EXECUTIVE SUMMARY

1. INTRODUCTION

1. 1 GENERAL

Power development is one of the key infrastructural elements for the economic growth of the country. National Thermal Power Corporation Ltd. was set up in November, 1975 with the objective of planning, promoting and organizing integrated development of thermal power in the country. Since, then, NTPC has been a key player in the power sector of the country and has emerged as a major power company of international standard and repute.

Considering the track record of the company, Govt. of India, subsequently allowed NTPC to venture into hydro power development and other non-conventional energy sources. Presently, the total installed capacity of NTPC stands at 26,404 MW, which includes 14 coal and 7 gas/naphtha based power stations. Apart from above, NTPC is presently implementing number of Greenfield and expansion projects in thermal and hydro areas. The major hydro electric projects under execution are Koldam (800 MW) in Himachal Pradesh, Loharinag Pala (600 MW) and Tapovan Vishnugad (520 MW) in Uttarakhand.

In December 2002, with the intent of harnessing hydropower potential from small and medium sized hydroelectric schemes, NTPC Hydro Ltd., a wholly owned subsidiary of NTPC was formed. Accordingly, two projects, namely Lata-Tapovan H.E. Project (171 MW) in Uttarakhand and Rammam Stage-III H.E. Project (120 MW) in West Bengal are being developed by NHL.

1. 2 PROJECT BACKGROUND

NTPC Hydro Ltd. (NHL) is planning to set up Rammam Stage-III Hydro Electric Project of 120 MW capacity in Darjeeling district of West Bengal and West Sikkim district of Sikkim. Techno Economic Clearance (TEC) for the project has been obtained from Central Electricity Authority (CEA)/Govt. of India.

1.3 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The principal Environmental Regulatory Agency in India is the Ministry of Environment and Forests (MOEF), which formulates environmental policies and accords environmental clearance for the projects. The State Pollution Control Board (SPCB) accords No Objection Certificate (NOC) and Consent for Establishment and Operation for the projects.

NHL has already received Stage-I and Stage-II site clearances from Ministry of Environment and Forests (MoEF) on 6.10.2005 for undertaking survey, investigations and collection of environmental data. Necessary statutory consents and clearances for the proposed project will be obtained from State Pollution Control Boards of West Bengal, Sikkim and MoEF.

1.4 LOCATION AND DESCRIPTION OF SITE

The Rammam Stage-III hydroelectric project is envisaged as a run of the river scheme and is located at a distance of about 50 km from Ghoom (Siliguri-Darjeeling road) and 130 kms from Siliguri. The nearest rail head is at New Jalpaiguri and the nearest airport is at Bagdogra. The diversion structure is located just downstream at the confluence of Rammam river with Lodhama Khola near Lodhama village and the power house site is located near village Barbatia on the right bank of river Rammam. The project location map is shown in Figure1.

The study area as shown in Figure-2 comprises of the following:

- Submergence area
- Area within 7 km of periphery of submergence area and other project appurtenances
- Catchment area (catchment area of directly draining streams)

2. PROJECT DETAILS

The proposed Rammam Stage III Project is a run of the river scheme. The installed capacity of the scheme is (3x40) 120 MW. The project comprises of the following components:

a) Barrage/Dam as a diversion structure
b) Intake Tunnel
c) Underground desilting chamber
d) Head Race Tunnel
e) Surge Shaft
f) Pressure Shaft
g) Power house
h) Tail Race Channel

The total land requirement for the project is 72.0 ha. The project layout map is enclosed as Figure-3.

3. ENVIRONMENTAL BASELINE STATUS

As a part of the EIA study, detailed data collection including field studies and secondary data on various aspects were conducted to ascertain the baseline environmental status. Following sections describe the baseline status of the environment.

3.1 WATER ENVIRONMENT

3.1.1 Water resources

The river Rammam is a major tributary of river Rangit, which originates from the Mane Bhanjan-Tongbu-Phalut ridge of the lower Himalayas. The river forms a natural boundary between the states of West Bengal and Sikkim. The main tributaries of river Rammam are Kali Khola, Shiri Khola, Lodhama Khola, Jhepi Khola and Riyang Khola.The river Rammam traverses a total length of 42 kms. The catchment area intercepted upto the project site is 247 km^2. The design floods of various return periods have been estimated as a part of DPR. The peak floods of 100 years, 50 years and 25 years return periods have been estimated as 1824.57 1605.60 and 1440.64 cumecs respectively.

3.1.2 Water Quality

Apart from domestic sources, there are no other sources of pollution observed in the project area. As a part of the field studies, water samples from river Rammam and other tributaries from various locations were collected. The water quality has been monitored for three seasons. The total hardness in various water samples ranged from 8-11.5 mg/l in various seasons. The total hardness level in the water is well below the permissible limit of

200 mg/l. The low EC and TDS values indicate the lower concentration of cations and anions. The concentration of most of the cations and anions are well within the permissible limits. The fluorides level was lower than the permissible limit (1 mg/l) for drinking purposes. Use of water with such fluorides level could lead to dental caries. The low COD and BOD indicates the absence of pollution sources. The concentration of various heavy metals was below the detectable limits, indicating the suitability of water for meeting domestic requirement. The concentration of cyanides and phenolic compounds was also below the detectable limits. The Total Coliform level was well in the permissible limit in the water samples. The oil & grease level were below 1.0 mg/l in all the samples, which is expected in the project area, as there are no sources of pollution which can increase oil & grease.

3.2 METEOROLOGY AND AIR ENVIRONMENT

3.2.1 Meteorology

The project area has three distinct seasons i.e. the winter, summer and monsoon. The winter season lasts from November to February, followed by the summer season which begins in March and continues upto June. Thereafter, the area receives rainfall under the influence of south-west monsoons, which continues upto about beginning of October. The month of October experiences a short transition period or the post-monsoon season.

The month of January is the coolest month with mean daily minimum temperature of 1.8^{o}C. The temperature rises gradually after February and the maximum temperature is observed in the month of August (19.7^{o}C). Based on the rainfall data available at various stations, the average rainfall in the area has been estimated as 2667 mm. The precipitation during the south-west monsoon accounts for about 80% of the annual rainfall. The relative humidity ranges from 86% to 94% in the monsoon months. During rest of the year, the relative humidity is slightly lower (66% to 76%).

3.2.2 Ambient air quality

Ambient air quality in the project area and its surroundings was assessed in winter, summer and post-monsoon seasons. The parameters studied were Respirable Particulate Matter (RPM), Suspended Particulate Matter (SPM), SO_2 and NOx. The frequency of monitoring was twice a week for four consecutive weeks at four stations.

Based on the findings of the ambient air quality survey, conducted for the post-monsoon season, it can be concluded that the ambient air quality is quite good in the area. Values of various parameters, e.g. SPM, RPM, SO_2 and NOx were well within the permissible limits specified for residential, rural and other areas. The absence of pollution sources and low population density in the area are the attributable factors for excellent quality of ambient air in the area.

3.3 Noise Environment

Baseline noise data has been measured using A-weighted sound pressure level meter. The survey was carried out in calm surroundings. Sound Pressure Level (SPL) measurement in the outside environment was made using sound pressure level meter. The monitoring was conducted in winter, summer and post-monsoon seasons. The monitoring was carried out in day time. The day time equivalent noise level at various sampling stations ranged from 35.8 to 38.1 dB(A), which were well within permissible limits specified for residential area.

3.4 LAND ENVIRONMENT

3.4.1 Landuse

The land use pattern of the study area has been studied through digital satellite imagery data. Digital IRC-1C/1D and Panchromatic remote sensing satellite data was procured from National Remote Sensing Agency (NRSA), Hyderabad. The land use pattern of the study area is outlined in Table-1.

TABLE-1

Land use pattern of the study area

Land use Cover	Area (ha)
Dense vegetation	5000 (8.5)
Agriculture land	44295 (75.3)
Mixed Cultivation	9236 (15.7)
Settlement/Rocky outcrop	235 (0.4)
Water bodies	59 (0.1)
Total	**58825 (100.00)**

Note : Figure in brackets indicate percentage.

The major land use categories in the study area are agricultural land and mixed cultivation which account for 91% of the study area. The area under forest is 8.5% of the total study area.

3.4.2 Geology

The rocks exposed at the barrage site on the hill slope are garnetiferous quartz muscovite biotite gneiss with quartz veins and lenses.

The desilting chamber is proposed underground in the right side hill of river Rammam near Lodhama confluence. The rocks exposed at desilting chamber site are garnetiferrous quartz biotite muscovite gneiss.

The HRT alignment passes through different geological conditions. The alignment passes below Jhepi Khola. The rock type exposed on left bank of Jhepi Khola towards downstream below the ground elevation of 900 m is quartz-biotite gneiss. On the right bank chlorite mica schist with some band of mica schist generally strike N 30^o to 60^o W – S 30^o to 60^o E with dip of 20^o to 60^o towards SSW.

The power house is proposed as deep seated surface type structure near the confluence of Rammam and Ramsu Khola confluence on a rocky lodge comprising chlorite schist intercalated with quartzite or vein quartz, striking along the slope and dipping upstream side at a steep angle.

3.4.3 Seismology

The project area forms a part of the seismic zone-IV (as per seismic zoning map of BIS). As per Bureau of Indian Standard (BIS) recommendation 0.1 g horizontal and 0.05 g vertical acceleration is to be considered for design of structures on consolidated foundations.

3.4.4 Soils

As a part of the field studies, soil samples were collected from various locations in the catchment area. The soils are in neutral range. The EC levels are low. The EC levels indicate that the salt content in the soils is low. The level of various nutrients and organic matter indicates low to moderate soil productivity.

3.4.5 Agriculture

In the study area, agriculture is the main occupation in the form of terrace cultivation. The major crops grown are Maize, Paddy, Potato, Cardamom etc. The major sources of water in the project area are rivers and nallahs, which flow adjacent to the habitations. These are used to meet the major water requirements in the project as well as study area. The water is conveyed to the point of consumption, i.e. habitations and agricultural fields, through open channels, which is then utilized for meeting various requirements. Majority of the cropped area is rainfed. The study area in general, depends on rainfall for irrigation. The use of agro-chemicals is negligible and farm yard manure is used on a small scale.

3.5 BIOLOGICAL ENVIRONMENT

3.5.1 Vegetation

The altitude in the study area ranges from 400 to 2000 m. The major forest type observed in the study area including the project area is semi-tropical low-level forests. At higher elevations within the project area, Temperate forests and sub-alpine forests are observed. The dominant tree species reported in the study area is given in Table-2.

TABLE-2
List of plant species reported in the study area

Common Name	Scientific Name
Trees	
Gokul	*Ailanthus grandis*
Siris	*Albizzia procera*
Utis	*Alnus nepalensis*
Lali	*Amoora wallichii*
Kadam	*Anthocephalus kadamba*
Sour	*Betula alnoides*
Kaijal	*Bischofia javanica*
Simul	*Bombax ceiba*
Pipali	*Bucklandia populnea*
Dhupi	*Cryptomeria japonica*
Lampate	*Duabanga sonneratioides*
Gamar	*Gmelina arborea*
Sidha	*Lagerstroemia parviflora*
Malatia	*Machilus edulis*
Chiple Kawla	*Machilus gammieana*
Mahua	*Mahoganis sp.*
Champ	*Michelia champaka*
Banana	*Musa sapiendis*
Chilauni	*Schima wallichii (M)*
Sal	*Shorea robusta (M)*
Odal	*Sterculia villosa*
Bahara	*Terminalia belerica*
Panisaj	*Terminalia myriocarpa*
Pakasaj	*Terminalia tomentosa*
Sautara	*Citrus lemon*
Herbs and Shrubs	
Satmuli	*Asparagus racemosus (M)*
Datura	*Datura fastposa (M)*
Bhang	*Cannabis sativa (M)*
Pipermint	*Mentha piperita (M)*
Tomru	*Zanthoxylum alatum*
Chirata	*Swertia chirata (M)*
Dhai phul	*Woodfordia floribunda*
Bamboo and Grasses	
Hill Bamboo	*Arundinasia racemosa*

Common Name	Scientific Name
Tama	*Dendrocalamus hamiltonii*
Dabdabe	*Garuga pinnata*
Bepari	*Ostodes paniculata*

Note:M - Plants having medicinal value

Singalila National Park is located on the north-west side of project area at a distance of about 5 km from the barrage/dam site. A part of the catchment area lies in the National Park. Singalila National Park extends within an altitudinal range of 2400-3636 m covering an area of 78 sq.km. The park supports a variety of vegetation types.

Ecological Survey

The terrestrial ecological survey has been conducted for three seasons. The survey for winter, summer and post-monsoon seasons were conducted in the months of January 2006, April 2006 and October 2006 respectively. A total number of 63 plant species were recorded during floristic survey at various sampling sites. The number of plant species belonging to different groups as observed during field studies conducted in various seasons is summarised in Table-3. The density of tree species at various sampling sites is given in Table-4.

TABLE-3

Number of various plant species observed at various sampling locations in different season

Sampling location	Winter			Summer			Post-monsoon		
	Trees	Shrubs	Herbs	Trees	Shrubs	Herbs	Trees	Shrubs	Herbs
Adit at Desilting Chamber	10	9	10	10	9	10	10	9	10
Adit at Jhepi	11	10	9	11	10	10	11	10	9
Power house colony	10	5	4	10	5	5	10	5	5
Submergence area	12	11	13	12	11	13	12	11	13
Penstock alignment	12	4	5	12	4	5	12	4	5

TABLE-4

Density of tree species at various sampling locations

Sampling Location	Number	Density (No. of stems/ha)
Adit at Desilting Chamber	10	240
Adit at Jhepi	11	210
Power house colony	10	190
Submergence area	12	290
Penstock alignment	12	200

It can be observed from Tables 3 and 4 that the diversity and density of various floral species at various sampling sites is very low. Major land acquisition is envisaged at barrage/dam site, where tree density is only 250/ha. This indicates the degraded status of vegetation at the barrage/dam site. The tree density near power house site was around 190 trees/ha. In a dense forest, tree density is of the order of 1000-1100 trees per ha. The tree density at barrage/dam and power house site is 290 and 190 trees/ha respectively. This indicates forests in the project area and its surroundings are largely degraded.

3.5.2 Fauna

The project area, does not have good vegetation and as a result significant wildlife population is not observed in and around the project area. The locals stated that wild animals are not common in this area, however, one may have stray sightings of fox, wild boar (*Sus scrofa*) and jackal (*Canis auteus*). The list of major animal species reported in the study area is given in Table -5.

TABLE-5
List of major animal species reported in the study area

S. No.	Zoological Name	English Name	Schedule as per Wildlife Conservation Act
MAMMALS			
1.	*Canis aureus*	Jackal	II
2.	*Felis bengalensis*	Leopard Cat	I
3.	*Felis chaus*	Jungle Cat	II
4.	*Hystrix indica*	Indian Porcupine	IV
5.	*Lepus nigricollis*	Indian Hare	IV
6.	*Macaca mulatto*	Rhesus Monkey	II
7.	*Muntiacus muntjak*	Barking Deer	III
8.	*Panthera pardus*	Leopard	I
9.	*Sus scrofacristatus*	Wild Boar	III
10.	*Vul bengalensis*	Indian Fox	II
BIRDS			
1.	*Acridotheres tristis*	Indian Myana	IV
2.	*Alectoris Chukar*	Chukor Patridge	IV
3.	*Arborophila torqueola*	Hill Patridge	IV
4.	*Bubo bubo bengalensis*	Eagle Owl	IV
5.	*Columbia livia*	Rock Pigeon	IV
6.	*Corvus macrorhynchos*	Jungle Crow	
7.	*Corvus splendens*	House Crow	
8.	*Dendrocopos himalayensis*	Himalayan Woodpecker	IV
REPTILES			
1.	*Agama tuberculata*	Common Lizard	
2.	*Argyrogena ventromaculatus*	Gray's rat snake	II
3.	*Naja naja*	Indian cobra	II
4.	*Varanus bengalensis*	Indian monitor lizard	II

The project site is located close to Singalila National Park. The park is located on the north-west side of the project area, at a distance of about 5 km from the barrage/dam site. The park has major mammalian fauna like the Red Panda (*Ailurus fulgens*), Himalayan Black Bear (*Selenarctos thibetanus*) Leopard cat (*Felis benghalensis*), Clouded Leopard (*Neofeis nebulosa*), Barking Deer (*Muntiacus muntjak*) Serow (*Capricornis sumatraensis*),

Yellow Throated Marten (*Matres flavigula*), Wild Boar (*Sus Scrofa*), Himalayan Mouse Hare (*Ochotona royle*), Wild dog (*Cunon alpinus*), Porcupine (*Hystrix indica*) and fox (*Vulpes vulpes*). Of the above mentioned faunal species, the five species belong to Endangered category. These are Red Panda (*Ailurus* sp.), Leopard Cat (*Felis benghalensis*), Barking deer (*Muntiacus muntjak*), Wild boar (*Sus scrofa*), Fox (*Vulpes vulpes*).

The park is quite rich in avi-fauna and has many interesting galliform species like the Satyrtragopan (*Tragopan satyra*), Kaleej Pheasant (*Lophura Leu – comelana*), Blood Pheasant (*Ithaginis cruentus*) and the red breasted Hill Patridge (*Abrophilla mandelii*). Besides this, birds of all shapes, sizes, colours and hues have their homes in this park.

3.5.3 Aquatic Ecology

The sampling was done during the winter (January 2006), summer (April 2006) and post-monsoon (October 2006) seasons.

A total of 7 phytoplankton species were reported at the various sampling locations. This indicates the poor species diversity of the waters in the area. The density ranged from 8 to 40 No./litre which indicates the poor primary productivity of the area. The lowest density of 8 No/litre was observed near power house site.

A total of 5 zooplankton species were observed at various sampling sites covered as a part of field studies during winter, summer and post-monsoon seasons. The density ranged from 2 to 3 no./litre during winter, 3 to 4 no./litre during summer season. In the post-monsoon season, the density ranged from 3 to 10 no./litre.

3.5.4 Fisheries

10 Fish species were recorded in river Rammam during field survey conducted in various seasons and are listed in Table-6

TABLE-6

Fish species recorded in Rammam river

Scientific Name	Local Name
Schizothorax richardsonii	Asala
Schizothorax progastus	Asala
Semiplotus semiplotus	Chepti
Acrossacheilus hexagonalepis	Katlay
Gara anandolei	Buduna
Glyptothorax stiatus	Kavry
Glyptothorax sp.	Dhodray
Pseudochneis suleatus	Kabray
Barilius barna	Khasray
Naemacheilus sikkimensis	Godela

4. PREDICTION OF IMPACTS

This section outlined impacts on various facets of environment.

4.1 WATER ENVIRONMENT

4.1.1 Water Resources

The river stretch downstream of the barrage/dam site upto the confluence point of tail race discharge will have reduced flow for a length of about 8.8 km. There are a significant number of streams outfalling in the river stretch between barrage/dam and the tail race discharge outfall sites. The river is likely to remain dry up for a distance of 1.8 km upto confluence of Jhepi Khola. In the intervening stretch, the flow shall be maintained by:

- Releases of flushing discharges from desilting chamber
- Contribution of flow from various streams/nallahs in the intervening stretch
- Gates of barrage/dam will remain open leading to continuous flow in the downstream river stretch during monsoon months.

4.1.2 Water quality

a) Construction phase

Effluent from labour colony

The peak migrant population is likely to be of the order of 2600. The quantum of sewage generated due to this population is expected to be of the order of 0.15 mld. The BOD load contributed by domestic sources will be about 117 kg/day. The sewage from construction colonies shall be treated in oxidation ditch before disposal.

Effluent from crushers

The effluent from the crushers would contain high suspended solids. It is proposed to treat the effluents from crushers in settling tanks.

b) Operation phase

Effluent from project colony

During operation phase, only a small number of O&M staff will reside in the colony. The sewage generated would be provided biological treatment before discharge.

4.1.3 Sediments

The proposed project is envisaged as a runoff the river scheme with a barrage/dam. At regular intervals, the gates of the barrage shall be opened to flush the sediments. Thus, in the proposed project, sedimentation problems are not anticipated.

4.2 CLIMATE AND AIR ENVIRONMENT

Ambient Air Quality

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

- Pollution due to fuel combustion in various construction equipment
- Fugitive emission from crusher
- Impact due to vehicular movement.

Pollution due to fuel combustion

The major construction equipment would be operated through electricity. Therefore, fossil fuel combustion would be minimal. Diesel would be used only in contingency. Thus, no

significant impact on ambient air quality is expected as a result of operation of various construction equipment.

Emissions from various crushers

During crushing operations, there would be emissions of dust particles. These emissions would be controlled through cyclone. Further, the labour camps would be located on the leeward side at appropriate location.

Impact due to vehicular Movement

The vehicular movement is likely to lead to entrainment of dust. However such ground level emissions do not travel for long distances. Thus, no major adverse impacts are anticipated on this account.

4.2.1 Impact on noise environment

The operation of construction equipment is likely to have insignificant impact on the ambient noise level.

4.3 IMPACTS ON LAND ENVIRONMENT

4.3.1 Quarrying operations

A project would require about 1.284 lakh m^3 and 0.65 lakh m^3 of coarse and fine aggregates respectively. The coarse aggregate requirement for the project is to be met by excavating boulders from river Lodhama Khola, Munmun Khola and river Rammam. About 20% of the requirement is to be met by utilizing the muck generated during excavation of underground works like HRT and desilting chamber. The boulder and excavated rock will be crushed in various sizes. Thus, in the proposed project, adverse impacts due to quarrying operations are not envisaged.

The fine sand required for the project shall be met by crushing the aggregates. The natural sand of river Rammam is also proposed to be used. The extraction of large quantity of building material like stones, pebbles, gravel and sand can affect the river water quality by increasing the turbidity levels. The impact is not expected to be significant.

4.4 IMPACTS ON ECOLOGY

4.4.1 Terrestrial Ecology

Increased human interferences

A large population (2600) is likely to congregate in the area during the project construction phase. This population residing in the area may use fuel wood (if no alternate fuel is provided). Therefore, alternate fuel should be provided to such population. Further, community kitchens should be provided using LPG or diesel as fuel.

Acquisition of forest land

The total land requirement for the project is 72.0 ha , of which 1.30 ha is the forest land. As a part of the Comprehensive EIA study, detailed Ecological survey was conducted for three seasons. Based on the findings of the survey, it can be concluded that the density and diversity in the project area to be acquired is quite low. The forests in and around the project area are quite degraded. No rare or endangered species are observed. The tree density observed at various sampling sites is given in Table-7.

TABLE-7
Tree density at various sampling sites

Sampling location	Tree density (No/ha)
Submergence area	290
Penstock alignment	200
Power house site and colony area	190
Adit at desilting chamber	240
Adit at Jhepi Khola	210

The tree density at various sampling site ranges from 190 to 290 trees/ha. At submergence area, the tree density is 290 trees/ha, while at other sampling locations, the density ranges from 190 to 240 trees/ha. Normally in a good forest, the tree density is of the order of 1000-1200 per ha. The diversity too is high in such forests. However, in the proposed project area, a maximum of 8 to 10 tree species of trees have been

observed at any sampling sites covered as a part of the Ecological Survey. No rare and endangered floral species are observed. Thus, overall the project area can be categorized as degraded and no major impact due to various activities during project construction and operation phases are envisaged. The loss of forest on account of acquisition of land for various project appurtenances is not expected to be significant and is proposed to be ameliorated by compensatory afforestation and other measures as suggested by the Forest Department.

Disturbance to wildlife

The operation of various construction equipment, and blasting is likely to generate noise. These activities can lead to some disturbance to wildlife population. From the available data, the project area does not have significant wildlife population. Likewise, area does not fall in the migratory routes of animals.

Impacts due to increased accessibility

During 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. Singalila National Park is located within the Catchment area and no land of the National Park is proposed to be acquired for the project. Thus, no impact is expected on these sites. However, during construction phase, there is an increased probability of poaching and other impacts due to aggregation of labour population. Thus, it is necessary to implement adequate surveillance in the area to ameliorate adverse impacts,

4.4.2 Aquatic Ecology

a) Construction phase

Due to construction of the proposed Rammam Stage III Hydroelectric Project, huge quantity of debris is expected to be 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, which would adversely affect the aquatic life. Therefore, a well defined muck disposal plan has been formulated to minimize impacts

on this account.

Operation phase

The completion of Rammam Stage III 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.

Amongst the aquatic animals, it is the fish life which would be most affected. The migratory fish species, e.g. snow trout is likely to be adversely affected due to obstruction created by the proposed barrage/dam. With the completion of barrage/dam, flow in the downstream stretch of the river would be reduced considerably more so during the lean period. Appropriate management measures have been recommended as a part of Environmental Management Plan.

5. SOCIO-ECONOMIC ASPECTS

5.1 STUDY AREA DETAILS

The study area comprises of 37 Revenue villages. The total population of the study area villages as per 2001 census is 188750. The number of females per 1000 males is 977. The average family size in study area villages is 5.02. The General Caste category is the dominant caste category observed in the study area villages. Scheduled Tribes account for about 4.15% of the total population, while the Scheduled Castes, (SC) comprise the 10.29% of the total population. The overall literacy rate in the study area villages is 62.07%.

About 41.1% of the total population in the study area is engaged in some form of vocational activity and is economically productive. Among the working population about 79.2% are categorized as main workers while about 20.8% have been categorized as marginal workers. The major occupation of the population residing in the study area is agriculture.

5.2 SOCIO-ECONOMIC ASPECTS OF PAFS

The total land to be acquired is 72.0 ha of which 57.60 ha is the private land. About 216 families are likely to be affected as a result of acquisition of land for various project appurtenances. The details are given as below:

- No. of families losing only land 162
- No. of families losing both homestead and land 36
- No. of families losing only homestead 18

Total **216**

As a part of the Comprehensive EIA study, a socio-economic survey covering about 211 families was conducted. The filled-in survey schedules were scrutinized for internal discrepancies both in the field as well as in Delhi. Thereafter the schedules were coded and fed into computer for analysis. Based on the results and opinions of the affected population (as captured through the schedules), the socio-economic profile of the PAFs has been reported and the Resettlement and Rehabilitation Plan has been prepared in line with the NTPC R&R Policy.

5.3 IMPACTS ON SOCIO-ECONOMIC ENVIRONMENT

5.3.1 Immigration of labour population

The peak migrant labour population is estimated at about 2600. Job opportunities will improve in this area. At present most of the population sustains by agriculture and allied activities. The project will open a large number of jobs to the local population both during project construction and operation phases.

5.3.2 Increased incidence of water-related diseases

The construction of barrage may convert the riverine ecosystem into a lacustrine ecosystem. The vectors of various diseases breed in shallow areas not very far from the margin of the water spread area. The project would increase the shoreline as compared to

the pre-project shoreline of river Rammam. Thus, there would be increase in the potential breeding sites for various disease vectors.

Normally, mosquitoes, which are the vectors for transmission of malaria are observed upto an elevation of 2000 m above sea level. The proposed project is located at an elevation of below 2000 m. Thus, measures need to be undertaken at these sites to prevent proliferation of mosquitoes. The flight of mosquito is generally limited upto 1 to 2 km from the breeding sites. Thus, it is recommended that borrow area are located at least 2 km from major habitations or labour camps/colonies.

5.4 REHABILITATION AND RESETTLEMENT PLAN

5.4.1 Rehabilitation Plan

In the proposed project following measures have been recommended:

- Compensation @ Rs. 2 million/ha in lieu of land to be acquired for the project
- Rehabilitation grant @ Rs. 75/day for 1000 days for each PAF losing land.
- Subsistence allowance to each PAF losing land @ Rs. 75/day for 250 days,
- Additional benefit to 84 project affected ST families @ Rs. 75/day for 500 days.

The cost required for implementation of Rehabilitation Plan shall be Rs. 136.91 million. The details are given in Table-8.

TABLE-8

Cost estimate for Rehabilitation Plan

S. No.	Measures	Cost (Rs. million)
1.	Compensation for land @ Rs. 2 million/ha for 57.60 ha	115.20
2.	Rehabilitation grant @ Rs. 75/day for 1000 days to 198 families	14.85
3.	Additional entitlements for 84 ST families @ Rs. 75/day for 500 days	3.15
4.	Subsistence grant of Rs. 75/day for 250 days for 198 families	3.71
	Total	**136.91**

5.4.2 Resettlement Plan

Compensation for houses

About 54 families will be losing houses. As per the norms being used in the rehabilitation, a plot of 200 sq.m. has to be provided to each of the displaced family. The total land requirement will be 1.08 ha. About 50% of the land in addition to the land required for construction of houses is to be acquired to provide for the infrastructure facilities. Thus, total land requirement for construction of houses shall be (1.08 + 0.5 *1.08) 1.62 ha say 1.7 ha. The cost of land will be about Rs. 3.4 million @ Rs. 2.0 million/ha.

Construction of houses

For construction of house, each family losing house is entitled for an assistance of Rs. 200,000 for construction of house which amounts to (54 * Rs. 200,000 * 10^{-6}) Rs. 10.80 million.

Shifting Grant

Each family will get Rs. 20,000 for shifting of building material, belongings, cattle, etc. from the affected zone to the resettlement zone. The total expenditure amounts to (54 * 20,000 * 10^{-6}) Rs. 1.08 million.

Resettlement Grant

Each family would be given Rs. 30,000 as Rehabilitation grant. The total expenditure on this account works out to (54 * 30,000 x 10^{-6}) Rs. 1.62 million.

Infrastructure development

It is proposed to resettle the oustees at 1 new resettlement site. The total expenditure on development of infrastructure facilities will be about Rs.4.47 million (Refer Table-9).

TABLE-9
Expenditure for development of infrastructure facilities

S. No.	Facility	Criteria	No.	Unit Cost (Rs.)	Total Cost (Rs. Million)
1.	Water Supply	2 for each resettled village	1	500,000	0.50
2.	Eight seated community toilet	1 per 25 families	3	100,00	0.30
3.	Construction of primary	100 m^2/village	1	300,000	0.30

S. No.	Facility	Criteria	No.	Unit Cost (Rs.)	Total Cost (Rs. Million)
	schools with playground				
4.	Construction of bus shed	1/village	1	30,000	0.03
5.	Construction of temples	1/village	1	200,000	0.20
6.	Approach roads	1/village	1	1000,000	1.00
7.	Sewer networks	1/village	1	200,000	0.02
8.	Dispensary	1/village	1	10,00,000	1.00
9.	Electrification	-	1	Lumpsum	1.00
10.	Construction of Aangawadi building near Schools	1/ village	1	30,000	0.03
11.	Construction of community halls	1/village	1	30,000	0.03
12.	Construction of fairprice shop	1/ village	1	20,000	0.02
13.	Construction of Panchayat Ghar	1/ village	1	20,000	0.02
14.	Construction of village Post Office	1/ village	1	20,000	0.02
	Total				**4.47**

* The operation cost for dispensaries and hospitals will be borne by the state government.

The total cost required for implementation of Rehabilitation Plan shall be Rs. 21.37 milion. The details are give in Table-10.

TABLE- 10

Cost estimate for Resettlement Plan

S.No.	Measures	Cost (Rs. million)
1.	Compensation for houses	3.40
2.	Construction of houses	10.80
3.	Shifting grant	1.08
4.	Resettlement grant	1.62
5.	Infrastructure development	4.47
	Total	**21.37**

5.4.3 Budget

The total cost required for implementation of Resettlement and Rehabilitation plan is Rs. 158.28 million. The details are given in Table-11.

TABLE-11

Cost estimate for implementation of Resettlement and Rehabilitation plan

S.No.	Measures	Cost (Rs. million)
1.	Rehabilitation Plan	136.91
2.	Resettlement Plan	21.37
	Total	**158.28**

6. ENVIRONMENTAL MANAGEMENT PLAN

6.1 Control of pollution from labour camps during construction phase

The aggregation of large labour population and technical staff during construction phase is likely to put significant stress on various facets of environment. The various issues covered in environmental management during construction phases are described in this section.

6.1.1 Facilities in labour camps

It is recommended that project authorities can compulsorily ask the contractor to make semi-permanent structures for their workers. These structures could be tin sheds. These sheds can have internal compartments allotted to each worker family. The sheds will have electricity and ventilation system, water supply and community latrines.

The water for meeting domestic requirements may be collected from the rivers or streams flowing upstream of the labour camps. The water quality in general is good and can be used after chlorination.

6.1.2 Sanitation facilities

One community latrine can be provided per 20 persons. The sewage from the community latrines can be treated in oxidation ditch before disposal.

6.1.3 Solid waste management from labour camps

For solid waste collection, suitable number of masonry storage vats, each of 2 m^3 capacity should be constructed at appropriate locations in various labour camps. These vats should

be emptied at regular intervals and should be disposed at identified landfill sites. Suitable solid waste collection and disposal arrangement shall be provided. A suitable landfill site should be identified and designed to contain municipal waste from various project township, labour colonies, etc.

6.1.4 Provision of free fuel

NHL should make necessary arrangements with their contractors to provide fuel to labour population migrating in the area. Appropriate fuel depot should be established in consultation with State Government.

6.2 ENVIRONMENTAL MANAGEMENT IN ROAD CONSTRUCTION

The approach roads will have to be constructed as a part of the proposed project. Steeply sloping banks are liable to landslides, which can largely be controlled by provision of suitable drainage. Landslides is proposed to be stabilized by several methods i.e. engineering or bio-engineering measures alone or a combination of these. Engineering solutions such as surface drainage, sub-surface drainage, toe protection and rock bolting can be used.

6.3 MANAGEMENT OF MUCK DISPOSAL SITES

In the hilly area, dumping is done after creating terraces; thus usable terraces are developed. The overall idea is to enhance/maintain aesthetic view in the surrounding area of the project in post construction period & avoid contamination of any land or water resource due to muck disposal. Suitable retaining walls shall be constructed to develop terraces so as to support the muck on vertical slope and for optimum space utilization. The muck disposal sites should be reclaimed with vegetation.

6.4 RESTORATION AND LANDSCAPING OF PROJECT SITES

It is proposed to develop small gardens at two locations. Similarly, two viewpoints are also proposed to be constructed.

6.5 GREENBELT DEVELOPMENT

It is proposed to develop greenbelt around the perimeter of various project appurtenances, selected stretches along reservoir periphery, etc. This will be carried out

in consultation with the State Forest Department.

6.6 PUBLIC HEALTH DELIVERY SYSTEM

A population of about 2600 is likely to congregate during the construction phase. The labour population will be concentrated at two or three sites. There is no medical facility in the immediate vicinity of the project area. It is proposed to develop a dispensary as a part of the proposed Rammam Stage-III hydroelectric project.

A first-aid post is to be provided at each of the major construction sites, so that workers are immediately attended to in case of an injury or accident.

This first-aid post will have at least the following facilities :

- First aid box with essential medicines including ORS packets
- First aid appliances-splints and dressing materials
- Stretcher, wheel chair, etc.

The other recommended measures are listed as below :

- The site selected for habitation of workers should not be in the path of natural drainage.
- Adequate drainage system to dispose storm water drainage from the labour colonies should be provided.
- Adequate vaccination and immunization facilities should be provided for workers at various construction sites.
- The labour camps and resettlement sites should be at least 2 to 3 km away from quarry areas.

6.7 COMPENSATORY AFFORESTATION

The total land to be acquired for the project is about 72.0 ha of which 1.30 ha is the forest land. It is proposed to afforest double the amount of forest land being acquired for the project. Thus, a total 2.6 ha of land can be afforested. Compensatory afforestation will be done by State Forest Department as per the stipulations outlined as a part of

forest clearance.

6.8 CONTROL OF AIR POLLUTION

The air pollution is basically generated due to primary crushing and fugitive dust from the heap of crushed material. The various crushers need to be provided with cyclones to control the dust generated while primary crushing the stone aggregates. It should be mandatory for the contractor involved in crushing activities to install cyclone in the crusher.

6.9 CONTROL OF WATER POLLUTION

Construction phase

During construction phase of the proposed project, 2 or 3 crushers are likely to operate at major construction sites. The effluent generated from crushers will have high suspended solids. It is proposed to provide settling tanks for treatment of effluent from various crushers.

During tunneling work, the ground water flows into the tunnel along with construction water which is used for various works like drilling, shotcreting etc. The effluent thus generated in the tunnel contains high suspended solids. It is proposed to construct a settling tank to settle the suspended impurities.

Operation phase

In the project operation phase, about 50 persons are likely to be involved for which a project colony is proposed to be commissioned. The colony will have suitable Sewage Treatment Plant (STP) to treat the sewage generated from the colony

6.10 FISH MANAGEMENT

a) Release of minimum flow

The dry segment of river between barrage/dam site and tail race at certain places may have shallow water subjecting the fish to prey by birds and other animals. Such a condition will also enable the poachers to catch fish indiscriminately. It is therefore, very essential for

the project authorities to maintain the minimum flow of 1 cumec for the survival and propagation of invertebrates and fish. In order to avoid the possible loss of aquatic life, at least minimum flow of water should always be released from the barrage/dam.

b) Sustenance of Endemic Fisheries

Snow trout (*Schicothorax richardsonii*) is the endemic species. The barrage/dam will act as a barrier to the free movement of fish species in the river Rammam. It is proposed to implement supplementary stocking programmes for the project area. It is proposed to stock river Rammam upstream and the downstream sides. On upstream side, stocking will be done upto diversion structure of Rammam-II HEP. On the downstream stocking will be done upto confluence of river Rangit with river Rammam. The rate of stocking is proposed as 100 fingerlings of about 30 mm size per km. The stocking can be done annually by the Fisheries Department, State Government of West Bengal. To achieve this objective, facilities to produce seed of trout need to be developed at suitable sites.

6.11 WILDLIFE CONSERVATION

Sangalila National Park is located about 5 km from the barrage/dam site. Since, no part of the National Park is to be acquired, hence direct impacts on the National Park are not anticipated. It is recommended that check posts be installed near major construction sites and labour camps. It is recommended to develop 3 check posts, which shall be operational during the entire construction phase. Each check post shall have guards. A range officer shall supervise the guards of various check posts. It is also recommended that the staff manning these check posts have adequate communication equipment and other facilities. It is proposed that 3 jeeps and wireless sets at each check post has been suggested. Apart from inter-linking of check posts, the communication wireless link needs to be extended to Divisional Forest Office and the local police station also.

6.12 SEISMICITY CONSIDERATIONS

The entire state of Sikkim comes under seismic zone IV of seismic zoning Map of India, which correspond to zone factors of 0.36 and 0.24 (effective peak ground acceleration in terms of g) of seismic intensities VIII and > IX (MSK-64 scale), respectively. These

factors need to be considered while designing the loads for which various project area appurtenances are to be designed.

6.13 NOISE CONTROL MEASURES

Workers operating in high noise should be provided with effective personal protective measures such as ear muffs or ear plugs to be worn during periods of exposure. The other measures to control noise could be as follows:

- Equipment and machineries should be maintained regularly to keep the noise generation at the design level;
- Silencers and mufflers of the individual machineries to be regularly checked;
- Exposure of workers to high noise areas, should be limited as per maximum exposure periods specified by OSHA.

6.14 ESTABLISHMENT OF ENVIRONMEMNTAL LABORATORY

An independent laboratory with facilities for chemical analysis should be set up at the project site. A separate air conditioned dust-proof room will have to be provided for installing analytical instruments.

6.15 ESTABLISHMENT OF AN ENVIRONMENTAL MANAGEMENT CELL

It is recommended that NHL should establish an Environmental Management Cell at the project site with requisite manpower. The task of the Cell will be to coordinate with regulatory agencies, to carry out environmental monitoring and to evaluate implementation of environmental mitigatory measures. The Environmental Cell will report to the appropriate authority having adequate powers to implement the required measures.

7. CATCHMENT AREA TREATEMNT (CAT) PLAN

Silt Yield Index (SYI) method has been used to prioritize sub-watershed in a catchment area for treatment. The area under very high and high erosion categories is to be treated at the project proponent cost. In the directly draining catchment of the proposed Rammam Stage-III, there is no area under very high erosion category. Hence, CAT plan has been suggested for high erosion category, as a part of the present EIA study, the expenses of which have to be borne by project proponents. The area under high erosion category is 3225 ha, which is about 61.16% of the total directly draining

catchment. The details are given in Table-12. The cost required for treatment of directly draining catchment is Rs.32.08 million.

TABLE-12
Area under various erosion categories

S. No.	Category	Area (ha)
1.	Very Low	-
2.	Low	-
3.	Medium	2048 (38.84)
4.	High	3225 (61.16)
5.	Very High	-
	Total	**5273 (100%)**

Note: Figure in brackets indicate percentage

8. SUMMARY OF ENVIRONMENTAL MONITORING PROGRAMME

An Environmental Monitoring Programme should be undertaken during construction and operation phase of the project. The details of environmental monitoring programme are given in Tables - 13 and 14 respectively.

TABLE-13
Summary of Environmental Monitoring Programme during Project Construction Phase

S. No.	Item	Parameters	Frequency	Location
1.	Effluent from Oxidation ditches	pH, BOD, COD, TSS, TDS	Once every month	Before and after treatment from Oxidation ditch
2.	Water-related diseases	Identification of water related diseases, adequacy of local vector control and curative measure, etc.	Three times a year	Labour camps and colonies
3.	Noise	Equivalent noise level (L_{eq})	Once in three months	At major construction sites.
4.	Ambient Air quality	SPM, RPM, SO_2 and NOx	Three times a year	At major construction

S. No.	Item	Parameters	Frequency	Location
				sites
5.	Meteorological aspects	Wind direction & velocity temperature humidity, rain	Three times a year	At one of the ambient air quality sampling sites

TABLE-14
Summary of Environmental Monitoring Programme during Project Operation Phase

S. No.	Items	Parameters	Frequency	Location
1.	Water	pH, Temperature, EC, Turbidity, Total Dissolved Solids, Calcium, Magnesium, Total Hardness, Chlorides, Sulphates, Nitrates, DO. COD, BOD, Iron, Zinc, Manganese	Three times a year	• 1 km upstream of weir site • Water spread area • 1 and 3 km downstream of Tail Race discharge
2.	Effluent from Sewage Treatment Plant (STP)	pH, BOD, COD, TSS, TDS	Once every week	• Before and after treatment from Sewage Treatment Plant (STP)
3.	Erosion & Siltation	Soil erosion rates, stability of bank embankment, etc.	Twice a year	-
4.	Ecology	Status of afforestation programs of green belt development	Once in a year	-
5.	Water-related diseases	Identification of water-related diseases, sites, adequacy of local vector control measures, etc.	Three times a year	• Villages adjacent to project sites

S. No.	Items	Parameters	Frequency	Location
6.	Aquatic ecology	Phytoplanktons, zooplanktons, benthic life, fish composition	Twice a year	• 1 km upstream of weir site • Water spread area • 1 and 3 km downstream of Tail Race discharge
7.	Landuse	Landuse pattern using satellite data	Once in a year	Catchment area
8.	Soil	pH, EC, texture, organic matter	Once in a year	Catchment area

9. COST FOR IMPLEMENTING ENVIRONMENTAL MANAGEMENT PLAN

The total amount to be spent for implementation of Environmental Management Plan (EMP) is Rs.294.89 million (excluding cost required for cost of trees and NPV of forest land to be acquired). The details are given in Table-15.

TABLE-15
Cost for implementing Environmental Management Plan (EMP)

S. No.	Item	Cost* (Rs. million)
1.	Sanitary facilities in labour camps	4.10
2.	Solid waste management	5.35
3.	Provision for free fuelwood distribution	7.86
4.	Environmental Management in road construction	9.90
5.	Management of muck disposal sites	10.31
6.	Landscaping and restoration of construction sites	2.00
7.	Greenbelt development	1.50
8.	Compensatory afforestation	0.17
9.	Public Health Delivery System	25.00
10.	Construction of settling tanks	2.00
11.	Sustenance of riverine fisheries	6.50
12.	Wildlife Conservation	8.37
13.	Setting up Environmental Laboratory	3.00
14.	Catchment Area Treatment Plan	32.08
15.	Resettlement & Rehabilitation Plan	158.28
16.	Cost of meteorological instrument and noise meter	0.05

S. No.	Item	Cost* (Rs. million)
17.	Environmental Monitoring Programme during construction phase (refer Table-9.2)	7.00
18.	Contingencies	10.00
	Total	**294.89**

Note: * The above cost is exclusive of the cost required for cost of trees and NPV of the forest land to be acquired.

ENVIRONMENTAL MONITORING PROGRAMME

The cost required for implementation of the Environmental Monitoring Programme during project construction phase is of the order of Rs.7.0 million. The details are given in Table 16.

TABLE-16
Cost for implementing Environmental Monitoring Programme during project construction phase

S. No.	Item	Cost (Rs. million)
1.	Effluent quality	0.98
2.	Ambient air quality	1.77
3.	Ecology	3.05
4.	Incidence of water related diseases	0.61
	Total	**6.41 Say Rs. 7.0 million**

The cost required for implementation of the Environmental Monitoring Programme during project operation phase is of the order of Rs.1.2 million/year. A 10% annual price increase may be considered for every year. The details are given in Table-17.

TABLE-17
Cost for implementing Environmental Monitoring Programme during operation phase

S. No.	Item	Cost (Rs. million/year)
1.	Water quality	0.20
2.	Soil quality	0.20
3.	Ecology	0.40
4.	Public health	0.10

S. No.	Item	Cost (Rs. million/year)
5.	Landuse pattern	0.30
	Total	**1.20**