifera) and *Cyclops* (Copepoda). Density of zooplankton was present in the range of 10 –32 ind. l^{-1}.

5.3 Macrozoobenthos

Macrozoobenthos of Dibang River were represented by the members of Ephemeroptera (09 Genera), Trichoptera (04 Genera), Plecoptera (01 Genus) and Diptera (02 Genera). The contribution of Ephemeroptera was maximum to the total macrozoobenthos. The dominant taxa of Ephemeroptera were *Caenis*, *Baetis muticus*, *Baetis niger, Centroptilum* and *Heptagenia*. However, the dominant taxa of Trichoptera were *Leptocerus*, *Brachycentrus* and *Hydropsychae*. It shows the good

water quality in the project area. The density of macrozoobenthos was present in the range of 904 – 1,120 ind. m^{-2}.

5.4 Primary Productivity

The gross primary productivity (P_g) was found in the range from 0.502 to 0.572 g C m^{-3} hr^{-1}. The net primary productivity (P_n) of the Dibang River was estimated to be in the range from 0.025 to 0.075 g C m^{-3} hr^{-1}. The monthly gross primary productivity (P_g) ranged from 180.736 to 206.073 g C m^{-3} $month^{-1}$. However, the net primary productivity (P_n) was recorded in range from 9.121 to 27.026 g C m^{-3} $month^{-1}$.

5.5 Fish

The catchment area of under the Dibang river of the Dibang Multipurpose Project covers the low altitude zone (<800 m above msl) of the river. Coldwater fish species are present close to the dam site. However, most of the warm water fish genera are present in the lower stretch of the river. A total of 27 species belonging to 9 families and 21 genera have been reported from the Dibang River of Dibang Multipurpose Project area. Ecological status assigned by the National Bureau of Fish Genetic Resources (NBGFR), ICAR, Lucknow to these fish species has been given. On the basis of NBFGR status, three fish species (*Semiplotus semiplotus, Tor putitora* and *Bagarius bagarius*) have been categorized as vulnerable (VU). However, seven species (*Crossocheilus latius latius, Schizothorax richardsonii, Chagunius chagunio, Tor tor, Olyra longicaudata, Mastacembelus armatus* and *Xenentodon cancila*) have been categorized as indeterminate (ID). Therefore, all the three vulnerable species i.e *Semiplotus semiplotus, Tor putitora* and *Bagarius bagarius* require conservation. The migratory fish species (*Schizothorax richardsonii*, *Tor putitora, Tor tor*, *Chagunius chagunio*, *Crossocheilus latius latius*, *Garra annandalei* and *Garra gotyla gotyla*) will also be affected due to the construction of dam and as such these species need conservation.

6. PREDCITION OF IMPACTS

6.1 Impacts on River Length with Normal Flow

The key impact on hydrologic regime due to construction of the proposed Dibang Multipurpose project is on account of change in the free flowing condition of the river. With the construction of the proposed project, a reservoir will be formed. The river

which in the present stage (pre-project scenario) is flowing freely over a stretch of 43 km, will get converted into a reservoir. The conversion of free flowing river into reservoirs will have certain positive and negative impacts on riverine ecology. However, in the catchment area of the proposed Dibang Multipurpose project, pollution loading is virtually negligible, on account of low population density, low cropping intensity with minimal use of agro-chemicals and absence of industrialization in the area. Thus, the pollution loading is low, and as a result no major impact on reservoir water quality is anticipated.

6.2 Impacts on Flood Moderation

In Dibang valley rainfall is concentrated during the monsoon months starting from May to October. Discharge in the river is comparatively higher and number of flood waves pass through the river during this period particularly in the months of June, July and August. Respective floods is very common in this river and for effective flood moderation in the valley as well as for reducing the flood contribution in the main stem of the Brahmaputra, flood storage in the proposed Dibang reservoir has been provided that it can absorb flood waves in quick succession.

The construction of the dam would lead to absorption of peak flood due to strorage in the dam. The peak flow of 12756.6 cumec and 9575.4 cumec will get attenuated due to storage in the dam. The peak flows will get attenuated to 3000 cumec. As a result, there will be reduction in water levels and areas affected by the attenuated flood.

6.3 Impacts on Aquatic Ecology due to Modification of Flow Regime

The free flowing water regime will be completely disturbed over a stretch of about 43 km, upstream of the dam site. The dams will store water to enable peaking power generation. As a result, barring for a period from June to August, river Dibang will have dry periods from few hours to up to few days for generation of peaking power. This storage period will result in drying up of the river, downstream of the dam site. The dry period will be followed by a wet or flow period with uniform flow corresponding to the number of units/turbines generating hydropower. Thus, the riverine ecology will be affected on account of modification in hydrologic regime. This

change can have significant impact on the riverine fisheries affecting physiological readiness to migrate, mature and spawn.

6.5 Impacts on Fish Migration

The building of a dam generally has a major impact on fish populations: migrations and other fish movements can be stopped or delayed, the quality, quantity and accessibility of their habitat, which plays an important role in population sustainability. One of the major effects of the construction of a dam on fish populations is the decline of migratory fish species. The dam prevents migration between feeding and breeding zones. The commissioning of the proposed hydroelectric project would seriously impede the migratory route of fisheries.

For the conservation and development of migratory fish population in river Dibang, Fish Management Plan has already been proposed in the EMP report of Dibang Multipurpose Project.

6.6 Impacts on Downstream Water Users

The proposed project is located in an area with low population density. The population density of the catchment area has been considered as 30 persons/sq. km. As per the EIA/EMP report, the CAT plan has been prepared for an area of 59811.88 ha or 600 km^2. Thus, the maximum population in the catchment area is of the order of 18000. Considering per capita water requirements as 70 lpcd, the total water requirement works out to 1260m^3/day or 0.0146 cumec. The major source of water for meeting irrigation and drinking requirements in the project area are rivers or nallahs which flow adjacent to the habitations. The water is conveyed to the point of consumption. Thus, no water is abstracted form river Dibang.

6.7 Impacts on Wildlife

The Dibru-Saikhowa National Park is located about 63 km downstream of the dam site. The elevation of the left and right banks are 130.00 m and 114.20 m respectively. The water level is at a depth of about 10 m and 1.5 m from the river on left and right banks respectively. The reduction in discharge in lean season shall

affect the water requirements of wildlife. Hence, it is recommended to release the Environmental flows for sustenance of riverine ecology at downstream.

Further, Dibru-Saikhowa National Park is subjected to three to four waves of flood every year. These recurring floods often change the course of Lohit and Brahmaputra rivers itself, causing both soil erosion and siltation, and playing a significant role in modifying the habitat of the Park. Deposits of silt carried down by the rivers from upstream mountainous area are shrinking the existing wetlands considerable besides changing the course of rivers, streams and nallahs with concomitant changes in the landscapes. Heavy siltation adversely affects the natural regeneration of local plant species. The waves of flood during the breeding season have a detrimental effect on the amphibian species inhabiting the park. The Indian Skipping Frog and Bhamo Frog are the two most dominant species due to their ability to survive high flood conditions. In addition, heavy siltation leads to desiccation of the soil environment, reducing its water retention capacity and supporting only scarce vegetation, which is unfavourable for the amphibians. In these respects, flood moderation due to Dibang Multipurpose Project will be beneficial for flora and fauna.

7. ENVIRONMENTAL FLOWS

Environmental Flows (EF) are the flows of water in rivers that are necessary to maintain aquatic ecosystems. In other words, a flow regime in the river, capable of sustaining a complex set of aquatic habitats and ecosystem processes are referred to as environmental flow.

7.1 Release of Minimum Flow

Regarding estimation of environmental flow downstream of dam, there is no methodology developed for Himalayan rivers which are subjected to various climatic, meteorological and geologic conditions. However, in this report the environmental flow for Dibang Multipurpose Project has been estimated using building block method. The proposed Minimum Flow on the basis of average flow during 17 years data for the proposed Dibang Multipurpose project is given in **Table 1.**

TABLE 1

Environmental Flows required as per Building Block Methodology

Month	EF considering average flows for a period of 17 years (cumec)	EF considering 90% dependable year (cumec)
May	314	467
June	535	183
July	480	36
August	427	147
September	277	242
October	154	95
November	58	49
December	52	55
January	57	60
February	66	77
March	68	125
April	148	170

The hydrograph, which has been formulated using Building Block Method, simulates the natural conditions in the river to fulfill the different flow regimes present through out the year. The identification and incorporation of these important flow characteristics will help to maintain the river's channel structure, diversity of the physical biotopes.

The release of minimum flows on the basis of average flow during 17 years data has been estimated. In addition, there will be contribution from Ashu Pani stream which confluences with river Dibang about 1.5 km downstream of the dam site. Thus, till the confluence of Ashu Pani with Dibang, the flow will be equal to the minimum releases from the dam, after which there will be contribution from Ashu Pani as well. The proposed Minimum Flow and contribution from Ashu Pani is given in **Table 2**.

TABLE 2
Contribution of Environmental flows and Ashu Pani discharge

Month	EF considering average flows for a period of 17 years (cumec) (flow upto 1.5 km downstream of the dam)	Contribution from Ashu Pani Nallah (cumec)	Total flow (cumec) (flow 1.5 km downstream of the dam)
May	314	6.6	320.6

June	535	11.8	546.8
July	480	10	490
August	427	9.4	436.4
September	277	5.7	282.7
October	154	4.5	159.5
November	58	2.3	60.3
December	52	2	54
January	57	2.2	59.2
February	66	2.7	68.7
March	68	2.7	70.7
April	148	4.4	152.4

The minimum depth required for fish sustenance of fish species observed in the study area is 0.5 to 0.7 m. The depth available for minimum flows recommended is above or equal to this range.

Based on the findings of the energy optimisation vs. firm power optimization study, it is proposed to operate at least one turbine during lean season. This will lead to loss of (12102.38 - 11330.87) 771.52 million units of energy. The loss in terms of average Annual Peaking Capability shall be (2881.35 – 2695.09) = 186.26 MW The comparison of required Environmental Flows with respect to flows being released is given in **Table 3**.

TABLE 3

Comparison of required Environmental Flows vis-à-vis proposed release of water

Month		**EF considering average flows for a period of 17 years (downstream of project) in cumecs**	**Releases through machines based on optimization studies in cumecs**
June	I	535	1308.30
	II	535	1335.83
	III	535	1353.66
July	I	480	1273.15
	II	480	1157.41
	III	480	841.75
August	I	427	615.87
	II	427	798.61
	III	427	631.31
September	I	277	481.03
	II	277	469.46
	III	277	469.46
October	I	154	520.83

Month		EF considering average flows for a period of 17 years (downstream of project) in cumecs	Releases through machines based on optimization studies in cumecs
	II	154	706.02
	III	154	736.53
November	I	58	462.96
	II	58	324.68
	III	58	324.68
December	I	52	183.03
	II	52	183.04
	III	52	191.25
January	I	57	210.81
	II	57	210.80
	III	57	189.39
February	I	66	208.33
	II	66	211.97
	III	66	370.41
March	I	68	578.70
	II	68	578.70
	III	68	547.14
April	I	148	824.07
	II	148	848.38
	III	148	1084.49
May	I	314	1359.55
	II	314	1360.36
	III	314	1163.52

It can be observed that on account of loss in hydropower the project shall maintain discharge higher than the required Environmental Flow during lean season. In the intervening stretch from dam site to dam toe power house, a minimum flow of 15 cumec will be maintained throughout the year.