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ASSAM POWER GENERATION CORPORATION LIMITED

CEIA STUDY FOR LOWER KOPILI H.E PROJECT IN KARBI ANGLONG & DIMA HASAO DISTRICTS OF ASSAM

EXECUTIVE SUMMARY



WAPCOS LIMITED

(A Government of India Undertaking)

76 C, Sector 18, Gurgaon - 122015, Haryana, INDIA

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EXECUTIVE SUMMARY REPORT OF CEIA STUDY FOR LOWER KOPLI H.E PROJECT IN KERBI ANGLONG & DIMA HASAO DISTRICT OF ASSAM

1. INTRODUCTION

The proposed Lower Kopili HEP is downstream development of existing Kopili HEP. The project envisages utilization of the regulated discharge from Kopili HEP, spills of Khandong and Umrong Dam and the discharge from the intermediate catchment by creation of a reservoir and utilizing a gross head of about 114 m.

Lower Kopili Hydro Electric Project is a storage scheme on the Kopili River at Longku. The live storage in the reservoir will last for a few days only if the power generation is continued at full installed capacity in the powerhouse. The scheme has been contemplated to run at full potential in monsoon season and operate as a peaking station in non-monsoon season. The installed capacity of project has been kept as 110 MW comprising of 2 units of 55 MW each. An Auxiliary Power House having a capacity of 10 MW (2x2.5 MW+1x5 MW) has also been planned at the toe of the dam for utilizing the mandatory releases for ecological purposes.

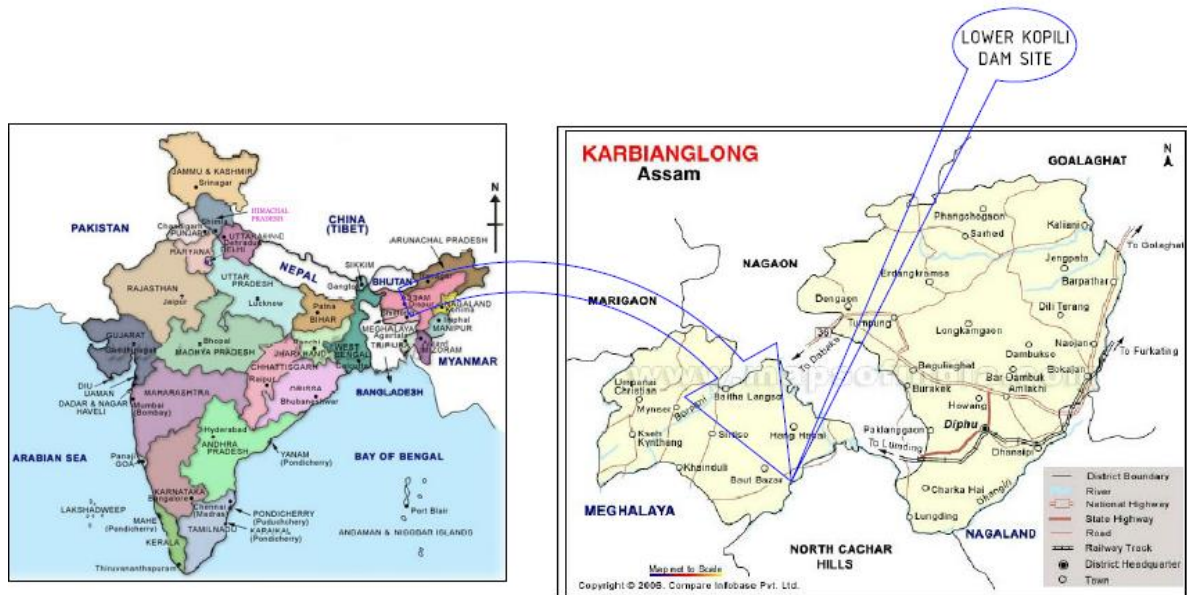


Figure-1: Project Location Map

2. PROJECT PROFILE

The Lower Kopili Hydroelectric project (120 MW) is located in east of Karbi Anglong and west of Dima Hasao districts of Assam. The dam structure is located on Kopili River (a major tributary of the Brahmaputra River) and the powerhouse structure is located on right bank of Kopili River. The project diversion site is located at village Longku. The coordinates of diversion site are 25°39'57.39"N and 92°46'53.62"E. Likewise coordinates of the powerhouse site are 25°41'54.02"N, 92°48'15.98"E.

The Lower Kopili HE Project envisages construction of a 70.13 m high concrete gravity dam across the river Kopili at Longku, about 20 km downstream of Kopili HEP Stage-I Power House. A water conductor system comprising of an Intake Structure, Head Race Tunnel along with Surge Shaft & penstock and a surface power house with installed capacity of 110 MW, for utilizing the inflow from a catchments area of 2076.62 sq. km with a gross head of 122.63 m is proposed. An Auxiliary Power House of installed capacity of 10 MW is also proposed at the dam toe for generation of Power.

The key components of the project are:

- A concrete gravity dam with sluice spillways, 345.15 m long, 70.13 m high across river Kopili at Longku.
- An independent intake structure with trash racks located at 35m upstream of Lower Kopili Dam to carry a discharge of 112.71 m³/sec.
- 6.65 m diameter, 3619.62 m long, Modified Horse shoe section, with one adit 334 m long, 6.0 m diameter. D-shaped at CH. 2216.44 m.
- 25.0 m diameter, 82.9 m total height with restricted orifice of 3.6m diameter provided as a riser shaft of 32.21 m height (one adit is also proposed for approach to bottom of Surge shaft)
- 5.20 m diameter, 703.8 m long upto bifurcation at 75 m upstream of D-line in the Power House. The pressure tunnel is steel lined for its full length.
- 2 nos. penstocks of 3.70 m diameter fully steel lined with lengths varying from 75 to 80 meters from bifurcation point to the Power house.
- Surface power house accommodate 2 units of 55 MW each
- Power House building of size 77.55 m (L) x 21.50 m (W) at the elevation of service bay with a common EOT crane 230 / 40 t capacity over units and service bay.
- 2 Nos. of draft tube gates at EL. 92.00m is proposed.
- 1 No., 26.3 m wide and 52.0 m long rectangular channel with reverse slope of 1 in 5, designed for carrying a discharge of 112.71 m³/sec.
- Surface type power house is proposed to accommodate 2 units of 2.5 MW each and 1 unit of 5 MW total 10 MW. Power House building is located just downstream of dam on the right bank side
- Tail Race channel of the Auxiliary Power House is a open channel

The proposed layout of the project is enclosed as Figure-2.

2.1 Land Requirement

The total land requirement of the project is 1577 ha. The forest land to be acquired for the project is 523 ha. The private land to be acquired for the project is 1054 ha. The details of land requirement for the project are given in Tables-1 and 2 respectively.

Table-1: Component-wise Land Area Required

S. No.	Name of the Components	Area (ha)
1.	Project Component & Infrastructures	355.00
2.	Submergence	552.00
3.	Infrastructures	72.00
4.	R&R	75.00
	Sub-Total	1054.00
5.	Land for other purposes (Recreational facilities, helipad, etc)	523.00
	Total	1577.00

Table-2: Land requirement for Lower Kopili Hydroelectric project

S. No.	Name of the District	Forest Land (ha)	Private Land (ha)	Total (ha)
1.	Dima Hasao	478.00	909.00	1387.00
2.	Karbi Anglong	45.00	145.00	190.00
	Total	523.00	1054.00	1577.00

2.2 Access Roads

Project can be reached from Guhawati through the National Highway (NH-52) road going further to Lanka with a distance of approximately 155 km. From Lanka upto dam site area, NH-52 exists with the distance of about 33 km and from NH-52 vehicular road shall be used

which runs along the project. PWD road Longku-Garampani shall be main access road to the project and from this access roads to the various components of the project will be constructed. It is proposed to construct the access road to the various project components as given in Table-3.

Table-3: Proposed Roads in the Project Area

S. No.	Description	Unit	Quantity
I)	Roads		
1	Lanka Garampani road to dam site & Rehabilitation area, dyke & intake shaft top including existing road diverted	km	5.52
2	Explosive magazine road	km	0.84
3	Lanka Garampani road to powerhouse	km	1.21
4	Approach road to colonies	km	0.37
5	Road to rock Quarry area	km	1.19
6	Road to Dumping area	km	0.61
7	Road to Adit portal	km	1.22
8	Road to Hydro mechanical workshop	km	0.10
9	Road to Electro mechanical workshop	km	0.03
10	Road to Surge Shaft	km	1.85
	Road to proposed bridge		0.16
	Total	km	13.04
II)	Improvement of Lanka Garampani road up to Umrangsu	km	60
III)	Bridges and culverts:		
1	No. of bridges	No.	3
2	No. of culverts	No.	10

2.3 Construction Schedule

It is proposed to construct the project within a period of 4 years including infrastructure development which is proposed to be completed within 9 months. The main works of the project will have to be completed within 3 years 3 months time.

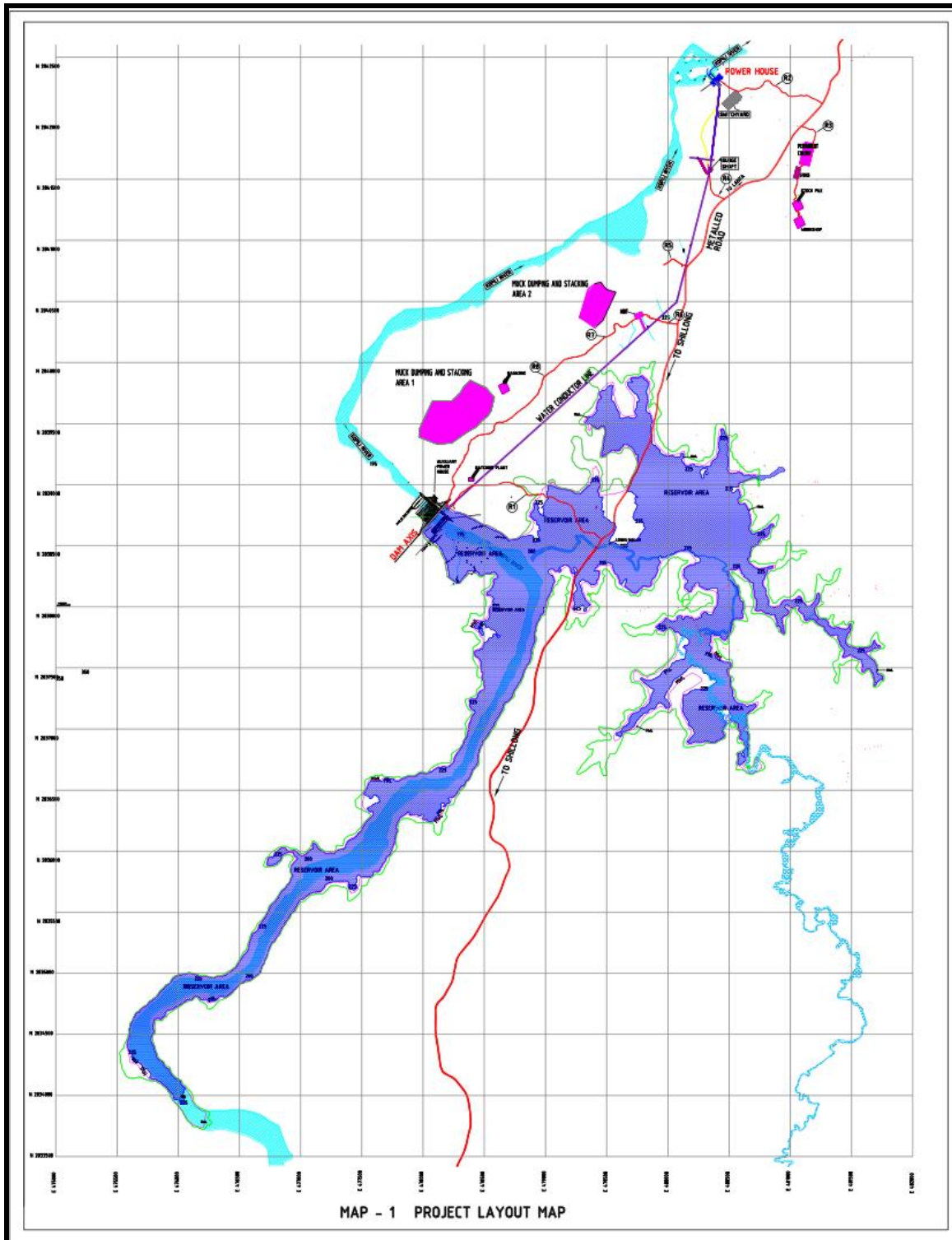


Figure-2: Project Layout Map

3. STUDY AREA

The study area considered for the CEIA study (Refer Figure-3) is given as below:

- Submergence area
- Area within 10 km of the periphery of the submergence area
- Area to be acquired for locating the various project appurtenances
- Area within 10 km of various project appurtenances
- Catchment area intercepted at the dam site extending up to diversion structure of Lower Kopili hydroelectric project

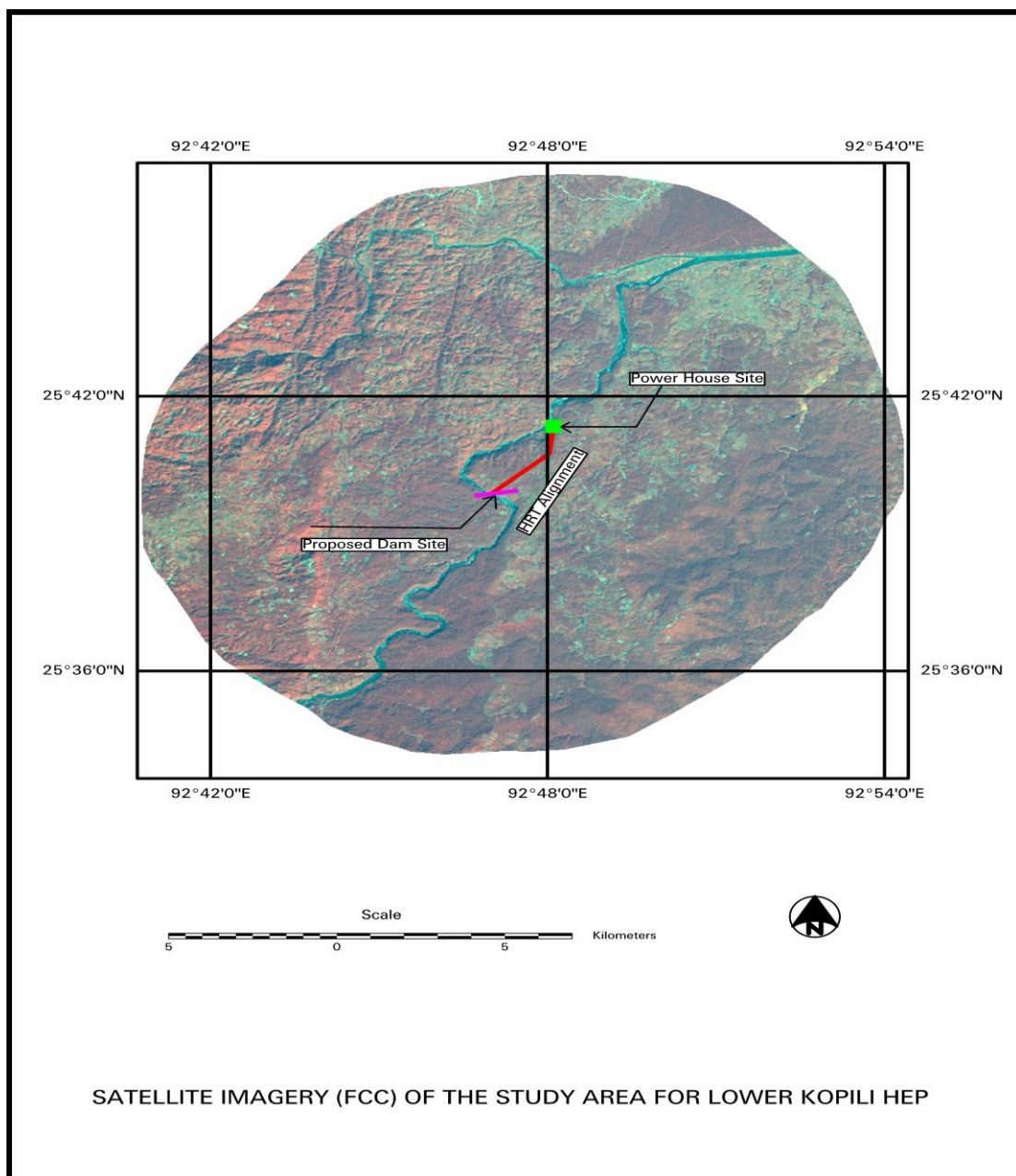


Figure-3: Satellite imagery of the study area for Lower Kopili HEP

4. ENVIRONMENTAL BASELINE STATUS

The baseline status for the above referred categories has been described in the following sections.

The baseline status has been divided into following three categories:

- Physico-chemical aspects
- Ecological aspects
- Socio-Economic aspects.

The baseline setting for physico-chemical aspects have been covered in this Chapter. The field studies have been conducted for 3 seasons as detailed in Table-4.

Table-4: Details of field studies conducted as a part of CEIA studies

Season	Months
Monsoon	August 2014
Winter	December 2014 – January 2015
Summer	April 2015

4.1 Physio-Chemical Aspects

4.1.1 Physiography

The area represents denuded hill topography with low mounds and valleys with a general slope towards north-east. The highest elevation is 356m just beyond the southern limit of the reservoir (near origin of Saini Langso nala). In general, the drainage system is dendritic however the near right angle swing of the SW-NE flowing Kopili river just after its meeting with Lonku nala indicate that at places it is structurally controlled. Trend of major ridges in the area is N-S to NW-SE. At dam site, the bed level of Kopili River is $\pm 170\text{m}$.

Kopili river has perennial drainage in the area, which follows a SE to NW course at dam site with moderate to steep valley slopes (with local slope breaks) towards both abutments. The flatter portions of denudated hills are comprised of weathered rock mass while valley slopes are comprised of slope wash material with intermittent rock exposure.

4.1.2 Soils

The pH of soil at various sites lies within neutral range of 7.0 to 7.24. The levels of NPK indicate moderate to high soil productivity. The sodium levels do not indicate any potential for soil salinization or adverse impacts on soil productivity.

In a hydroelectric project, no significant impact on soil quality is expected barring, soil pollution at local level due to disposal of construction waste. For amelioration of such impacts appropriate management measures are recommended.

4.1.3 Water Quality

The pH level in the project area of Lower Kopili hydroelectric project ranged from 4.2 to 5.4 at various sampling sites covered as a part of the study. The pH level indicate acidic nature of the water, and does not meet within the permissible limit specified for meeting drinking water requirements.

The TDS level in monsoon season ranged from 40 to 47 mg/l. The TDS level ranged from 59 to 66 mg/l in winter season and 61 to 66 mg/l in winter season. The TDS level were well below the permissible limit of 500 mg/l specified for drinking water.

The hardness level indicate soft nature of water. The hardness level was well below the permissible limit of 200 mg/l specified for drinking water. Hardness is caused by divalent metallic cations. The principal hardness causing cations are calcium, magnesium, strontium and ferrous and iron. The low levels of calcium and magnesium are mainly responsible for the soft nature of water.

The chlorides and sulphates level were well below the permissible limit of 200 mg/l, specified for meeting drinking water requirements.

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 DO level ranged from 4.2 to 4.9 mg/l at various sampling locations monitored for three seasons as a part of the study. The water quality of river Kopili is unfit for domestic, irrigation, bathing or industrial use.

4.1.4 pH Values of river Kopili and Tributaries

The test result of water sample collected from Kopili river and its tributaries mainly Kala nala, Longku nala and Langsomipi regarding their pH value are compiled. The study result clearly describes the acidic nature of the Kopili river water. Water samples collected at various locations have been found containing a pH value ranges between 3.3 -4.1. The water is not fit for its use in construction related works.

Four independent sources which are tributaries of Lower Kopili river have been identified in the vicinity of project area as potential source for obtaining construction water utilization for project works. It has also been suggested by CSMRS to verify the chemical analysis of water from some reputed laboratory in light of its implications on the longevity of the structure and the component. Dong Ekpi Nala is not perennial and discharge is very low, hence no further chemical analysis is carried out. The test result of water samples collected from these sources reveal a pH value between 6.7 to 7.4, which is very much in range of acceptable limit (PH ranging between 6.5 to 8.5) for construction water.

4.1.5 Ambient Air Quality

The maximum RPM level observed in survey conducted during the summer season was 27.8 $\mu\text{g}/\text{m}^3$. During field studies, RPM level was observed to be well much below the permissible limit of 60 $\mu\text{g}/\text{m}^3$, specified for industrial, residential, rural and other areas at various stations covered during the survey.

The SO_2 level was observed to be <5.0 $\mu\text{g}/\text{m}^3$ at all the sampling locations. The highest NO_x value observed in summer season was 14.2 $\mu\text{g}/\text{m}^3$. The NO_x level observed at various sampling stations was much lower than the permissible limit of 40 $\mu\text{g}/\text{m}^3$ for industrial, residential, rural and other areas.

Based on the findings of the ambient air quality survey, conducted for the post-monsoon, winter and summer seasons, it can be concluded that the ambient air quality is quite good in the area.

4.1.6 Noise Environment

The day time equivalent noise level in monsoon and winter seasons at various sampling stations ranged from 37.3 to 38.1 dB(A) and 36.9 to 40.0 dB(A). The day time equivalent noise level in summer season ranged from 37.5 to 40.2 dB(A) respectively. The day time equivalent noise level in various seasons were well within the permissible limit specified for residential area.

4.1.7 Land use pattern

The land use pattern of the study area is given in Table-5.

Table-5: Landuse pattern of the study area of Lower Kopili HE Project

S.No	Category	Area(ha)	Area(%)
1	River	7486	1.50
2	Dense Vegetation	334972	67.07
3	Open Vegetation	56048	11.22
4	Agricultural Land	39795	7.97
5	Scrubs	60287	12.07
6	Settlements	814	0.16
	Total	499402	100.00

The major landuse categories in the study area are Dense Vegetation and scrubs, as they account for about 67.07% and 12.07% of the total study area. The area under open vegetation is 11.22% of the study area. Settlements account for about 0.16% of the study area. The area under water bodies and Agricultural Land is 0.18% and 7.97% of the study area.

4.2 Ecological Aspects

4.2.1 Vegetation

As per the State Forest Report, published by the Forest Survey of India, the forest cover of Assam is 27,645 sq km which constitute nearly 35.24% of the geographic area and includes very dense, moderately dense and open forest (FSI, 2005). The forest in the state can be divided into six major forest types which are characterised by Tropical Wet Evergreen, Tropical Semi-Evergreen, Tropical Moist Deciduous, Sub-tropical broad-leaved Hill, Sub-tropical Pine and Littoral swamp Forests. The catchment area of proposed Lower Kopili HEP covers almost all these types of forest. However, in the project area is over a stretch of about around 10 to 15 km along the Kopili river and covers tropical semi-ever-green, moist mixed deciduous and riparian fringing forests. The project area fall in two Forest Divisions i.e. Haflong Forest Division covering Dima Haso district and Diphu Forest Division covers the entire KarbiAnglong in Karbi Anglong.

The vegetation in these forests particularly lower valleys of project area comprises Assam Valley Tropical semi-evergreen forest, East Himalayan moist mixed deciduous forest and tropical riparian fringing forest, whereas Cachar Tropical evergreen and Cachar Tropical semi-evergreen forest occur in lower hills of Assam and adjoining Cachar round the Surma valley. The forests present in the Lower Kopili and adjoining area have been grouped into different forest types following the classification of Champion & Seth (1968), Negi, (1989, 1996), Kanjilal (1934-1940), Rao & Panigrahi (1961), and Mudgal & Hajra (1999). The major forest types found in the Study Area are given below:

- 1B/ C3 Cachar tropical evergreen forest
- 2B/ C1 Assam Valley Tropical semi-evergreen forest
- 2B/C2 Cachar tropical semi-evergreen forest
- 3C/C3b East Himalayan moist mixed deciduous forest
- 4E/ RS1 Tropical Riparian fringing forest

Vegetation Profile / Floristics In The Project Impact Zone

About 172 species of angiosperms including trees, shrubs, climbers and herbs are recorded in the project area during study period. The ground vegetation comprised of ephemeral, annual, and perennial species of grasses, sedges, legumes and non-legume forbs. The study area falls in two hill districts of Assam where river kopili forms boundary in between two districts. Left bank area along river kopili falls under Karbi Anglong district whereas area along the right bank of river kopili falls under Dima Hasao district. However, forests type is common along both banks of river in the project as well as Study Area. The details are given in Table-6.

Table-6: Different life forms of the plant species recorded in various seasons from study area.

Plant Species	No. of Species	Percentage of Species
Trees	63	34.45
Shrubs	40	21.85
Climbers	17	9.28
Herbs	53	28.96
Ferns	10	5.46
Total	183	100.00

4.2.2 Fauna

During the primary survey a total of 59 species, come from 24 families were confirmed from the surrounding areas. Majority of the species belongs to order Passeriformes. Most common species observed during the primary survey were *Merops leschenaultia* (Chestnut Bee-eater), *Motacilla alboides* (White Wagtail), *Columba livia* (Rock Pigeon), *Streptopelia chinensis* (Spotted Dove), *Treron phoenicoptera* (Bengal green Pigeon), *Acridotheres tristis* (Indian Myna), *Corvus splendens* (Common Crow), *Dicrurus adsimillus* (North Indian Black Drongo), *Pycnonotus atriceps* (Black headed Bulbul), *Pellorneum albiventris* (Assam Brown Babbler) and *Passer domesticus* (House Sparrow).

The project area is relatively less researched and information on the reptiles is rare. From published literature (Das et al., 2009) and anonymous sources a total of 32 species grouped under 11 families were reported to inhabit the surrounding areas of Lower Kopili H. E. Project.

4.2.3 Fish Communities & Status

In river Kopili 28 valid ichthyo species belonging to 22 genera and 12 families have been recorded by Das, 2009. At present many species like *Amblypharyngodon mola*, *Ompok pabo*, *Botia dario*, *Channa striatus*, etc. are found in very less quantity (Sharma and Das, 2010).

During field investigations extensive fishing was conducted at various sites with the help of hired fishermen. A total of 4 species namely *Garra gotyla gotyla*, *Danio rerio*, *Puntius sophore* and *Barilius bendelisis* could be landed from the downstream part of influence zone (near power house and 4 km downstream of powerhouse site) in the side streams only however, found absent in the kopili river. In the immediate surroundings of proposed dam site, none of the fish could be landed during the primary survey. Local people had also been interviewed with respect to the presence of fish species. The people were of the opinions that no fish species are present from the immediate vicinity of Lower Kopili H.E. project. Absence of fish diversity in the vicinity area can be attributed to the acidic water of coal mining activities, which affect the water quality adversely.

4.3 Socio-Economic Aspects

4.3.1 Demographic profile

The total number of Project Affected Families is 1609. About 10.4% of the project affected persons were below 5 years in age. The percentage of PAPs between 6 to 12 years and 13 to 17 years is 15.1% and 12.1% respectively. About two-third of the population is in the 'employable age' between 18- 60 years with about 42% in the younger employable age between 18-40 years. The percentage of SC and ST population is 1.5 % and 71.1% respectively. The overall literacy rate in the command area is 88%. It is observed that total working population is 75.3%. The remaining (24.7%) are the dependent population. The dominant occupation is agriculture and service.

5. PREDCTION OF IMAPCTS

5.1 Impacts on Water Environment

5.1.1 Water quality

a) Construction phase

Sewage from labour camps/colonies

The project construction is likely to last for a period of 4 years. The peak labour strength likely to be employed during project construction phase is about 800 workers and 200 technical staff. The increase in the population as a result of migration of labour population during construction phase is expected to be of the order of 2800. Considering per capita water supply as 135 lpcd, the domestic water requirement has been estimated as 0.38 mld.

Considering sewage generation as 80% of the total water supplied, quantum of sewage generation is expected to be 0.30 mld

Effluent from crushers

During construction phase, at least one crusher will be commissioned at the quarry site by the contractor involved in construction activities. It is proposed only crushed material would be brought at construction site. A total quantity of 50 m³/hr of effluent is expected to be generated from various crushers.

Pollution due to muck disposal

The major impact on the water quality arises when the muck is disposed along the river bank. The project authorities have identified suitable muck disposal sites which are located near the river channel. The muck will essentially come from the road-building activity, tunneling and other excavation works. The unsorted waste going into the river channel will greatly contribute to the turbidity of water continuously for long time periods. The high turbidity is known to reduce the photosynthetic efficiency of primary producers in the river and as a result, the biological productivity will be greatly reduced. Therefore, prolonged turbid conditions would have negative impact on the aquatic life.

Effluent form tunneling sites

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.

Effluent from Batching Plants

During construction phase, batching plants will be commissioned for production of concrete. Effluent containing high suspended solids shall be generated during operation and cleaning of batching plants.. However, no major adverse impacts are anticipated due to small quantity of effluent and large volume water available for dilution in river Kopili.

Effluent from Fabrication Units and Workshops

The fabrication units and workshops which shall be functional during construction phase will generate effluents with high suspended solids and oil and grease level.

b) Operation phase

Effluent from project colony

During project operation phase, due to absence of any large-scale construction activity, the 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 with sewage treatment plant and other infrastructure facilities, the problems of water pollution due to disposal of sewage are not anticipated. In the operation phase, about 50 families (total population of 200) will be residing in the project colony. About 0.03 mld of sewage will be generated. The total BOD loading will be order of 9 kg/day.

Impacts on reservoir water quality

The flooding of previously forest and agricultural land in the submergence area will increase the availability of nutrients resulting from decomposition of vegetative matter. Phytoplankton productivity can supersaturate the euphotic zone with oxygen before contributing to the accommodation of organic matter in the sediments. Enrichment of impounded water with organic and inorganic nutrients will be the main water quality problem immediately on commencement of the operation.

Eutrophication risks

Another significant impact observed in the reservoir is the problem of eutrophication, which occurs mainly due to the disposal of nutrient rich effluents from the agricultural fields. However, in the present case, fertilizer use in the project area is negligible, hence, the runoff at present does not contain significant amount of nutrients. Even in the post-project phase, use of fertilizers in the project catchment area is not expected to rise significantly. Thus, in project operation phase, problems of eutrophication, which is primarily caused by enrichment of nutrients in water, are not anticipated.

5.1.2 Impacts on Hydrologic Regime

The proposed Lower Kopili hydroelectric project envisage of reservoir up to its live storage capacity, which would then be used for peaking power. The filling up of reservoir for peaking power operations can lead to drying up of river downstream of dam site, especially in non-monsoon seasons. The impact is most severe in lean season. This can lead to significant adverse impacts on downstream riverine ecology. To mitigate the adverse impacts, Environmental flows shall be released for maintaining the aquatic ecology and water quality of river.

The recommended Environmental Flows to be released are as follows:

- **Monsoon Season- May to September** - 30% of the average flows during 90 % dependable year.
- **Non-monsoon Non lean Season- October & April** - 25% of the average flows during 90% dependable year.
- **Lean Season- November to March** - 20% of the average flows during 90% dependable year.

5.2 Impacts on Air Environment

Pollution due to fuel combustion in various equipment

The operation of various construction equipment requires combustion of fuel. Normally, diesel is used in such equipment. The major pollutant which gets emitted as a result of combustion of diesel is SO₂. The SPM emissions are minimal due to low ash content in diesel. The short-term increase in SO₂, even assuming that all the equipment are operating at a common point, is quite low, i.e. of the order of less than 1 µg/m³. Hence, no major impact is anticipated on this account on ambient air quality.

Emissions from crushers

The operation of the crusher during the construction phase is likely to generate fugitive emissions, which can move even up to 1 km in predominant wind direction. During construction phase, one crusher each is likely to be commissioned near proposed quarries for dam and power house. During crushing operations, fugitive emissions comprising mainly the suspended particulate will be generated. Since, there are no major settlements close to the crusher sites for dam and power house, hence, no major adverse impacts on this account are anticipated. However, during the layout design, care should be taken to ensure that the labour camps, colonies, etc. are located on the leeward side and outside the impact zone (say about 2 km on the wind direction) of the crushers.

Fugitive Emissions from various sources

During construction phase, there will be increased vehicular movement. Lot of construction material like sand, fine aggregate are stored at various sites, during the project construction phase. Normally, due to blowing of winds, especially when the environment is dry, some of the stored material can get entrained in the atmosphere. However, such impacts are visible only in and around the storage sites. The impacts on this account are generally, insignificant in nature.

Blasting Operations

Blasting will result in vibration, which shall propagate through the rocks to various degrees and may cause loosening of rocks/boulders. The overall impact due to blasting operations will be restricted well below the surface and no major impacts are envisaged at the ground level. During tunneling operations, dust will be generated during blasting. Ventilation system will be provided with dust handling system to capture and generated dust. The dust will settle on vegetation, in the predominant down wind direction. Appropriate control measures have been recommended to minimize the adverse impacts on this account.

Pollution due to increased vehicular movement

During construction phase, there will be increased vehicular movement for transportation of various construction materials to the project site. Similarly, these will be increased traffic movement on account of disposal of muck or construction waste at the dumping site. The maximum increase in vehicle is expected to 20 vehicles per hour. Large quantity of dust is likely to be entrained due to the movement of trucks and other heavy vehicles. Similarly, marginal increase in Hydrocarbons, SO₂ and NO_x levels are anticipated for a short duration.

Dust emission from muck disposal

The loading and unloading of muck is one of the source of dust generation. Since, muck will be mainly in form of small rock pieces, stone, etc., with very little dust particles. Significant amount of dust is not expected to be generated on this account. Thus, adverse impacts due to dust generation during muck disposal are not expected.

5.3 Impacts on Noise Environment

The operation of construction equipment is likely to have insignificant impact on the ambient noise level. 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 is recommended that exposure period of affected persons be limited as per the maximum exposure period specified by Occupational Safety and Health Administration (OSHA).

5.4 Impacts on Land Environment

The major impacts anticipated on land environment during construction are as follows:

Quarrying operations

The construction of the proposed Lower Kopili hydroelectric Project, would involve handling of large quantities of materials. The details of quarries for fine and coarse aggregates are given in Tables-7 and 8 respectively.

Table – 7: Quarries selected for Fine Aggregates

Quarry No.	Location	Haulage Distance	Type of Aggregate	Estimated Quantity
'A	Near Sudariang Nala Lat: 25°35'30" N Long: 92°44'30" E	10 km u/s of dam axis	Fine Aggregate	40,500 m ³ /year
'C'	Near Langpher Nala, Panimur Lat: 25°42'49" N Long: 92°50'21" E	7 km d/s of proposed Power house	Fine Aggregate	55,000 m ³ /year

Table – 8: Quarries selected for Corase Aggregate

Quarry No.	Location	Haulage Distance	Type of Aggregate	Estimated Quantity
'B'.	Near Kala Nala Lanka Umrangshu Lat: 25°41'53.56" N Long: 92°48'47.50 E	3 km d/s of proposed Power house	Coarse Aggregate	15,58,037 m ³

It is proposed to implement appropriate slope stabilization measures to prevent the possibility of soil erosion and landslides in the quarry sites.

Operation of construction equipment

During construction phase, various types of equipment will be brought to the site. These include crushers, batching plant, drillers, earthmovers, rock bolters, etc. The siting of this 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 shall be made for proper siting of these facilities. Efforts must be made to locate equipments in such a way that the adverse impacts on environment are minimal, i.e. to locate the construction equipment, so that impacts on human and faunal population are minimal.

Muck disposal

The total quantity of muck expected to be generated has been estimated to be of the order of 10.05 lac m³. Considering, 40% swelling, the total muck to be handled is 14.07 lac m³. About 35% material of muck shall be used as construction material Thus, 9.85 lac m³ of muck is planned to be disposed at the identified disposal areas. The holding capacity of disposal areas is estimated as 10.32 lac m³.

Changes in landuse

The proposed project involves construction of dam that will require forest and private land. The total area required for various project components like dam structure, powerhouse and other is appurtenances is 1577 ha. The construction of the project would lead to formation of a reservoir over an area of 552 ha, which in pre project scenario is river, river bed, vegetal cover, etc. Similarly landuse of the area to be used for muck disposal and quarry sites will be changed and detailed measures has been suggested in the EMP for their reclamation.

Impacts due to roads

The project can be reached from Guhawati through the National Highway (NH-52) road going further to Lanka with a distance of approximately 155 km. From Lanka upto dam site area, NH-52 exists with the distance of about 33 km and from NH-52 vehicular road shall be used which runs along the project.

5.5 Impacts on Biological Environment

a) Construction phase

5.5.1 Impacts on Terrestrial flora

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, a large population (2,800) including technical staff, workers and other group of people are likely to congregate in the area during the project construction phase.

Diversion 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. The total land requirement for the project is 1577 ha.

5.5.2 Impacts on Terrestrial fauna**Disturbance to wildlife**

The total land required for the project is 1577 ha of which about 552 ha comes under submergence, (including river bed). Most of the submergence lies within the gorge portion. Thus, creation of a reservoir due to the proposed project is not expected to cause any significant adverse impact on wildlife movement. The project area and its surroundings are not reported to serve as habitat for wildlife nor do they lie on any known migratory route. Thus, no impacts are anticipated on this account.

Impacts on migratory routes

The faunal species observed in the project area are not migratory in nature. The proposed submergence area is not the migratory route of wild animals. The construction of the proposed Lower Kopili H.E. project will form a reservoir of about 552 ha, which is also not reported to be on the migratory route of any major faunal species.

Impacts on avi-fauna

The project area and its surroundings are quite rich in avi-fauna. With the damming of the river, a reservoir of an area of about 552 ha will be created, with quiescent/tranquil conditions. The reservoir banks will have wet environment throughout the year which can lead to proliferation of vegetation e.g. grass, etc. along the reservoir banks. This is expected to increase the avi-faunal population of the area.

5.5.3 Aquatic Flora**a) Construction phase**

During construction phase wastewater mostly from domestic source will be discharged mostly from various camps of workers actively engaged in the project area. Around 0.38 mld of water is required for the workers during the peak construction phase, of which 80% (i.e. about 0.30 mld) will be discharged back to the river as wastes, more or less as a point sources from various congregation sites where workers will reside. Appropriate sewage treatment measures will be commissioned so as to avoid adverse impacts on riverine ecology.

b) Operation phase

The construction of a reservoir as a part of any hydroelectric project 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. 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.

5.5.4 Impacts on Aquatic Fauna**a) Construction phase****Impacts due to extraction of construction material**

It is proposed to extract construction material from borrow areas in the river bed. The extraction of construction material may affect the river water quality due to increase in the turbidity levels.

Impacts due to discharge of sewage from labour camp/colony

The proposed hydro-power project envisages construction of a project colony. The labour camp and colonies are proposed close to project site. This would result in emergence of domestic waste water which is usually discharged into the river. However, it is proposed to commission appropriate units for treatment of domestic sewage before its disposal in to the river.

(b) Operation Phase**Impacts on Riverine Fisheries**

The pH level of river kopili is acidic in nature and no fish is available. A total of 4 species namely *Garra gotyla gotyla*, *Danio rerio*, *Puntius sophore* and *Barilius bendelisis* from the downstream part of influence zone (near power house and 4 km downstream of powerhouse site). In the immediate surroundings of proposed dam site, none of the fish could be landed during the primary survey.

Impacts on Fish Migration

No migratory fish species are reported in the project area, hence, no impacts on this account is anticipated.

5.6 Increased Incidence of Water-Related Diseases**a) Construction Phase**

About 1000 labourers and technical staff will aggregate in the project area during construction phase. The labourers would live in dormitories provided by the Contractor where proper sanitary facilities are to be provided as per contract agreement. However, some of the labourers coming from outside the project area could be carrier of certain diseases therefore proper screening of labour population will be done by the contractor.

Excavations

The excavation of earth from borrow pits etc. could accumulate water during rainy season which could increase breeding ground for various vectors and mosquitoes. However, in the present case, the borrow areas are within the river bed, which in any case remain under water. Thus, no additional habitat for mosquito breeding is created due to excavation.

Inadequate facilities in labour camps

Labourer camps without adequate facilities for potable water supply and sewage treatment could lead to outbreak of epidemics of water-borne diseases. Adequate measures for supply of potable water and sewage treatment have been recommended as a part of Environmental Management Plan.

b) Operation phase

The construction of a reservoir replaces the riverine ecosystem by a lacustrine ecosystem. The vectors of various diseases breed in shallow areas not very far from the reservoir margins. The magnitude of breeding sites for mosquitoes and other vectors in the impounded water is in direct proportion to the length of the shoreline.

5.7 Impacts Due to Construction Power

The nearest Grid Sub-Station is 33 kV Umrangsu sub-station which is located about 20 km from the project site. The power at 33 kV voltage level from 33 kV Umrangsu sub-station may be drawn to Project site for requirement of power during construction. Since the reliability of construction power is essential to meet the target dates of construction of projects, it is further proposed to augment the reliability of system to install four of DG sets of 4 M.VA capacity. The operation of DG sets could lead to increase in air pollution on account of diesel consumption.

5.8 Protection of Concrete & Steel from Acidic Water

The pH level of water in Kopili river ranges from 3.2 to 5.2. The protection of concrete structures is required for taking preventive measure against corrosive nature caused due to acidity of water. The prevention of corrosion to concrete surface is proposed to be protected by the following way:

- High density concrete (HPC) on water exposed surfaces in Dam.
- All Concrete in contact with direct water shall consist of 5 to 6% Silica fumes (microsilica).
- Concrete mix with suitable admixtures such as metakaolin along with fly ash (about 30-35%) shall be used to resist the acid attack.
- Epoxy coated reinforcement or Corrosion resistant Reinforcement.
- Polyurethane spray on water exposed concrete surface.

5.9 Downstream Impacts

The Lower Kopili Hydro Electric Project is a run of river scheme project. The diversion of water for hydropower generation will lead to drying or reduction of flow river stretch in monsoon season. The lean season, it will lead to drying of river stretch to store water for MDDL to FRL for peaking power generation. There are no major users of water in the intervening stretches, as the river stretch flows through a gorge. Also, the water of river Kopili is highly acidic in the project area. Thus, rivering fisheries is not found in the area. As a result, there are no major users of water of river Kopili in the project. Thus, no major adverse impacts are anticipated on downstream water users. It is proposed to release minimum Environmental Flows. The number of hours for which peaking in various months for 90% dependable year is available in Lower Kopili HEP is given in Table-9.

Table-9: Number of hours of peaking available in 90% dependable year for Lower Kopili HEP

Month		Discharge in 90% Dependable year (cumec)	Rated discharge (cumec)	Environmental Flows (cumec)	Discharge available in 90% Dependable year for peaking operations (cumec)	No. of hours of peaking operation (hours)
June	I	6.54	112.7	1.96	4.58	1.0
	II	79.95	112.7	23.99	55.96	11.9
	III	41.28	112.7	12.38	28.90	6.2
July	I	63.76	112.7	19.13	44.63	9.5
	II	84.02	112.7	25.21	58.81	12.5
	III	74.09	112.7	22.23	51.86	11.0
August	I	130.34	112.7	39.1	91.24	19.4
	II	75.96	112.7	22.79	53.17	11.3
	III	43.02	112.7	12.91	30.11	6.4
September	I	132.54	112.7	39.76	92.78	19.8
	II	86.02	112.7	25.81	60.21	12.8
	III	133.25	112.7	39.98	93.27	19.9
October	I	106.21	112.7	26.55	79.66	17.0
	II	86.35	112.7	21.59	64.76	13.8
	III	50.32	112.7	12.58	37.74	8.0

Month		Discharge in 90% Dependable year (cumec)	Rated discharge (cumec)	Environmental Flows (cumec)	Discharge available in 90% Dependable year for peaking operations (cumec)	No. of hours of peaking operation (hours)
November	I	44.38	112.7	11.10	33.29	7.1
	II	37.50	112.7	9.38	28.13	6.0
	III	18.79	112.7	4.70	14.09	3.0
December	I	22.30	112.7	4.46	17.84	3.8
	II	22.11	112.7	4.42	17.69	3.8
	III	23.07	112.7	4.61	18.46	3.9
January	I	21.83	112.7	4.37	17.46	3.7
	II	18.87	112.7	3.77	15.10	3.2
	III	21.35	112.7	4.27	17.08	3.6
February	I	21.69	112.7	4.34	17.35	3.7
	II	20.09	112.7	4.02	16.07	3.4
	III	21.94	112.7	4.39	17.55	3.7
March	I	20.61	112.7	4.12	16.49	3.5
	II	21.68	112.7	4.34	17.34	3.7
	III	21.07	112.7	4.21	16.86	3.6
April	I	16.08	112.7	4.02	12.06	2.6
	II	15.98	112.7	4.00	11.99	2.6
	III	16.31	112.7	4.08	12.23	2.6
May	I	53.43	112.7	13.36	40.07	8.5
	II	81.94	112.7	20.49	61.46	13.1
	III	116.88	112.7	29.22	87.66	18.7

Source: DPR

5.10 World Heritage Sites in the Project area

No world heritage site exists in the project area.

5.11 Presence of Cemetery, Graves In the Project Area

As reported by local villagers there are no permanent cemeteries and graveyard within the project area.

5.12 Presence of Caves in The Project Area

Few caves are observed Longku Nallah. However, there is no religious significance of these caves.

5.13 Impacts on Socio-Economic Environment

a) Construction Phase

Employment opportunities

The construction phase will last for 4 years. The peak labour force and technical staff required is estimated at about 1,000. The total number of persons inhabiting the area including the service population will be about 2,600. The following impacts are envisaged:

Improved business opportunities

Improved access facilities in the project area

Improvement in infrastructure

The availability of infrastructure is generally a problem during the initial construction phase. Though the construction workers would be willing to pay for certain facilities like health, education, etc., the facilities itself are often not made available timely and of the desired quality. The adequacy of water supply, sewage treatment, housing etc. should, therefore, be ensured before and adequate measures would be taken at the very start of the project.

Increased incidence of vector-borne diseases due to excavations Impacts on public health due to inadequate facilities in labour camps

b) Operation Phase

Impacts due to acquisition of land and homesteads

One of the most important and negative impact due to the commissioning of the project would be that a number of families could be displaced from their lands, and economic activity. As per the assessment, a total of 1854 landholders/ land titleholders would be losing land in varying proportions. About 18 PAFs would be losing homesteads.

6. ENVIRONMENTAL MANAGEMENT PLAN

6.1 Compensatory Afforestation and Biodiversity Conservation Plan

The total land requirement of the project is 1577 ha. The forest land to be acquired for the project is 523 ha. The private land to be acquired for the project is 1054 ha. Thus, a total of (523* 2) 1046 ha of land needs to be afforested. The afforestation work is to be done by the Forest Department. Local species shall be preferred for plantation under compensatory afforestation. In addition, following measures are also recommended:

- Afforestation
- Soil stabilization measures & improving water regime,
- Promote use of non-conventional energy so as to reduce pressure on natural resources,
- Sustenance of Livelihoods
- Establishment of botanical gardens for conservation and propagation of RET species.
- Control of grazing & implementation of anti poaching measures, etc.
- Peoples participation in the biodiversity conservation programmes
- Community development initiatives
- Training & Publicity Programmes

6.2 Public Health Delivery System

A population of about 2800 is likely to congregate during the construction phase. The labour population will be concentrated at two or three sites. It is recommended that a dispensary should be developed during project construction phase itself, so that it can serve the labour population migrating in the area as well as the local population.

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.

6.3 Management of Muck Disposal Sites

The muck would be piled at an angle of repose at the proposed dumping sites. For stabilization of dumped materials various engineering and phyto-remedial measures are being proposed. 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 Plan for Quarry Areas

The quarry slopes after excavation of the construction material needs to be stabilized. It is suggested that quarry slopes should be maintained at a slope 1:1. The slope should then be covered with topsoil of at least 30 cm. It is suggested that for stabilization, grass, herbs & shrubs should be grown over these slopes. Afforestation with suitable plant species of high ecological and economic value along with turfing by suitable grass species can be undertaken over the two quarry sites after providing required slope and laying top soil over the slopes.

6.5 Landscaping and Restoration of Construction Areas

After completion of all the construction activity, the construction sites and other temporary settlements would be removed and area covered with the top soil to support the growth of plant species. These plant species which grow first are considered ecological pioneers and would initiate the process of succession and colonization. Areas close to colony and suitable areas will be landscaped to develop children parks, gardens, etc.

6.6 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 are proposed to be stabilized by several methods i.e. engineering or bio-engineering measures alone or a combination of these.

6.7 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.

6.8 Solid Waste Management

As per the requirements of the Municipal Solid Waste (Solid Waste Management & Handling) Rules 2000, land filling would be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall be done following proper norms and landfill sites shall meet the specifications as given in these rules.

6.9 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.

6.10 Measures for Noise Control

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 impacts on the ambient noise levels in the area

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.

6.11 Water Pollution Control Construction phase

During construction phase of the proposed project, 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.

6.12 Fish Management

a) Release of minimum flow

The recommended Environmental Flows to be released are given as follows:

- **Monsoon Season- May to September** - 30% of the average flows during 90 % dependable year.
- **Non-monsoon Non lean Season- October & April** - 25% of the average flows during 90% dependable year.
- **Lean Season- November to March** - 20% of the average flows during 90% dependable year.

The approved 10 daily flow series for the 90% dependable year are given in Table-10.

Table-11:Recommended Environmental Flows

Month	Period	Inflow	EF	EF to be released	Turbine release for 24 hrs	Actual EF released through Aux.PH	Spill
		(m ³ /s)	(%)	(m ³ /s)	(m ³ /s)	(m ³ /s)	(m ³ /s)
Lean Season, 90% DY							
December	I	22.30	20	4.46	17.84	4.46	Nil
	II	22.11	20	4.42	17.69	4.42	Nil
	III	23.07	20	4.61	18.46	4.61	Nil
January	I	21.83	20	4.37	17.46	4.37	Nil
	II	18.87	20	3.77	15.10	3.77	Nil
	III	21.35	20	4.27	17.08	4.27	Nil
February	I	21.69	20	4.34	17.35	4.34	Nil
	II	20.09	20	4.02	16.07	4.02	Nil
	III	21.94	20	4.39	17.55	4.39	Nil
March	I	20.61	20	4.12	16.49	4.12	Nil
	II	21.68	20	4.34	17.34	4.34	Nil
	III	21.07	20	4.21	16.86	4.21	Nil
Avg.		21.4		4.3	17.1	4.3	
Non-Monsoon Non-Lean Season, 90% DY							
October	I	106.21	25	26.55	84.97	26.55	Nil
	II	86.35	25	21.59	69.08	21.59	Nil
	III	50.32	25	12.58	40.26	12.58	Nil

Month	Period	Inflow	EF	EF to be released	Turbine release for 24 hrs	Actual EF released through Aux.PH	Spill
		(m ³ /s)	(%)	(m ³ /s)	(m ³ /s)	(m ³ /s)	(m ³ /s)
November	I	44.38	25	11.10	35.50	11.10	Nil
	II	37.50	25	9.38	30.00	9.38	Nil
	III	18.79	25	4.70	15.03	4.70	Nil
April	I	16.08	25	4.02	12.86	4.02	Nil
	II	15.98	25	4.00	12.78	4.00	Nil
	III	16.31	25	4.08	13.05	4.08	Nil
May	I	53.43	25	13.36	42.74	13.36	Nil
	II	81.94	25	20.49	65.55	20.49	Nil
	III	116.88	25	26.55	93.50	26.55	Nil
		53.7		13.4	40.3	13.4	
Monsoon Season							
June	I	6.54	30	1.96	4.58	1.96	Nil
	II	79.95	30	23.99	55.97	23.99	Nil
	III	41.28	30	12.38	28.90	12.38	Nil
July	I	63.76	30	19.13	44.63	19.13	Nil
	II	84.02	30	25.21	58.81	25.21	Nil
	III	74.09	30	22.23	51.86	22.23	Nil
August	I	130.34	30	39.10	91.24	39.10	Nil
	II	75.96	30	22.79	53.17	22.79	Nil
	III	43.02	30	12.91	30.11	12.91	Nil
September	I	132.54	30	39.76	92.78	39.76	Nil
	II	86.02	30	25.81	60.21	25.81	Nil
	III	133.25	30	39.98	93.28	39.98	Nil
		79.2	30	23.8	55.4	23.8	

The power station is proposed to comprise of 2 units of 55 MW each. Two units each of 2.5 MW and 1 unit of 5 MW is envisaged to utilize the mandatory Environmental Flows. These units shall be operated to meet the requirement of the Environmental Flows into the river just downstream of the dam

7. CATCHMENT AREA TREATMENT (CAT) PLAN

Silt Yield Index (SYI) method has been used to prioritize sub-watershed in a catchment area for treatment. The area under high erosion category has to be treated by the project proponents, which accounts for about 41.23% of the total free draining catchment area. The details are given in Table-11.

Table-11: Area under different erosion categories

Category	Area (ha)	Area (Percentage)
Low	20984	25.57
Medium	27243	33.20
High	33836	41.23
Total	82062	100.00

A CAT Plan comprising of following measures is proposed:

- Gap Plantation
- Afforestation
- Nursery development and maintenance of nursery
- Vegetative fencing
- Check Dams

8. RESETTLEMENT AND REHABILITATION PLAN

The provisions of the “Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013” have been taken into consideration, and the best option has been recommended for preparation of Rehabilitation Plan for the PAFs.

8.1 Measures for Resettlement

- One-time financial assistance of a minimum of Rs. 25,000/- to each affected family of an artisan, small trader or self-employed person or an affected family which owned non-agricultural land or commercial, industrial or institutional structure in the affected area, and which has been involuntarily displaced from the affected area due to land acquisition.
- House building assistance shall be awarded to all the project affected families who are being displaced @ Rs. 1, 50,000/ha.
- One-time financial assistance minimum of Rs. 25,000/- or as the appropriate Government may, by notification specify, for construction of cattle shed
- One time financial assistance of Rs. 50,000/-for each displaced family for shifting of the family, building materials, belongings and cattle.
- Each affected family, losing land, will be given a monthly subsistence allowance equivalent to Rs. 3000/ month for a period of one year from the date of award.
- Scheduled Castes and the Scheduled Tribes displaced from Scheduled Areas shall receive an amount equivalent to Rs. 50,000/-, in addition to subsistence allowance
- Each affected family shall be given a onetime “Resettlement Allowance” of Rs. 50,000/-
- The stamp duty and the other fees payable for registration of the land of the house allotted to the affected families shall be borne by the requiring body
- The land for house allotted to the affected families shall be free from all encumbrance
- The land and the house allotted may be in the joint names of wife and husband of the affected family.

8.2 Measures for Rehabilitation

The compensation for acquisition of private land would be paid to the respective land owners/ land titleholders within the provisions of Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. In the proposed project, no homesteads are being acquired, thus, no resettlement is required and only rehabilitation plan is being suggested.

The details of the provisions for the implementation of Rehabilitation Plan at the site are given as follows:

- Compensation for Land acquisition as per the provisions of Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013
- One-time financial assistance of a minimum of Rs. 25,000/- to each affected family of an artisan, small trader or self-employed person or an affected family which owned non-agricultural land or commercial, industrial or institutional structure in the affected area, and which has been involuntarily displaced from the affected area due to land acquisition
- One person from each affected family shall be offered necessary training facilities for development of entrepreneurship, technical and professional skills for self-employment.
- For families losing land under canal network, Compensation for Land acquisition as per the provisions of Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 shall be given.

8.3 Budget

A total budget of Rs. 11666.01 lakh would be required for implementation of R&R Plan. The details are given in Table-12.

Table-12: Budgetary estimate for implementation of R&R Plan

S. No.	R&R Components	Cost (Rs. lakh)
1.	Resettlement plan	56.25
2.	Facilities at Resettlement Site	300.00
3.	Rehabilitation plan	11309.36
	Total	11666.01

9. LOCAL AREA DEVELOPMENT PLAN

It is proposed to upgrade the infrastructure in various schools in the project area and its vicinity. The following activities are proposed under LADP activities:

- Educational facilities
- Healthcare facilities
- Improvement of Infrastructure & living standards
- Development of training / educational institute

A sum of Rs. 581.0 lakh shall be spent by the Project Proponent for implementation of various measures outlined in Local Area Development Plan as per details outlined in Table-13.

Table-13: Budget for Local Area Development Plan

S. No.	Items	Budget (Rs. Lakhs)
1.	Upgradation of Educational facilities	66.0
2.	Construction of community toilets	400.0
3.	Expenditure on Health care facilities	115.0
	Total	581.0

10. DISASTER MANAGEMENT PLAN

The following measures have been suggested as a part of the Disaster Management Plan:

- Dam Safety and Maintenance Manual
- Emergency Action Plan (EAP)
- Administration and Procedural Aspects
- Preventive Action
- Communication System
- Notifications
- Evacuations Plans and Evacuation Team
- Public Awareness for Disaster Mitigation

- Management after receding of Flood Water

11. 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 - 14 and 15 respectively.

TABLE-14: Summary of Environmental Monitoring Programme during Project Construction Phase

S. No.	Item	Parameters	Frequency	Location
1.	Effluent from STPs	pH, BOD, COD, TSS, TDS	Once every month	Before and after treatment from each STP
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 level	Equivalent noise level (L_{eq})	Once in three months	At major construction sites.
4.	Ambient Air quality	PM _{2.5} , PM ₁₀ , SO ₂ and NO ₂	Once every season	At major construction sites
5.	Ecology	Status of afforestation programmess of green belt development, Terrestrial Flora and fauna and aquatic ecology	Once every season	
6.	Aquatic ecology	Phytoplanktons, zooplanktons, benthic life, fish composition	Once every season	

Table-15: Summary of Environmental Monitoring Programme during Project Operation Phase

S. No.	Items	Parameters	Frequency	Location
1.	Water	pH, Temperature, EC, TSS, Turbidity, Total Dissolved Solids, Calcium, Magnesium, Total Hardness, Chlorides, Sulphates, Nitrates, DO. COD, BOD, Iron, Zinc, Manganese	Once every season	<ul style="list-style-type: none"> • 1 km upstream of submergence site • Submergence area • 1, 3 and 5 km downstream of dam site
2.	Effluent from Sewage Treatment Plant (STP)	pH, BOD, COD, TSS, TDS	Once every week	<ul style="list-style-type: none"> • Before and after treatment from Sewage Treatment Plant (STP)
3.	Ecology	Status of afforestation programmess of green belt development, Terrestrial Flora and fauna and	Once every season	-

S. No.	Items	Parameters	Frequency	Location
		aquatic ecology		
4.	Water-related diseases	Identification of water-related diseases, sites, adequacy of local vector control measures, etc.	Once every season	<ul style="list-style-type: none"> Villages adjacent to project sites
5.	Aquatic ecology	Phytoplanktons, zooplanktons, benthic life, fish composition	Once every season	<ul style="list-style-type: none"> 1 km upstream of reservoir site Submergence area 1, 3 and 5 km downstream of dam site
6.	Landuse	Landuse pattern using satellite data	Once in a year	Catchment area
7.	Meteorological aspects	Wind direction & velocity, temperature, humidity, rain	Continuous	At one of the ambient air quality sampling sites

12. COST ESTIMATES

12.1 Cost for Implementing Environmental Management Plan

The total amount to be spent for implementation of Environmental Management Plan (EMP) is Rs. 17735.88 lakh or Rs. 177.36 crore. The details are given in Table-16.

Table-16: Cost for Implementing Environmental Management Plan

S. No.	Item	Cost (Rs. lakh)
1.	Compensatory Afforestation, and Bio-diversity conservation	1910.35
2.	Catchment Area Treatment	1223.70
3.	Public health delivery system	423.60
4.	Muck management	340.00
5.	Stabilization of quarry sites	115.0
6.	Restoration and Landscaping of construction sites	100.00
7.	Environmental management in road construction	169.52
8.	Greenbelt development	20.00
9.	Solid Waste Management	234.84
10.	Water pollution control	185.00
11.	Energy Conservation measures	100.00
12.	Disaster Management Plan	370.00
13.	Resettlement and Rehabilitation Plan	11666.01
14.	Local Area Development Plan	581.00
15.	Plan to preserve cultural identity of the locals	122.86
16.	Environmental Monitoring during construction phase (Refer Table-19.2)	103.00
17.	Monitoring and Evaluation Aspects	60.00
18.	Purchase of meteorological instruments	10.00
19.	Purchase of noise meter	1.00
	Total	17735.88

12.2 Cost for Implementing Environmental Monitoring Programme

The cost required for implementation of the Environmental Monitoring Programme is of the order of Rs.103.00 lakh @ Rs.22.2 lakh/ year. The details are given in Table-17. The cost required for implementation of the Environmental Monitoring Programme in operation phase is of the order of Rs. 22.83 lakh/year. The details are given in Table-18.

Table-17: Cost for Implementing Environmental Monitoring Programme during construction phase

S. No	Item	Cost (Rs. lakh/year)	Total cost for construction period of 4 years with 10% escalation year (Rs. lakh)
1	Water quality	1.44	6.68
2	Ambient Air quality	5.76	26.72
3	Ecology	12.0	55.68
4.	Incidence of water related diseases	3.00	13.92
	Total	22.2	103.00

Table-18: Cost for Implementing Environmental Monitoring Programme during operation phase

S. No	Item	Cost (Rs. lakh/year)
1	Water quality	2.83
2	Ecology	12.00
3	Incidence of water related diseases	3.00
4.	Landuse pattern	5.00
	Total	22.83