



# THDC INDIA LIMITED

**DRAFT CEIA REPORT FOR KALAI-II  
(1200MW) HYDRO ELECTRIC PROJECT IN  
DISTRICT ANJAW, ARUNACHAL PRADESH**

## **EXECUTIVE SUMMARY REPORT**



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# **EXECUTIVE SUMMARY REPORT**

## EXECUTIVE SUMMARY

### 1. INTRODUCTION

The Brahmaputra basin has a total drainage of about 5,80,000 sq km of which 2,65,260 sq km lies in India. The Brahmaputra basin spreads in Tibet, India, Bhutan and Bangladesh. In India, the basin drains almost complete North-Eastern states comprising of Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Tripura, Nagaland and Sikkim and a substantial part of West Bengal. Lohit river is the farthest eastern major tributary of mighty Brahmaputra river. The river Lohit or Tellu, originates at an elevation of about 6190 m from the snow clad peaks in the Eastern Tibet. The Lohit basin lies between Latitude 27° 34' N and 29° 36' N and Longitude 95° 38' E and 97° 44' E. Further looking at the potential of river Lohit it is evident that the river basin has a potential of more than 7500 MW.

### 2. PROJECT DESCRIPTION

The Kalai-II H.E. Project envisages run of the river scheme with pondage on Lohit river, a left bank tributary of Brahmaputra river. The objective is to utilize flows of Lohit river over large head available for hydro power generation. The Gross and Live Storage of the Kalai-II reservoir are 318.88 M cum and 29.76 M cum with FRL at El 904.80 m and MDDL at El 900.00 m respectively. The dam on river Lohit shall be concrete dam with spillway and a separate diversion structure for diverting a regulated discharge of 1128.06 cumec through 5 nos. 7.5m dia & 1 no. 8.5m dia Head Race Tunnels. The powerhouse shall be underground with a capacity of (6 x 190 + 60) 1200 MW located on the right bank of the river.

The total land required for the project is 869.3503 ha., and the entire land to be acquired for the project is forest land. The total estimated cost of the project with IDC & escalation at the completion level is Rs. 13688.29 crore, at December 2024 price level. The construction period for the project shall be 78 months

The salient features of the project are enclosed as Table-1. The project layout is enclosed as Figure-1.

**Table-1: Salient features of Kalai-II Hydroelectric Project**

<b>HYDROLOGY</b>	
Catchment area	15654 km <sup>2</sup>
Design Flood (PMF)	24268 m <sup>3</sup> /sec
Diversion Flood (1 in 25 years Monsoon Flood)	9563 m <sup>3</sup> /sec
Annual avg Inflow	28022 Mm <sup>3</sup>
<b>RESERVOIR</b>	
Full Reservoir Level (FRL)	EL904.80 m
Minimum Draw Down Level (MDDL)	EL 900.00 m
Total Storage Volume	318.88 M cum
Live storage (Above MDDL)	29.76 M cum
Dead Storage Volume	289.12 M cum

Reservoir Area at FRL	638.456 Ha
<b>Diversion Tunnel</b>	
Location	On Left bank
Dia and Shape	3 Nos. Circular & 14.4m Dia finished
Total Length of 3 tunnels	3338 m
Lining Type	Concrete Lined
Number of gates	6 Nos. (2 Nos. per tunnel)
Gate Opening size (W x H)	6.0 m (W) x 14.4 m (H)
Type of Gate	Vertical Lift Fixed Wheel
Location	On Right bank
Dia and Shape	2 Nos. Circular & 14.4 m Dia finished
Total Length of 2 tunnels	1693 m
Lining Type	Concrete Lined
Number of gates	4 Nos. (2 Nos. per tunnel)
Gate Opening size (W x H)	6.0 m (W) x 14.4 m (H)
Type of Gate	Vertical Lift Fixed Wheel
<b>DAM</b>	
Type	Concrete Gravity Dam
Dam Location	3.7 Km D/S to Chingwanti bridge
Top of Dam Elevation	EL 908.00 m
Length of Dam between abutments	272 m
Foundation Level	EL 710.00 m
Dam Height from deepest foundation level	198.00 m
River Bed Level	EL 779.8 m
<b>SPILLWAYS</b>	
Sluice Spillway	
Design Flood for Spillway	24268 cumec (PMF)
Number of bays of spillways	8
Size of each bay	8.0 m x 12.0 m
Spillway Crest Elevation	EL 820 m
Spillway Gate Type and size	8 Nos. Radial 8.0 m x 12.0 m
Bulkhead Type and Size (WxH)	1No. Vertical Lift Fixed Wheel Type, 8 m x 16 m
<b>Auxiliary Spillway</b>	
No. and size of Auxiliary spillway	2 Nos. 8m x 10 m
Crest Elevation	EL 894.80 m
Gate Type and size	2 Nos. Radial (With Flap Gate) 8 m x 10 m
Bulkhead Type and size	1 No. Vertical Lift Fixed Wheel 8.0 m x 10 m
<b>Intake Structure</b>	
Number of Intakes Opening	6
Invert Level of Tunnels	EL 882.00 m
Design Discharge (Main unit)	180.202 m <sup>3</sup> /sec
Design Discharge (Auxiliary Unit)	227.05 m <sup>3</sup> /sec

Intake (1 to 5)- Service Gate Gate Type and size	5 Nos. Vertical Lift Fixed Wheel 6.2 m x 7.5 m
	1 No. Vertical Lift Fixed Wheel Bulkhead 6.2 m x 7.5 m
Intake (6)- Service Gate Gate Type and size	1 No. Vertical Lift Fixed Wheel 7.1 m x 8.5 m
	1 No. Vertical Lift Fixed Wheel Bulkhead 7.1 m x 8.5 m
<b>HEAD RACE TUNNEL</b>	
No. and Dia	5 Nos., 7.5m dia., 1 No., 8.5m dia
Length of 1 no. 8.5m dia HRT	63.3 m
Total Length of 5 Nos., 7.5m dia HRT	534.7 m
Lining Type	Concrete Lined
<b>PRESSURE SHAFT</b>	
Type & Numbers	Underground and Steel lined, circular, 6 No.
Number & Size	5 Nos. 6.2m dia circular, total 899m long & 1 No. 7.0m dia (151 m long) bifurcating into 6.2 m (29m long) & 3.5m (29m long).
<b>PENSTOCK ASSEMBLY CHAMBER</b>	
Type	Cavern
Size	160 m (L) x 15 m (W) x 13 m (H)
<b>POWER HOUSE</b>	
Type	Underground
Dimensions (L X W X H)	250 m (L) x 23.5 m (W) x 54.1 m (H)
Number of units	6x190 + 1x60 MW
Installed Capacity	1200 MW
EOT Cranes	2 Nos.
Capacity	275 T/ 50 T
<b>Main Turbine</b>	
Type	Vertical Francis
Number of Units	5 Nos.
Maximum/Minimum net head/Rated Net head	123.59 m/112.27 m /115.47 m
Design Discharge/unit	180.2 m <sup>3</sup> /sec
Unit capacity of turbine	192.89 MW
Rated Speed	150 RPM
Efficiency	94.5%
<b>Auxiliary Turbine (Riparian)</b>	
Type	Vertical Francis
Number of Units	1 No.
Rated net head	120.24 m
Design Discharge/unit	173.05 m <sup>3</sup> /sec
Unit capacity of turbine	192.89 MW
Rated Speed	150 RPM
Efficiency	94.5%
<b>Auxiliary Turbine (Riparian)</b>	

Type	Vertical Francis
Number of Units	1 No.
Rated net head	121.68 m
Design Discharge/unit	54 m <sup>3</sup> /sec
Unit capacity of turbine	60.91 MW
Rated Speed	272.73 RPM
Efficiency	94.5%
<b>SURGE GALLERY</b>	
Type	Downstream surge chamber
Size	228 m (L) x 20.75 m (8) x 63.2 m(H)
Main units Surge Chamber	
Max. Surge level	EL 793.70 m
Min. Surge level	EL 774.60 m
Gate type and size	5 Nos. Vertical Lift Fixed Wheel 7.6 m x 10 m
<b>Auxiliary units Surge Chamber</b>	
Max. Surge level	EL 788.93 m
Min. Surge level	EL 778.87 m
Gate type and size for 190 MW Unit	1 No. Vertical Lift Fixed Wheel 7.6 m x 10 m
Gate type and size for 60 MW Unit	1 No. Vertical Lift Fixed Wheel 3.2 m x 4 m
<b>TAIL RACE TUNNEL</b>	
No./ Length	3 Nos./ Total 3939 m length
Size and Shape	11.2 m dia., Circular Shaped
Design Discharge	901.01 m <sup>3</sup> /sec (Normal)
Type of Lining	Concrete lined
Tailrace Outfall Gate Type	Vertical Lift Fixed Wheel Type
Number of Gates	6 Nos. (2 Nos. per tunnel)
Tailrace Outfall Gate Size (WxH)	7.20 m x 11.2 m
Outlet Invert Elevation	772.0 m
Minimum Tail Water Level	EL779.80 m
<b>AUX. TAIL RACE TUNNEL</b>	
No./ Length	1 Nos./ Total 333 m length
Size and Shape	9.5 m dia., Circular Shaped
Design Discharge	227.05 m <sup>3</sup> /sec (Rated)
Type of Lining	Concrete lined
Tailrace Outfall Gate Type	Vertical Lift Fixed Wheel type
Number of Gates	1 No.
Tailrace Outfall Gate Size (WxH)	7.65 m x 9.5 m
<b>POTHEAD YARD</b>	
Type and size	Surface 192 m x 44 m
Elevation of Pot Head Yard	EL 820.0 m
<b>POWER BENEFITS</b>	
Annual Energy (90 DY)	4922.07 GWh
Design Energy (90 DY)	4852.95 GWh

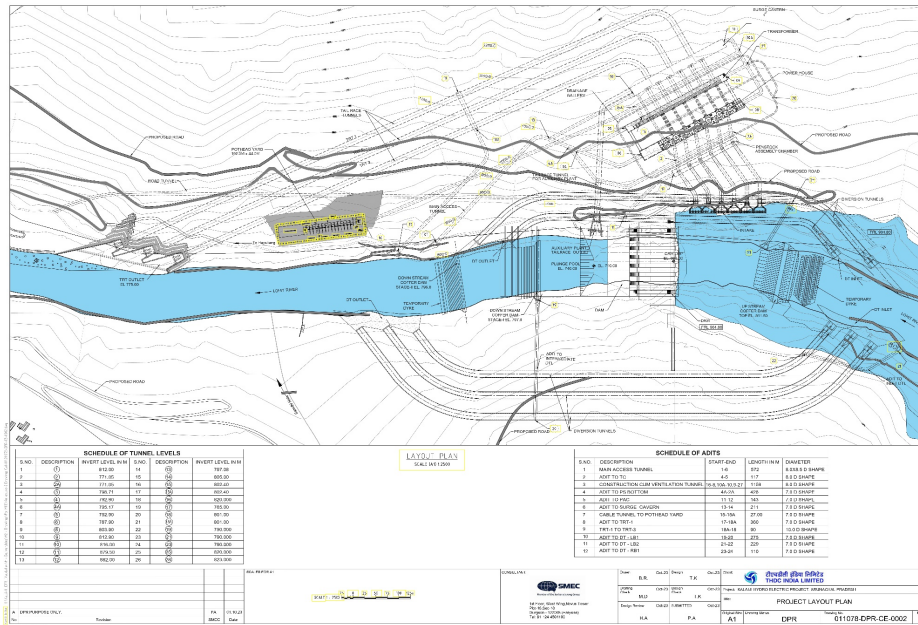


Figure-1: Project Layout Map

3. STUDY AREA

The study area considered for the CEIA study is given as below (refer Figure-2):

- 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 Kalai-I hydroelectric project

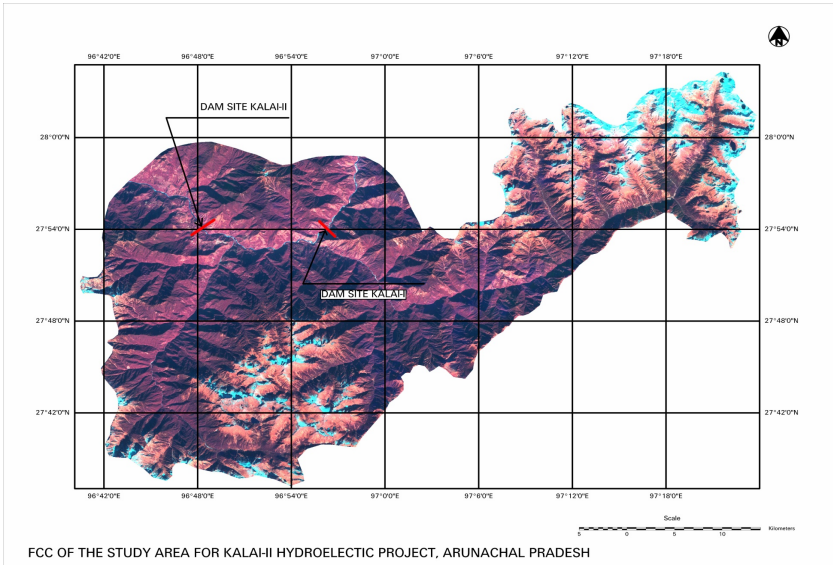


Figure-2: FCC of the Study Area for Kalai-II HEP

#### **4. ENVIRONMENTAL BASELINE STATUS**

Environmental quality of the region helps to assess the level of pollution and prediction of impacts of the region. The baseline status of the environmental quality has been monitored with respect to air, water, soil and noise in the study area. The monitoring was carried out for three seasons' viz. pre-monsoon, monsoon and winter season.

##### **4.1 Climate**

The climate of the Lohit basin varies from severe cold in higher reaches to tropical heat. A substantial portion of catchment lies in Tibet. The sharp variation in altitudes results in abrupt changes in climatic conditions. The high mountains act as a barrier for the movement of monsoon winds. The rainfall in the Indian catchment is influenced by the mountains; generally rainfall sets in May and continues till October. After October, the intensity of rainfall decreases, though some precipitation occurs in the month of February and March also. However, November to January are dry months.

##### **4.2 Geology**

The project area is located within the western belt of the Lohit Granitoid (Plutonic) Complex. Regionally this comprises of metadiorite, gabbro-diorite and quartz-diorite rocks. The rock has been variably metamorphosed and has gneissic banding in some areas. The rockmass is jointed and often fractured in nature.

##### **4.3 Hydrogeology**

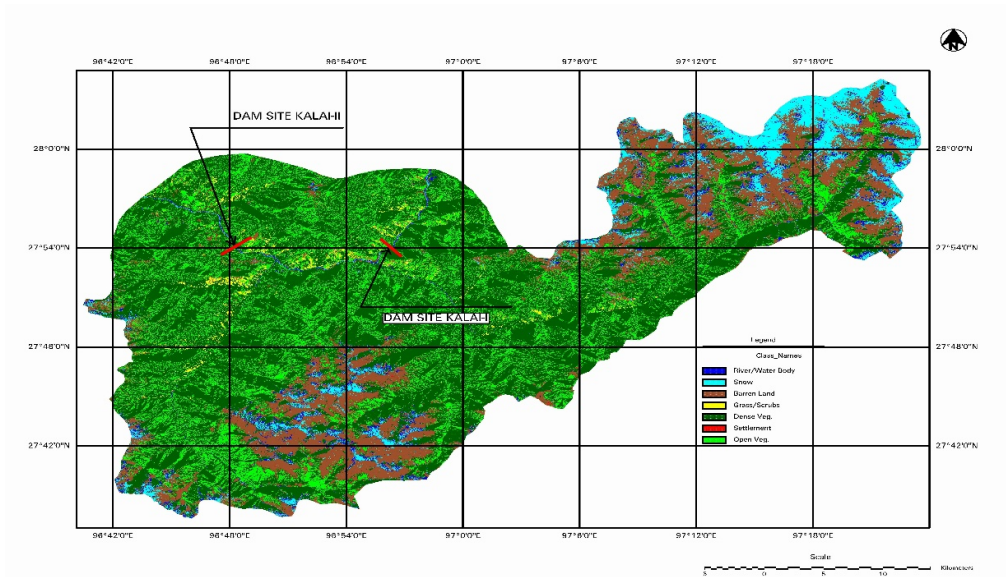
The occurrence and behaviour of ground water is controlled by climate, topography, geology, structure etc. The major part of the district is occupied by consolidated formations of Mishmi massif and Tidding formation. The ground water conditions in the district can best be described under two distinct hydrogeological units, i.e. conditions prevailing in the consolidated formations and conditions prevailing in the unconsolidated formations.

##### **4.4 Seismicity**

The project site lies in seismic Zone-V as per the seismic zoning map of India as incorporated in Indian Standard Criteria for Earthquake Resistant Design of Structures IS:1893 - (Part I) 2002.

##### **4.5 Landuse Pattern**

The major land use category in the study area is forest, which accounts for almost 72.55% of the study area. The other major category is Degraded/Barren Land accounting for about 17.54% of the study area. The Grass/Scrubs accounts for about 1.0% of the study area. Area under snow accounts for about 6.3% of the study area. The area under settlement is about 0.09% of the study area. The Classified imagery of the study area for Kalai-II HEP is enclosed as Figure-3.



**Figure-3: Classified imagery of the study area for Kalai-II HEP**

#### 4.6 Water Quality

Electrical Conductivity (EC) values in the surface water samples exhibited seasonal variation, reflecting generally low ionic concentrations. During the monsoon, EC ranged from 110 to 184  $\mu\text{S}/\text{cm}$ , slightly higher due to runoff and increased mineral dissolution. In winter, EC values dropped to a range of 60 to 152  $\mu\text{S}/\text{cm}$ , while the pre-monsoon season recorded EC between 98 and 146  $\mu\text{S}/\text{cm}$ . These values are indicative of dilute surface waters with minimal salinity or dissolved solids.

Total Hardness also remained low across all sampling sites, ranging from 18 to 76 mg/L, classifying the water as 'soft' to 'moderately hard' per standard water quality categories.

Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) levels were consistently low across all three seasons, pointing to minimal organic load and effective natural self-purification. This is likely due to the low population density, limited anthropogenic influence, and absence of industrial discharge in the surrounding areas.

Furthermore, heavy metal concentrations across all samples were found to be well within the permissible limits for drinking water as prescribed by national standards.

#### 4.7 Soil Quality

The soil demonstrates favorable chemical and physical characteristics, including near-neutral pH, low salinity and sodium hazards, and sufficient nutrient availability. These conditions collectively support sustainable agricultural productivity and maintain healthy soil ecosystems throughout the year.

#### 4.8 Ambient Air Quality

The concentration of various ambient air quality parameters, i.e.,  $\text{PM}_{10}$ ,  $\text{PM}_{2.5}$ ,  $\text{SO}_2$ , and  $\text{NO}_2$  in the study area covering three seasons viz. Pre-monsoon, monsoon and winter seasons

was found to be well within the permissible limits of National Ambient Air Quality standard applicable for rural residential area.

#### 4.9 Noise Levels

The ambient noise levels were monitored at various locations in the study area for three seasons viz. Pre-monsoon, monsoon and winter seasons. Across all seasons, the recorded noise levels remained well within the permissible limits for residential areas, indicating compliance with the prescribed ambient noise standards.

#### 4.10 Flora

As per Champion and Seth (1968), Rao and Panigrahi (1961), Sahni (1981), Rao and Hajra (1986), and Kaul and Haridasan (1987), forest types in Lohit basin in the project area were-

- Tropical evergreen forests,
- Himalayan subtropical forests,
- Himalayan Wet temperate forests, &
- Secondary forests

Ecological studies were conducted during three seasons within study area. A total of 209 plant species were recorded within a 10 km radius of the study area over 3 seasons (monsoon, winter, and pre-monsoon season). This data was compiled through extensive field surveys conducted during the study period, as well as by consulting secondary sources, including published literature and discussion with local people. The plant species recorded in different seasons were- trees (45), shrubs (29), herbs (84), grasses (24), ferns (6), climbers (17) and bamboos (4) in the study area. As per IUCN Red Data List, none of the species fall in threatened category. The dominant tree species at various sampling sites include *Macaranga denticulate*, *Celtis tetrandra*, *Brassaiopsis glomerulata*, *Macropanax dispermus*, *Trema orientale*, *Gmelina arborea*, and *Altingia excels*.

#### 4.11 Fauna

A total of 20 mammal species from 12 families were recorded in the study area during field studies conducted for 3 seasons. The commonly reported mammal species were common langur, Assamese macaque, Takin, wild dog, Indian fox, rats, Himalayan striped squirrel, Hodgson's flying squirrel, etc. Takin species is categorized as Schedule-I species, as per Indian Wildlife Protection Act.

Amongst avifauna, commonly reported species were common hoopoe, myna, wood shrike, rock pigeon, spotted dove, black drongo, house crow, Rock pigeon, Redjungle fowl, Grey-headed woodpecker, Red vented bulbul, etc. The commonly observed herpetofauna were Asian grass lizard, common toad, Khasi lizard water snake, etc. A total of 16 butterfly species belonging to the families Nymphalidae, Pieridae, Lycaenidae, and Papilionidae were reported from the Study Area.

There are no ecologically sensitive sites in the Study Area. The distance of ecologically sensitive sites w.r.t to project site are given as below:

- Kamlang Sanctuary : 13.4 km
- Namdapha National Park: 58.5 km
- Namdapha National Park and Tiger Reserve: 26.3 km

#### **4.12 Aquatic Ecology**

A total of 14 phytoplanktons and 12 zooplanktons species were represented during field studies for 3 seasons. A total of 10 macro benthos were identified, belonging to the families baetidae, limoniidae, chironomidae, corixidae, hydrophilidae, *ephemeridae*, heptageniidae, nereididae and tipulidae due to field studies.

#### **4.13 Fisheries**

The commonly observed fisheries during field studies conducted for three seasons were *Tor* spp. *Schizothorax*, *Acrossocheilus*, *Labeo*, *Chagunius*, *Garra* spp etc. The spawning ground of most of the fishes is characterized by a gravelly substrate with a slower water flow rate. *Tor* spp. are long distance migrants, while other species such as *Schizothorax*, *Acrossocheilus*, *Labeo*, *Chagunius*, and *Garra* spp. migrate mid to short distances. The spawning period for long distance migrants is from September to October, while for other species the migration period is mainly from June to August. All the fishes in the present study need a gravelly substrate for spawning.

#### **4.14 Socio-Economic Impacts**

The study area has 23 villages with a total population of 1934. The male and female population in study area comprises about 49.12% and 50.88% respectively of the total population. Schedule Tribes (ST) are the dominant caste group, accounting for 98.65% of the total population. The General Caste comprise of only 1.35% % of the total population. There are no Scheduled Caste household/ families in the Study Area villages.

It is observed that about 39.92% of the total population in the study area is literate, while about 60.08% are illiterate. About 40.12% of the total population is engaged in some form of economically productive activity or vocational activity, and have been designated as Total Working population About 87.25% of the working population is designated as Main workers while the remaining 12.75% has been designated as Marginal workers. Non-workers account for about 59.88% of the total population.

### **5. IMPACTS AND MITIGATION MEASURES**

Based on the project details and the baseline environmental status, potential impacts as a result of the construction and operation of the proposed Kalai-II hydroelectric project have been identified. The likely impacts on various aspects of environment are covered in the following Sections.

## **5.1 Impacts on Water Environmental**

### **a) Construction Phase**

#### **i) Sewage from labour camps**

The peak labour strength likely to be employed during project construction phase is about 1000 workers and 200 technical staff. Based on experience of similar projects and above referred assumptions, the increase in the population as a result of migration of labour population during construction phase is expected to be of the order of 3000. The domestic water requirement has been estimated as 135 lpcd. Thus, total water requirements work out to 0.41 mld, and sewage generated is expected to be of the order of 0.33 mld. The sewage shall be treated in Sewage Treatment Plants (STPs), prior to disposal.

#### **ii) Effluent from crushers**

During construction phase, at least one crusher will be commissioned at the quarry site by the contractor involved in construction activities. Water is required to wash the boulders and to lower the temperature of the crushing edge. The effluent from the crusher would contain high-suspended solids. A total quantity of 75 m<sup>3</sup>/hr of effluent is expected to be generated from various crushers. It is proposed to treat the effluent from crushers in before disposal so as to ameliorate even the marginal impacts likely to accrue on this account.

#### **iii) 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. The effluent shall be treated in settling tank prior to its disposal.

#### **iv) 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. The effluent shall be treated in oil and grease separator unit, prior to its disposal

#### **v) Effluent from 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. The effluents shall be treated prior to disposal.

### **b) Operation phase**

#### **i) Effluent from project colony**

About 50 technical staff will reside in the area in a well-designed colony with sewage treatment plant and other infrastructure facilities, the impact of water pollution due to disposal of sewage will be insignificant. The sewage generated will be treated in a Sewage Treatment Plant (STP), prior to disposal. Thus, no impact on receiving water body is anticipated.

**ii) Impacts on Reservoir water quality**

In the proposed project, most of the land coming under reservoir submergence is under trees, which shall be cleared, prior to filling up of the reservoir. The proposed project is envisaged as a runoff the river scheme, with significant diurnal variations in reservoir water level. In such a scenario, significant re-aeration from natural atmosphere takes place, which maintains Dissolved Oxygen in the water body. Thus, in the proposed project, no significant reduction in DO level in reservoir water is anticipated.

**iii) Eutrophication risks**

The area under agriculture is quite low, and fertilizer use is negligible. Hence, 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. The proposed project is envisaged as a run off the river scheme, with significant diurnal variations in reservoir water level. Thus, residence time would be of the order of few days, which is too small to cause any eutrophication. Thus, in project operation phase, problems of eutrophication, which is primarily caused by enrichment of nutrients in water, are not anticipated.

**iv) Impacts on river bed stability**

During construction phase, it is proposed to extract construction material from borrow areas in the river bed. The extraction of construction material will lead to formation of pits. The pits at sites after extraction of construction material will be under constant action on account of erosion in high flows and deposition under low flows. These pits with passage of time will be stabilized due to settlement of silt and sediments in the pits created on the river bed. Thus, no major impacts are anticipated on this account.

**5.2 Impacts on Hydrologic Regime**

The proposed Kalai-II HEP Electric Project is a run of the river scheme project on river Lohit. The water will be stored on a diurnal basins from MDDL to FRL for peaking power generation. During peaking power operations, downstream of Tail Race Disposal site, there will be a rated discharge of 1128.06 cumec.

There are no major users of water in the intervening stretch from the dam site to tail race disposal, as the river flows through a gorge. Thus, no major adverse impacts are anticipated on downstream water users. This can lead to adverse impacts on riverine ecology, which needs to be ameliorated through the release of Environmental Flows.

### **5.3 Impacts on Noise Environment**

#### **a) Construction phase**

##### **i) Impacts due to operation of construction equipment**

A cumulative effect of surface excavation activities at Dam complex generates enormous noise and vibration in the project and its surrounding areas. Controlled blasting shall be adopted to reduce the noise. With these measures the noise levels are attenuated significantly.

Regular servicing and maintenance of these of various construction equipment shall control the noise levels. The DG sets shall be provided with adequate enclosures to attenuate the noise levels. Controlled blasting is adopted to reduce the noise. With these measures the noise levels are attenuated significantly.

Notification will be given to residents within 300 feet (about 90 m) of major noise generating activities. The notification will describe the noise abatement measures that will be implemented. Monitoring of noise levels will be conducted during the construction phase of the project. In case of exceeding of pre-determined acceptable noise levels by the machinery will require the contractor(s) to stop work and remedy the situation prior to continuing construction.

##### **ii) Noise generated due to blasting**

Noise generated by blasting is instantaneous, site specific and depends on type, quantity of explosives, dimension of drill hole, degree of compaction of explosives in the hole and rock. noise level due to blasting operations are expected to be of the order of 75-86 dB(A). Since, the nearest settlement are about 0.8 to 1.0 km away, the incremental noise due to blasting is expected to be 50-60 dB(A). As the blasting is likely to last for 4 to 5 seconds depending on the charge, noise levels over this time would be instantaneous and short in duration. Considering attenuation due to various sources, even the instantaneous increase in noise level is not expected to 60 dB(A). Hence, noise level due to blasting is not expected to cause any significant adverse impact.

##### **iii) Impacts on labour**

The effect of high noise levels on the operating personnel needs 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, shall be avoided.

The ear muffs or plugs shall be provided to the workers operating in the high noise areas. The working hours of the laborers working on dredgers will decided considering the guidelines of Occupational Safety and Health Administration (OSHA), as outlined in Table-2.

**Table-2: Maximum Exposure Periods specified by OSHA**

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

**b) Operation phase**

There will be no high noise generating equipments/operations during operation phase

**5.4 Impacts on Air Environment****a) Construction Phase****i) Emissions from DG sets**

The power requirement for construction activities is estimated about 25.0 MVA. The operation of DG sets would lead to air pollution on account of increased SO<sub>2</sub> emissions from DG stack. It is proposed to install scrubber in DG sets, for control of SO<sub>2</sub> emissions from DG stack.

**ii) 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 dam and proposed power house sites. During the layout design, care shall be taken to ensure that the labour camps, colonies, etc. are located on the leeward side and outside the impact zone. (say about 500 m on the wind direction) of the crushers.

**iii) Fugitive Emissions from various sources**

The fugitive emissions i.e. mainly dust pollution is contributed by the vehicular traffic and storage of sand and other aggregates. 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, 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.

The fugitive emissions i.e. mainly dust pollution is contributed by the vehicular traffic and storage of sand and other aggregates. During crushing of the muck, moisture content is maintained in the sand and other aggregates by spraying water to arrest the entrainment of dust. Due to wet condition of stored material, fugitive emissions are controlled.

**iv) Dust emissions 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.

**v) Impacts Due to Fuel Combustion in Equipment and Vehicles**

The increased traffic load in any particular segment of the road will result into direct increase in pollutants released from the vehicles. However, based on modelling studies impacts are not expected to be significant.

**vi) Impacts on Soil Materials, Vegetation and Human Health**

The transportation of excavated/construction material on unpaved roads results in entrainment of fugitive dust emission. These dust particles are usually blown away along the wind direction and gets deposited on the vegetation and agricultural crops and can affect photosynthesis and other physiological activities of the plants. Based on air quality modelling studies, the impact is not expected to be significant.

**Mitigation Measures**

- Contractor will be responsible for maintaining properly functioning construction equipment to minimize exhaust.
- Construction equipment and vehicles will be turned off when not used for extended periods of time.
- Unnecessary idling of construction vehicles to be prohibited.
- Effective traffic management to be undertaken to avoid significant delays in and around the project area.
- Road damage caused by sub-project activities will be promptly attended to with proper road repair and maintenance work.
- Identification of construction limits (minimal area required for construction activities).
- When practical, excavated spoils will be removed as the contractor proceeds along the length of the activity.
- When necessary, stockpiling of excavated material will be covered or stacked at offsite location with muck being delivered as needed during the course of construction.
- Excessive soil on paved areas will be sprayed (wet) and/or swept and unpaved areas will be sprayed and/or mulched.
- Contractors will be required to cover stockpiled soils and trucks hauling soil, sand, and other loose materials
- Contractor shall ensure that there is effective traffic management at site.
- Dust Suppression – The roads, construction area and vicinity (access roads, and working areas) shall be sprinkled with water on daily basis to suppress dust.
- Crushers will be fitted with cyclones to control emissions of particulate matter.

- During the layout design, care needs to be taken to ensure that the labour camps, colonies, etc. are located on the leeward side and outside the impact zone. (say about 500 m on the wind direction) of the crushers.

### **b) Operation Phase**

In a water resources project, air pollution occurs mainly during project construction phase. During operation phase, no major impacts are envisaged.

## **5.5 Impacts on Land Environment**

### **a) Construction phase**

The total land required for the project is 869.3503 ha. The entire land to be acquired for the project is considered as forest land. About 230.4203 ha is part of Namsai Forest Division, and 638.93 ha is part of Anjaw Forest Division. On certain portions of land, community/private settlements are private/community properties. For such categories of land, compensation on account of forest land acquisition will be paid. The community land has been considered as the forest land for the purpose of preparation of Environmental Management Plan.

### **ii) Changes in land use and land cover**

The total land to be acquired for the project is about 869.3503 ha, of which about 638.456 ha of land shall come under reservoir submergence at Full Reservoir Level (FRL). Thus, land, which at present, is either under forests or community ownership will get converted into a water body (reservoir). About 9.6419 ha of area will be acquired for underground works.

The land to be acquired for other project appurtenances including dam, water conductor system, power house and other project appurtenances, will be converted in to a built-up area. In addition land will get converted into roads and other infrastructure, i.e., a built-up area. The area to be utilized for muck disposal or for quarrying will be permanently disturbed and will be stabilized or reclaimed, so that it does not environmental hazards in future.

The labour camps, contractor's working space will be used temporarily and shall be properly reclaimed on completion of construction activities.

### **iii) Impacts due to location of construction equipment**

Various types of equipment will be brought to the site, including 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.

Efforts shall be made to site the contractor's working space in such a way that the adverse impacts on environment are minimal, i.e. to locate the construction equipment, so that an impact on human and faunal population is minimal.

**iv) Soil erosion**

The runoff from the construction sites will have a natural tendency to flow towards river Lohit or its tributaries. River Lohit has significant flow, hence, impacts on this account are not expected to be significant. Appropriate measures to treat sewage/effluents generated from various sources to mitigate the adverse impacts to the extent possible.

**v) Impacts due to Muck disposal**

The total quantity of muck expected to be generated has been estimated to be of the order of 10448914.42 m<sup>3</sup> or 104.49 lac m<sup>3</sup>. A total of 04 muck dumping sites shall be used, with a total area of 70.22 ha and capacity of 139.029 lakh m<sup>3</sup>.

Various activities proposed as a part of the management plan are given as below:

- Land acquisition for muck dumping sites
- Civil works (construction of retaining walls, boulder crate walls etc.)
- Dumping of muck
- Levelling of the area, terracing and implementation of various engineering control measures e.g., boulder, crate wall, masonry wall, catch water drain.
- Spreading of soil
- Application of fertilizers to facilitate vegetation growth over disposal sites.

For stabilization of muck dumping areas following measures of engineering and biological measures have been proposed.

**Engineering Measures**

- Wire crate wall
- Boulder crate wall
- R.C.C
- Catch water Drain

**Biological Measures**

- Plantation of suitable tree species and soil binding species
- Plantation of ornamental plants
- Barbed wire fencing

**vi) Impacts due to Road Construction**

A network of project roads would be constructed to improve access to various work sites. These roads would be linked either to existing roads or to the project roads themselves. The roads are required to ensure easy transportation of construction material, equipment at site. The key impacts due to road are listed as below.

- Removal of trees on slopes and re-working of the slopes in the immediate vicinity of roads can encourage landslides, erosion gullies, etc.
- Construction of new roads increases the accessibility of a hitherto undisturbed areas resulting in greater human interferences and subsequent adverse impacts on the ecosystem.
- Increased air pollution during construction phase.

**Management Measures**

The various aspects to be considered while making the project roads are briefly described in the following figures and paragraphs.

**Construction**

- Area for clearing shall be kept minimum subject to the technical requirements of the road.
- Where erosion is likely to be a problem, clearing operations shall be so scheduled and performed that grading operations and permanent erosion control of features can follow immediately thereafter.
- Method of balanced cut and fill formation shall be adopted to avoid large difference in cut and fill quantities.
- Cut slopes shall be suitably protected by breast walls, provision of flat stable slopes, construction of catch water and intercepting drains, treatment of slopes and unstable areas above and underneath the road, etc.
- Landslide prone areas shall be treated with location specific engineering protection measures.
- Where rock blasting is involved, controlled blasting techniques shall be adopted to avoid over-shattering of hill faces.
- Excavated material shall be disposed after taking due measures.

**Drainage**

- All artificial drains shall be linked with the existing natural drainage system.
- Surface drains shall have gentle slopes. Where falls in levels are to be negotiated, check Wiers with silting basins shall be constructed and that soil is not eroded and carried away by high velocity flows.
- Location and alignment of culverts should also be so chosen as to avoid severe erosion at outlets and siltation at inlets.

**Grassing and Planting**

- Tree felling for road construction/works should be kept bare minimum and strict control must be exercised in consultation with the Forest Department. Equivalent amount of new trees should be planted as integral part of the project within the available land and if necessary, separate additional land may be acquired for this purpose.
- Afforestation of roadside land should be carried out to a sufficient distance on either side of the road.

**vii) Solid Waste Management Plan**

The labour colonies will generate substantial amount of municipal wastes. In view of the condition that might exist in the labour camps, most likely the solid wastes will contain majority of vegetable matter followed by paper cans and glasses. The degradable portion of the solid waste would be disposed off by composting. The non- degradable portion such as

plastic bottles, cans, etc. shall be segregated and disposed of at separate sites identified by the district administration. A suitable landfill site can be identified and designed to contain the municipal waste from all the Project Township, labour colonies, etc.

The project proponent shall earmark a suitable site for storage of hazardous waste, prior to collection by an authorized vendor for handling the hazardous work. Hazardous waste shall be sent or sold by the occupier to an authorized actual user or disposed in an authorized disposal facility only. Occupier shall transport wastes through an authorized or certified transporter to an authorized actual user or to an authorized disposal facility as per the provisions of these rules.

E- Waste Management shall be done in accordance with the procedures prescribed in the guidelines published by the Central Pollution Control Board from time to time. For Implementation of e-waste (Management and Handling) Amendment Rules, 2016.

#### **b) Operation Phase**

No additional land will be procured during operation phase. No additional muck dumps/ storages/installation of additional machineries will be established. No tree felling is envisaged. With these mitigation measures, the impact on the land will be insignificant.

#### **5.6 Impacts on river bank and their stability**

As a part of geological and competency appraisal of the reservoir area, areas of slope movements/ disturbances along river banks were identified and are listed as below:

- Fairly small slump or debris fall scars, mostly in the steeper overburden covered slopes. These are generally very shallow and limited in extent.
- A zone of crushed rock mass along the left bank road from the Chingwanti Bridge for about 0.5 km upstream. This is not an active landslide and is mainly due to the construction of the road in the left bank.

A total eight such slide zones, requiring river bank protection have been identified, A River Bank Restoration Plan shall be implemented with specific treatment measures for each site.

These are listed as below:

- Stabilization comprising wire crate walls and geo synthetics/ geo-textiles with provision of drainage.
- Stabilization measures for higher slopes comprising wire crate walls and geo-synthetics with proper drainage has been envisaged.
- Concrete walls, soil nails, shotcreting and geo- synthetics in addition to provision of proper drainage.

## 5.7 Impacts on flora

### a) Construction phase

#### i) Impacts on Terrestrial flora due to increased human interferences

The direct impact of construction activity of any water resource project in a Himalayan terrain is generally limited in the vicinity of the construction sites only. As mentioned earlier, a large population (3,000) including technical staff, workers and other group of people are likely to congregate in the area during the project construction phase. Workers and other population groups residing in the area may use fuel wood, if no alternate fuel is provided to them. Hence to minimize impacts, community kitchens have been recommended. These community kitchens shall use LPG or diesel as fuel.

#### ii) Acquisition of Forest Land

During project construction phase, land will be required for location of construction equipment, storage of construction material, muck disposal, widening of existing roads and construction of new project roads. The total land requirement for the project, is 869.3503 ha. A part of the community land also includes forest land as well. For EMP purposes, the entire quantity of land has been considered as the forest land. The dominant tree species at various sampling sites include *Macaranga denticulate*, *Celtis tetrandra*, *Brassaiopsis glomerulata*, *Macropanax dispermus*, *Trema orientale*, *Gmelina arborea*, and *Altingia excels*. The tree density in the submergence, dam and power house sites ranged from 356 to 412 per ha. The number of tree species observed at various sites ranged from 13 to 17. Normally in a dense forest, tree density is of the order of 1000-1200 trees/ha. Thus, in forest land to be acquired for the project, the tree density is low to moderate.

No Rare, Endangered or Threatened species are reported in the land to be acquired for the project.

#### iii) Impacts due to Vehicular movement and blasting

Dust is expected to be generated during blasting, vehicle movement for transportation of construction material or construction waste. The dust particles shall settle on the foliage of trees and plants, thereby reduction in amount of sunlight falling on tree foliage. This will reduce the photosynthetic activity. Based on experience in similar settings, the impact is expected to be localized upto a maximum of 50 to 100 m from the source. In addition, the area experiences rainfall for almost 8 to 9 months in a year. Thus, minimal deposition of dust is expected on flora. Thus, no significant impact is expected on this account.

## **Mitigation Measures**

### **A. Compensatory Afforestation**

The Indian Forest Conservation Act (1980) stipulates:

- If, non-forest land is not available, compensatory plantations are to be established on degraded forest lands, which must be twice the forest area affected or lost, and
- If, non-forest land is available, compensatory forest are to be raised over an area equivalent to the forest area affected or lost.

The total land to be acquired for the project shall be estimated. Compensatory afforestation is proposed in lieu of acquisition of this land. It is proposed to afforest the degraded forest patches and as per Forest Conservation Act (1980).

The total forest land to be acquired for the project is 869.3503 ha. It is proposed to cover double the area of degraded forest land under compensatory afforestation.

### **B. Biodiversity Conservation Plan**

As a part of Biodiversity Conservation Plan, the following measures are proposed:

- Afforestation
- Eco-Development Works
- Compensation for Loss of crops
- Establishment of Botanical Gardens for conservation and propagation of RET species.
- Publicity and awareness

#### **b) Operation Phase**

##### **i) Impacts due to increased accessibility**

During project operation phase, accessibility to the area will improve due to construction of roads, which in turn may increase human interferences leading to adverse impacts on the terrestrial ecosystem viz. flora and fauna of the area, due to human interferences.

During construction and operation phases and to prevent poaching in forest area around the project area, it is recommended that check posts be installed near major construction sites and labour camps to control poaching activities.

## **5.8 Impacts on Terrestrial fauna**

### **a) Constuction phase**

#### **i) Disturbance to wildlife**

The major portion 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. Thus, no impacts are anticipated on this account.

#### **ii) Impacts on migratory routes**

The project area and its surroundings are quite rich in avi-fauna. However, water birds are not very common in the area. The main reason for this phenomenon is that water birds

generally require quiescent or slow moving water environment. However, in the proposed project area and its surroundings due to terrain conditions, water flow is swift, which does not provide suitable habitat for the growth of water birds.

### **iii) Impacts due to Blasting**

The other major impact could be the blasting to be carried out during construction phase. This impact needs to be mitigated by adopting controlled blasting and strict surveillance regime and the same is proposed to be used in the project. This will reduce noise level and vibrations due to blasting to a great extent. Likewise, siting of construction equipment, godowns, stores, labour camps, etc. may generally disturb the fauna in the area. However, no large-scale fauna is observed in the area. Thus, impacts on this account are not expected to be significant. However, few stray animals sometimes venture in and around the project site. Thus, to minimize any harm due to poaching activities from immigrant labour population, strict anti-poaching surveillance measures need to be implemented, especially during project construction phase.

### **iv) Impacts due to labour population and construction activities**

During construction phase, large number of machinery and construction workers shall be mobilized, which may create disturbance to wildlife population in the vicinity of project area. The operation of various equipment will generate significant noise, especially during blasting which will have adverse impact on fauna of the area. The noise may scare the fauna and force them to migrate to other areas. Likewise, siting of construction plants, workshops, stores, labour camps etc. could also lead to adverse impact on fauna of the area.

During construction phase, accessibility to area will lead to influx of workers and the people associated with the allied activities from outside will also increase, which can lead to illegal hunting and poaching. The increase in human interference could have an impact on terrestrial ecosystem.

### **v) Impacts on Ecologically Sensitive Areas**

There are no ecologically sensitive sites in the Study Area. The distance of ecologically sensitive sites w.r.t to project site given as below:

- Kamlang Sanctuary : 13.4 km
- Namdapha National Park: 58.5 km
- Namdapha National Park and Tiger Reserve: 26.3 km

Thus, no impact on Ecologically Sensitive Areas is anticipated.

### **Mitigation Measures**

To minimize any harm due to poaching activities from immigrant labour population, strict anti-poaching surveillance measures shall be implemented, especially during project

construction phase. Sitting of construction equipment, godowns, stores, labour camps, etc. may generally disturb the fauna in the area.

A detailed Wildlife Protection Plan comprising of the following aspects shall be implemented:

- Habitat improvement for avi-fauna
- Anti-poaching Measures
- Creation of drinking water facilities
- Training and Awareness Programme

## **b) Operation phase**

### **i) Increased accessibility**

The increased accessibility to the area can lead to increased human interferences in the form of illegal logging, lopping of trees, collection of non-timber forest produce, etc. Since significant wildlife population is not found in the region, adverse impacts of such interferences are likely to be marginal.

### **ii) Impacts on avi-fauna**

The project area and its surroundings are quite rich in avi-fauna. However, water birds are not very common in the area. The main reason for this phenomenon is that water birds generally require quiescent or slow moving water environment. However, in the proposed project area and its surroundings due to terrain conditions, water flow is swift, which does not provide suitable habitat for the growth of water birds. With the damming of the river, a reservoir of an area of about 638.456 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.

### **Mitigation Measures**

An important measure for habitat improvement for avifauna is to be installation of artificial nest boxes in the influence zone and catchment area of the project after consultation with the forest department as well as local NGOs. These nest boxes has been found to be quite beneficial for attracting hole nester birds. The size and capacity of boxes vary from one species to another.

## **5.9 Impacts on 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 0.41 mld of water is required for the workers during the peak construction phase out of which 80% (i.e. about 0.33 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.

**Mitigation Measures**

Appropriate sewage treatment measures will be commissioned to treat the sewage and effluent generated from various sources to ameliorate adverse impacts on riverine ecology.

**b) Operation phase**

The completion of Kalai-II hydroelectric Project would bring about significant changes in the riverine ecology, as the river transforms from a fast-flowing water system to a quiescent lacustrine environment. Such an alteration of the habitat would bring changes in physical, chemical and biotic life.

**Mitigation Measures**

As a part of the mitigation measures, Environmental Flows have been recommended to minimize the impacts due to modification of hydrologic regime.

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

During the construction phase a large quantity of construction material like stones, pebbles, gravel and sand would be needed. Some amount of material is available in the river bed. 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. This is mainly because the dredged material gets released during one or all the operations mentioned below:

- excavation of material from the river bed.
- loss of material during transport to the surface.
- overflow from the dredger while loading
- loss of material from the dredger during transportation.

The cumulative impact of all the above operations is increase in turbidity levels. Good dredging practices can however, minimize turbidity. The dredging and deposition of dredged material may affect the survival and propagation of benthic organisms. The macro-benthic life which remains attached to the stones, boulders etc. gets dislodged and is carried away downstream by turbulent flow. The areas from where construction material is excavated, benthic fauna gets destroyed. In due course of time, however, the area gets recolonized, with fresh benthic fauna. The density and diversity of benthic fauna, will however, be less as compared with the pre-dredging levels.

**ii) Impacts due to discharge of sewage from labour camp/colony**

The proposed hydro-power project envisages construction of a project colony at village Hawai. The labour camp and colonies are proposed close to project site. It is proposed to treat the and effluents from various sources prior to their disposal.

**b) Operation Phase****i) Impacts due to damming of river**

The damming of river Lohit due to the proposed hydroelectric project will result in creation of about 638.456 ha of submergence area. The dam will change the fast flowing river to a quiescent lacustrine environment. The creation of a pond will bring about a number of alterations in physical, abiotic and biotic parameters both in upstream and downstream directions of the proposed dam site. The micro and macro benthic biota is likely to be most severely affected as a result of the proposed project.

The reduction in flow rate of river Lohit especially during lean period would lead to reduction in rate of flow may even create condition of semi-dessication in certain stretches of the river. This would result in loss of fish life by poaching. Hence, it is essential to maintain minimum flow required for well being of fish life till the disposal point of the tail race discharge.

**ii) Impacts on migratory fish species**

The fish fauna observed at various sampling sites belonged to 3 families i.e. Cyprinidae, Silisoridae and Cobitidae. The fish species observed in Kalai-II HEP project area include *Schizothorax richardsonii* and *Acrossocheilus hexagonolepis*.

Snow trout, a migratory fish species represented by *Schizothorax* sp. are endemic to Himalayas. In winter months, when the water temperature reduces, snow trouts migrate downstream for a considerable distance and constitute the major fisheries, particularly in the middle and lower stretches.

Mahaseer migrates upward and ascend to the smaller tributaries for breeding, During months of May and June. The construction of dam would affect the upward and downward migration of fish and may disturb the fish habitat.

**iii) Impacts on Aquatic Ecology due to modification of flow regime**

The commissioning of a hydroelectric project, significantly affects the hydrologic regime. The proposed hydroelectric project too will have similar impacts on hydrologic regime, with a corresponding impact on riverine ecology including fisheries. As a result, barring for monsoon season, (May to September), the river Lohit will have dry periods for few hours for generation of peaking power. This storage period will result in drying up of the river, downstream of the dam site. The dry period will be followed by a wet or flow period with uniform flow corresponding to the number of units/turbines generating hydropower. Thus, the riverine ecology will be affected on account of modification in hydrologic regime.

**iv) Impacts due to Reservoir Formation**

The reservoir formation would lead to conversion of lentic system to lotic system. This in turn is not conducive for bottom dweller species. The river stretches shall undergo through scarcity of water due to diversion and cannot sustain large fish die to its shallowness and low

discharge. Thus, reduced diversity affects the capacity of fisheries to fight against environmental stress. The changes in water quality specially water temperature, turbidity etc. can trigger the behavioral changes like spawning and migratory behavior as these physical parameters are considered as stimuli for fish migration. Shallow water and low turbidity may also increase the visual predation of fish population.

### **Mitigation Measures**

#### **A. Release of Environmental Flows**

The recommended Environmental Flows to be released in the Lohit basin study report are as follows:

- **Monsoon Season- June to September** - 20% of the average flows during 90 % dependable year.
- **Non-monsoon Non lean Season- October & November** - 20% of the average flows during 90% dependable year.
- **Non-monsoon Non lean Season- April & May** - 20% of the average flows during 90% dependable year.
- **Lean Season- December to March** - 15% of the average flows during 90% dependable year.

In line with the above, the recommended minimum environmental flows in the Lohit Basin Study have been adopted in the project designs, Power Potential Studies etc. which have been approved by CEA.

Recommendation of Environmental Flows in the Cumulative Impact Assessment & Carrying Capacity Study (CIA & CCS) of Lohit Basin Study is given in Table-3.

**Table-3: Recommendations of Environmental Flows in the CIA & CCS of Lohit Basin**

<b>S. No.</b>	<b>Season</b>	<b>Percentage of Environmental Flows</b>	<b>Average Environmental Flows (cumec)</b>
1.	Monsoon (June to September)	20%	163.48
2.	Lean Season (December to March)	15%	39.71
3.	Non Monsoon Non Lean Season (October and November)	20%	90.67
4.	Non Monsoon Non Lean Season (April and May)	20%	103.60

The recommended Environmental Flows as per Table-3 has been adopted.

The power station is proposed to comprise of 6 units of 190 MW each and 1 unit of 60 MW. One unit each of 60MW and 190MW i.e. 250 MW is envisaged to utilize the Environmental

Flows. These two units shall be operated to meet the requirements of the environmental flows into the river just downstream of the dam.

## **B. Sustenance of fisheries**

The stocking program shall comprise of the following:

- Acclimatization stocking (a new fish species is introduced in a water course)
- Supplementary stocking (a species already living in a water body)
- Transfer stocking (transportation of mature fish from one water body to another)
- Repetitive stocking (species which do not propagate in natural conditions).

It is proposed to implement supplementary stocking programmes for the project area. In addition to reservoir area, it is proposed to stock river Lohit for a length of 10 km each on the upstream and the downstream side of the Reservoir. The rate of stocking is proposed as 100 fingerlings of about 30 mm size per km. For reservoir area, the rate of stocking could be 200 fingerlings of about 30 mm size per ha. The stocking can be done annually by the Fisheries Department, State government of Arunachal Pradesh.

### **5.11 Increased Incidence of Water-related Diseases**

The construction of the proposed dam would convert riverine ecosystem into a lacustrine ecosystem. The vectors of various diseases may breed in shallow parts of the impounded water. The magnitude of breeding sites for mosquitoes and other vectors is in direct proportion to the spread area of impounded water is in direct proportion to the length of the shoreline. Adequate measures for supply of potable water and sewage treatment have been recommended as a part of Environmental Management Plan. A proper surveillance, immunization schedule and medical facilities would be provided for the labour population migrating into the project area.

## **6. ENVIRONMENTAL MANAGEMENT PLAN**

### **6.1 Labour Management Plan**

Construction projects, engage large number of contract workers, are highly prone to hazards pertaining to site activities. The proposed project like any other construction project has significant impact on health and safety during project construction and its operation stage, which need to be adequately addressed.

It is recommended that the contractors involved in project construction activities prepare a Health and Safety Plan, which shall cover the following aspects:

- Project specific health and safety objectives, targets and programmes in line with health and safety policy
- Resources, roles, responsibility and authority for implementation of health and safety rules
- Health and safety requirements to be followed by sub-contractors
- Operation control procedures (SOPs)

- Access control of employees
- Safety of visitors
- Management of critical activities such as work at a height, material handling and working with plant and machinery
- Fire prevention and firefighting plan
- Emergency preparedness and response plan
- Traffic management plan
- Provision of Personal Protective Equipment as per work requirement
- Health and safety performance monitoring measures such as Inspection, Audit Incident reporting and investigation procedure

## **6.2 Occupational Health Management Plan**

Before the work is initiated every day, the routine check-up especially with regard to its hydraulic systems, mechanical conditions, and other operating systems shall be performed. Initial medical examination for all workers must be arranged during the first year of appointment and the periodical check-up during subsequent years as per the requirements. Implementation of safety and health management system, Provision of necessary personal protective equipment and checking the efficacy measures through audits at regular intervals.

The key aspects to be covered under Occupational Health Management Plan are listed as below:

- Health and safety performance monitoring measures such as Inspection, Audit Incident reporting and investigation procedure
- Safety of Machine Use at Project Site
- Occupational Health & Safety (OHS)
- Occupational Health & Safety Measures to Control Dust Inhalation
- Noise Induced Hearing Loss (NIHL)
- Occupational Lung Diseases (OLD)

There will be regular health camps for all the workers and nearby rural people. Lung function tests, chest X-rays etc. shall be carried out and any health disorders will be evaluated. The budget shall be earmarked for the necessary protective devices and training needs.

## **6.3 Safety practices during construction phase**

The information on following aspects pertaining to safety have been presented in this Section:

- Personal Safety Equipment
- Rescue Team
- Illumination and Earthing
- Maintenance of Traffic and Safety on Public Roads
- Blasting
- Management of Explosives
- Traffic management during construction phase
- Measures to be taken during excavation of earth
- Safety practices during construction phase

- Fire protection in labour camp and staff colonies

#### 6.4 Catchment Area Treatment Plan

Sub-watersheds have been prioritized into different erosion groups using the Silt Yield Index (SYI) approach. The CAT plan has been formulated for intervening drainage catchment up to the Kalai-II Hydroelectric project on the Lohit River. Thus, the catchment area proposed to be treated in the present study is 1486 sq. km. (148600 ha). A detailed CAT Plan has been prepared and various measures alongwith provisioned cost is given in Table-4.

**Table-4: Estimated cost of CAT Plan Implementation**

S. No.	Measures	Unit	Qty.	Rate (Rs.)	Amount (Rs. lakh)
<b>1</b>	<b>Engineering Measures</b>				
a	Contour Bunding	Ha	195.25	52125.00	101.77
b	Brushwood Check Dams	Nos.	61.00	6251.84	3.81
c	Gabion Structures	Nos.	6.00	15843.00	9.51
d	DRSM Check Dam	Nos.	19.00	133200.00	61.27
	<b>Total</b>				<b>176.36</b>
<b>2</b>	<b>Biological Measures</b>				
	Afforestation including maintenance	Ha	1307.51	224000.00	<b>2928.82</b>
<b>3</b>	<b>Pasture Development</b>		464.00	100000.00	<b>464.00</b>
<b>4</b>	<b>Nursery Development</b>				
	Nursery Development (Including infrastructure development and maintenance)	L.S.			<b>300.00</b>
<b>5</b>	<b>Total (1-4)</b>				<b>3869.18</b>
<b>6</b>	<b>Micro Planning (@3% of Total (1-4))</b>				<b>116.075</b>
<b>7</b>	<b>Operational Support</b>	L.S.			<b>900.00</b>
<b>8</b>	<b>Community Development (@1% of Total (1-4))</b>				<b>38.692</b>
<b>9</b>	<b>Monitoring and Evaluation (@5% of Total (1-4))</b>				<b>193.459</b>
<b>10</b>	<b>Contingency (@5% of Total (1-4))</b>				<b>193.459</b>
	<b>Grand Total</b>				<b>5310.87</b>

#### 6.5 Greenbelt Development

Green belt around the reservoir would be created to avoid erosion of soil and prevention of land slips from the banks. The main objectives of creating a green belt around a reservoir are to:

- Check soil erosion around the reservoir
- Check landslides and slips around the reservoir
- Develop the habitat for wildlife particularly avi-fauna

The green belt will start from the immediate vicinity of the reservoir rim on both the banks, where moderate slopes are available for plantation. The average width of the green belt will be around 10 m varying depending upon the physiographic and land features.

The tree plantation will be done at a spacing of 2.5 x 2.5 m. About 1600 trees per ha will be planted. The maintenance of the plantation area will also be done by the project proponent. The treated waste water and the manure generated by composting of solid waste generated for labour camps will be used for the greenbelt development. The species for greenbelt development shall be selected in consultation with Forest Department

### **6.6 Energy Conservation Measures**

To provide an alternate for the energy requirement of the workers, contractor/s will be made responsible to provide subsidized kerosene/LPG to their workers which will in turn discourage them from illegal tree felling and removal of fuel wood and timber from the adjoining forests. A key component of achieving energy conservation would be the development of an Energy Management Action Plan. This plan would be included as part of the Construction and Operational EMPs.

## **7. RESETTLEMENT AND REHABILITATION PLAN**

The total land requirement for the Kalai II Hydro-Electric Project is estimated to be approximately 869.3503 hectares. During field surveys, it was observed that local residents possess a clear understanding of the physical location and extent of their traditional landholdings. However, due to the absence of formal land records in the state, these holdings have never been officially demarcated or documented. Instead, land extents are informally estimated by the farmers themselves, based on their own understanding and usage patterns.

Based on field assessments, a total of 961 Project Affected Families (PAFs) have been identified under the project and categorized according to the degree of impact. Of these, 171 PAFs (17.8%) are classified under Full Submergence, indicating the complete loss of homesteads due to project activities. Another 187 PAFs (19.5%) fall under the Highly Impacted category, meaning their houses are located within 100 meters of the project site and are likely to experience significant disturbances. The remaining 603 PAFs (62.7%) are categorized as Impacted, facing partial effects such as loss of agricultural land, plantations, gardens, restricted access, or other forms of moderate disruption. The above data is extracted solely based on RS-GIS base analysis; the numbers may slight change after the land measurement task by the responsible authority.

Out of a total of 961 Project Affected Families (PAFs), 875 households (approximately 91.0%) are affected by land acquisition, indicating a significant majority experiencing loss of

agricultural land, plantations, fruit garden or related assets etc. In contrast, only 86 households (about 9.0%) are not impacted in terms of losing land.

A Resttlement and Rehabilitation Plan has been formulated as per the norms of Right Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. The objectives of Resettlement Action Plan (RAP) are to:

- Identify adverse impacts and determine mitigation measures
- Present the entitlements and action plan for the affected persons for payment of compensation and assistance for restoring livelihoods, and improving or at least retaining the existing living standards in the post resettlement period.
- Facilitate design of a monitoring program to check the adequacy and implementation of mitigate measures.

### Measures for Resettlement

The details of measures for Resettlement are highlighted in Table-5. The cost estimate for development of infrastructure at Resettlement sites is given in Table-6.

**Table-5: Provisions in the proposed R&R Plan for Kalai-II HEP for Resettlement**

S. No.	Description	Unit	Assumed Provision#	Cost (Rs. lakh)
	<b>Housing Benefits and compensation</b>			
1	<p>a) If a house is lost in rural areas, a constructed house shall be provided as per the Indira Awas Yojana specifications.</p> <p>b) If a house is lost in urban areas, a constructed house shall be provided, which will be not less than 50 sq mts in plinth area</p> <p>c) In case family in urban areas does not opts to take the house offered, one-time financial assistance of not less than Rs. 150,000/- for house construction</p> <p>d) If any affected family in rural areas so prefers, the equivalent cost of the house may be offered in lieu of the constructed house</p>		<p>181 PAFs @ 50 Sqm per AF = 9050 sqm</p> <p>0.91 ha considering cost of land as per 30.0 lakh/ha</p>	27.3
<b>2.</b>	<b>Cattle Shed</b>			
	One-time financial assistance of a minimum of Rs. 55,000/- or as the appropriate Government may, by notification specify, for construction of cattle shed	Per family	181 PAFs x Rs. 50,000/ PAF	90.5
<b>3.</b>	<b>Transportation Grant</b>			
	One time financial assistance of Rs. 50,000/-for each displaced family for shifting of the family, building materials,	Per family	181 PAF x Rs. 50,000/ PAF	90.5

S. No.	Description	Unit	Assumed Provision#	Cost (Rs. lakh)
	belongings and cattle.			
<b>4.</b>	<b>Subsistence Allowance</b>			
	a) 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	Per family	181 PAFs x Rs.3000 p.m. for 12 months	65.16
<b>5.</b>	<b>One time Resettlement Allowance</b>			
	Each affected family shall be given a onetime "Resettlement Allowance" of Rs. 150,000/	Per family	181 PAFs X Rs. 150000/ PAF	271.5
<b>6.</b>	<b>Stamp Duty and Registration</b>			
	a) 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 b) The land for house allotted to the affected families shall be free from all encumbrance c) The land and the house allotted may be in the joint names of wife and husband of the affected family.			
	<b>TOTAL</b>			<b>Rs 544.96</b>

**Note:** The above provision is tentative and subject to change in line with the R&R Policy pronounced by the state.

**Table-6: Cost estimate for development of infrastructure at Resettlement sites**

S. No.	Additional Area Development Activities	Cost (Rs.lakh)
1	Power supply	217.20
2	Piped water supply	150.00
3	Sanitation facilities	150.00
4	Higher secondary school with play ground	225.00
5	Health Care Facility	75.00
	<b>Total</b>	<b>817.20</b>

### Measures for Rehabilitation

The details of the provisions for the implementation of Rehabilitation Plan at the site are provided in Table-7. The provisions in the proposed R&R Plan for Kalai-II HEP for skill development are given in Table-8. The costing in the Rehabilitation and Resettlement Plan is tentative and the final costing shall be arrived after the completion of the property survey and

the provisions in the approved R&R Plan. The training programmes of Ministry of Tribal Affairs (MoTA) are given in Table-9

**Table-7: Provisions in the proposed R&R Plan for Kalai-II HEP for Rehabilitation**

<b>S. No</b>	<b>Description</b>	<b>Unit</b>	<b>Assumed Provision#</b>	<b>Cost (Rs. lakh)</b>
<b>1</b>	<b>Rural artists / Self-employed</b>			
	One-time financial assistance of a minimum of Rs. 50,000/- 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		961 PAFs x Rs.50000/ PAF	480.5
<b>2</b>	<b>Cattle Shed</b>			
	One-time financial assistance of a minimum of Rs. 50,000/- or as the appropriate Government may, by notification specify, for construction of cattle shed or	Per family	961 PAFs x Rs.50000/ PAF	480.5
<b>3</b>	<b>Transportation Grant</b>			
	One time financial assistance of Rs. 100,000/-for each displaced family for shifting of the family, building materials, belongings and cattle.	Per family	961 PAFs x Rs.100,000/ PAF	961.0
<b>4</b>	<b>Subsistence Allowance</b>			
	<p>a) Each affected family, losing land, will be given a monthly subsistence allowance equivalent to Rs. 5000/ month for a period of one year from the date of award.</p> <p>b) Scheduled Castes and the Scheduled Tribes displaced from Scheduled Areas shall receive an amount equivalent to Rs. 50,000/-, in addition to subsistence allowance</p>	Per family	961 PAF x Rs. 5000 p.m. x 12 months	576.6
<b>5</b>	<b>Choice of Annuity or Employment</b>			
	<p>a) At least one member per affected family will be provided job (either in the project or arrange for a job in such other project), after providing suitable training and skill development in the required field</p> <p>b) Onetime payment of Rs. 500,000 per affected family</p> <p>c) Annuity policies that shall pay not less than Rs. 2000 per month per family for 20 years, with appropriate indexation to the Consumer Price Index for Agricultural Labourers</p>		961 PAFs x Rs.500,000 per PAF	<b>4805.0</b>
<b>Total</b>				<b>7303.6</b>

**Note:** The above provision is tentative and subject to change in line with the R&R Policy pronounced by the state. The cost is exclusive of the land compensation, which shall be

borne by the project proponent as per the rate fixed by District administration and as per the guidelines as given in the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013.

**Table -8: Provisions in the proposed R&R Plan for Kalai-II HEP for skill development**

Description	Unit	Assumed Provision	Cost (Rs. lakh)
Reimbursement of tuition fee @ of Rs. 800.00 per month to all children (as on date of Section-4 notification) from each affected family for pursuing education up to Class XII. In case of girl child, the reimbursement of tuition fee shall be @ Rs. 1000 per month for 12 years other criteria remaining same		1000 Nos (500 girls and 500 boys)	<b>1296.0</b>
Educational scholarship @ Rs. 1000.00 per month to all children (as on date of Section-4 notification) from each affected family for pursuing higher education, i.e. graduation course, for stipulated course duration. In case of girl child, the Educational scholarship shall be @ Rs. 1500.00 per month for 12 years other criteria remaining same.		600 Nos (300 girls and 300 boys)	<b>1080.0</b>
The affected families not covered under clause 7.11.1 to 7.11.2 above, would be eligible for vocational training. The training would be imparted at ITI's for skill development to two persons per eligible family OR reimbursement up to Rs. 20000.00 per annum per person for two persons per eligible family for some identified vocational training of one year duration so as to enable such persons to take on suitable jobs.		1000 Nos	<b>400.0</b>
<b>Total</b>			<b>2776.0</b>

**Table-9: Scheme of MoTA identified for skill development of PAPs**

S. No.	Options for Skill development
1.	Bamboo Furniture Making
2.	Dhaba & Restaurant
3.	Fruit & Vegetable shop
4.	Horticulture
5.	Minor Forest Product
6.	Piggery
7.	Poultry

**Measures for Compensation for loss of rights of collection of forest produce and traditional land use of Unclassed State Forests (USF) and Reserve Forests (RF).**

The amount of compensation on account of social impact and loss of customary rights of tribal people to collect & use forest produce and the traditional land use of Unclassed State Forests (USF) and Reserve Forests (RF), if any,

- Loss of animal husbandry, loss of fodder is 10% of NPVs i.e.(10% of 626,000) Rs. 62,600/ha for Rs. 544.21 lakh for 869.3503 ha.

**Budget for Resettlement & Rehabilitation Plan**

A total budget of Rs. 11985.97 lakh would be required for implementation of R&R Plan. The details are given in Table-10.

**Table-10: Budgetary estimate for implementation of R&R Plan**

S. No.	R&R Components	Cost (Rs. lakh)
1.	Resettlement plan	544.96
2.	Facilities at Resettlement Site	817.20
3.	Rehabilitation plan	7303.6
4.	Skill development	2776.0
5.	Compensation for loss of rights on forest produce	544.21
	<b>Total</b>	<b>11985.97</b>

**8. LOCAL AREA DEVELOPMENT PLAN (LADP)**

The objective of the plan is to empower the families of the study area villages and partially affected villages. Villages that would be fully affected, which need to be relocated, shall be provided R&R benefits as per the Policy and also other resettlement benefits. An amount of Rs. 68.54 crore is being provisioned for implementation of Local Area Development Plan (LADP).

**Upgradation of infrastructure of schools in the study area:**

Project Proponent shall upgrade infrastructure in various schools. An amount of Rs. 65 lakh per school shall be given (Refer Table-11). 7 schools are proposed to be upgraded, an amount of Rs. 595 lakh needs to be earmarked for this purpose.

**Table-11: Break up of cost required for upgradation of existing schools**

S. No.	Particular	Amount (Rs.lakh)
1	Building (classrooms 4 + office room 1 + staff room+ 1 hall, whitewashing & painting)	30
2	Furniture & fixtures and equipments	10
3	Equipment for laboratories	20
4	Up-gradation of school library	10
5	Van for use by students and teachers	15
6	Improvement of drinking water facilities	10
	<b>Total</b>	<b>85</b>
	<b>Total cost for 7 No. schools</b>	<b>595</b>

**Modality for Grant of Scholarships**

It is proposed to give incentives to such youths who wish to pursue college or higher education. These students will be supported in their college education as well. For college education, each student will get monthly support for meeting their fee and study material requirement. In addition, they will get monthly support for meeting their hostel requirements, as they will have to move out of their areas for higher studies. It is proposed that monthly scholarship shall be given to about 200 students.

A total of 400 students will be supported for college education. A total amount of Rs. 864.0 lakh has been earmarked for providing scholarships, as part of local area development plan. The details are given in Table-12.

**Table-12: Budget for scholarships**

S. No.	Activities	Amount (Rs. lakh)
1	School education (Rs. 1000/month for 144 months for 200 students)	288.0
2	College education	
	a) Fees & study material (@ Rs. 1000/ student for 48 months for 400 students)	192.0
	b) Hostel expenses (@ Rs. 2000/month for 48 months for 400 students)	384.0
	<b>Total</b>	<b>864.0</b>

**Healthcare Facilities for Healthcare facilities**

An amount of Rs. 995.0 lakh has been earmarked for up-gradation of healthcare facilities in the vicinity of the project Area. The details are given in Table-13.

**Table-13: Cost for up-gradation of upgradation of healthcare facilities**

S. No.	Item	Amount (Rs. lakh)
1.	Upgradation of Hospital building	400.0
2.	Furniture, Beds and other items	30.0
3.	Upgradation of Pathological laboratory	150.0
4.	X-ray machine, ECG machine, ventilator etc	90.0
5.	Upgradation of operation theater	150.0
6.	Purchase of two vans with medical facilities	80.0
7.	Computer, printers, UPS, etc	5.0
8.	Other expenses	50.0
	<b>Total</b>	<b>955.0</b>

**Measures for Improvement of Infrastructure & Living Standards**

An amount of Rs. 2920.0 lakh has been earmarked for various measures improving the living standards. The details are given in Table-14.

**Table-14: Budget for Improvement in Infrastructure & Living Standard**

S. No.	Items	Budget (Rs.lakh)
1.	Voluntary organization working for welfare of local by hiring of NGOs	50.0
2.	Support for mobile towers	100.0
3.	Transmission line 33kv/11kv to villages -100 Km	900.0
4.	Solar Panel for lighting	200.0
5.	Fruit / Juice caning centers, computer centers etc	100.0
6.	Foot over bridges	1000.0
7.	Construction of post-offices etc.	20.0
8.	Community development works	450.0
	<b>Total</b>	<b>2920.0</b>

**Training / Educational Institutes**

Project Proponent will construct a Training / Educational Institute for imparting training / education to local people. The location of the institute will be decided in consultation with State Government and the institute constructed on land provided by District Administration. A sum of Rs. 1500 lakh shall be contributed by the project proponent.

**Preservation of Worship Place**

Request was made to undertake preservation of worship place in the area. A budget of about Rs 20 lakh has been envisaged for the same.

**Budget for Local Area Development Plan**

A sum of Rs. 6854.0 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-15.

**Table-15: Budget for Local Area Development Plan**

S. No.	Items	Budget (Rs. Lakhs)
2.	Upgradation of Educational facilities	595.0
1.	Scholarship to students	864.0
3.	Expenditure on Health care facilities	955.0
4.	Improvement of Infrastructure & living standards	2920.0
5.	Expenditure on Training / Educational Institute	1500.0
6.	Preservation of Worship Place	20.00
	<b>Total</b>	<b>6854.0</b>

**9. DISASTER MANAGEMENT PLAN**

The key features of Disaster Management Plan are:

- Dam Safety and Maintenance Manual
- Emergency Action Plan (EAP)
- Administration and Procedural Aspects
- Preventive Action
- Communication System
- Evacuation Plans
- Evacuation Team
- Public Awareness for Disaster Mitigation
- Notifications
- Notification Procedures
- Management after receding of Flood Wates
- Village Level Incidence Response Team

The estimated total cost of execution of disaster management plan including the equipment would be Rs. 4545.0 lakh. The details are given in Table-16.

**Table-16: Estimated cost of Disaster Management Plan of Kalai-II HEP**

S. No	Particulars	Amount (Rs. lakh)
1	Surveillance and monitoring	60.00
2	Infrastructure development for prevention	350.00

<b>S. No</b>	<b>Particulars</b>	<b>Amount (Rs. lakh)</b>
3	Administrative and Procedural Aspects	200.00
4	Communication System	425.00
5	Recovery, Evacuation and rescue operation	920.00
6	Mitigation and Rehabilitation	2450.00
7	Notification and Public awareness	50.00
8	Miscellaneous	100.00
	<b>Total</b>	<b>4545.0</b>

## **10. PLAN FOR PROTECTION OF CULTURAL IDENTITY**

The project proponents shall implement various measures to preserve the cultural identity of the locals on account of interferences and intermingling due to labour population migrating in the project area. The proposed measures include:

- The requisite interaction with indigenous people will be managed with care and sensitivity through local personnel, in consultation with Gaon Burah (traditional headman of the village).
- An approach of only essential interaction with the indigenous people outside the project area shall be adopted by the project proponents so that there shall be no impact of different culture and people in social and cultural life of the indigenous people.
- No exploitation of natural resources in and around the project area by the labourers / staff of project proponents as well as of contractors will be allowed.
- Necessary measures shall be initiated to curb any form of extraction of resources from the village outside the project area by the labourers / staff of project proponents as well as of contractors.
- Project area shall be fully and effectively demarcated.
- Check gates at different locations shall be installed.
- Vehicles on road will be allowed to move under notified speed limit to avert possible road accidents.
- Traffic on road will be strictly monitored to ensure that there is no interaction between the indigenous people and the labourers/ staff of project proponents as well as contractors.
- Specific pass shall be issued to the worker leaving the project area.
- Strict action shall be taken against the worker/officials not adhering the norms and regulations.
- A committee with participant of local leaders/prominent person shall be constituted to deal with the problems arising due to any illegal activities by the workers.

## 11. ENVIRONMENTAL MONITORING PROGRAMME

An Environmental Monitoring Programme shall be undertaken during construction and operation phases of the project. The details of Environmental Monitoring Programme are given in Tables- 17 and 18 respectively.

**Table-17: Summary of Environmental Monitoring Programme during Project construction Phase**

S. No.	Item	Parameters	Frequency	Location
1.	Effluent from Sewage Treatment Plants (STP)	pH, BOD, COD, TSS, TDS	Once every month	Before and after treatment from each STP
2.	Ambient Noise Level	Equivalent noise level ( $L_{eq}$ )	Once in three months	At major construction sites.
3.	Ambient Air quality	PM <sub>10</sub> , SO <sub>2</sub> and NO <sub>2</sub>	Once every season	At major construction sites
4.	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

**Table-18: 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	Thrice a year	<ul style="list-style-type: none"> <li>1 km upstream of dam site</li> <li>Water spread area</li> <li>1, 3 and 5 km downstream of dam site</li> </ul>
2.	Effluent from Sewage Treatment Plant (STP)	pH, BOD, COD, TSS, TDS	Once every week	<ul style="list-style-type: none"> <li>Before and after treatment from Sewage Treatment Plant (STP)</li> </ul>
3.	Meteorology	Temperature, humidity, wind speed & direction, rainfall	Continuous	<ul style="list-style-type: none"> <li>Near Dam site</li> </ul>
4.	Terrestrial Ecology	<ul style="list-style-type: none"> <li>Qualitative and Quantitative assessment of terrestrial flora and fauna.</li> <li>Monitoring of restoration of muck disposal area and quarry sites</li> <li>Status of afforestation</li> </ul>	Three seasons in a year	Afforestation sites, Greenbelt development sites, Muck disposal and quarry sites, forest areas adjacent to project sites.

S. No.	Items	Parameters	Frequency	Location
		programmes and greenbelt development • Changes in migration patterns of terrestrial faunal species		
5.	Aquatic Ecology	<ul style="list-style-type: none"> <li>• Phytoplanktons</li> <li>• Zooplanktons</li> <li>• Benthic life</li> <li>• Fish composition in reservoir</li> <li>• Fish yield in reservoir</li> </ul>	Three seasons in a year	<ul style="list-style-type: none"> <li>• 1 km upstream of dam site</li> <li>• Water spread area</li> <li>• 1, 3 and 5 km downstream of dam site</li> </ul>
6.	Water-related diseases	Identification of water-related diseases, sites, adequacy of local vector control measures, etc.	Three times a year	<ul style="list-style-type: none"> <li>• Villages adjacent to project sites</li> </ul>
7.	Landuse	Landuse pattern using satellite data	Once in a year	Catchment area

## 12. BUDGETARY ALLOCATION FOR VARIOUS MITIGATION MEASURES

### 12.1 Budgetary Allocation for Environmental Management Plan

The total earmarked for implementation and Environmental Management Plan is Rs. 1148.28 lakh. The details are given in Table-19.

**Table-19: Cost estimate for Implementing Environmental Management Plan**

S. No.	Item	Cost (Rs. lakh)
1.	Implementation of Safety Measures	155.0
2.	Cost estimate for Medical Check-up	414.0
3.	Fisheries Management Plan	240.0
4.	Greenbelt Development	139.28
5.	Public Awareness Programme	100.0
6.	Conservation Plan for Schedule-I Faunal Species	100.0
	<b>Total</b>	<b>1148.28</b>

### 12.2 Budget for Allocation for implementation of Mitigation Measures

The cost for implementation of mitigation measures is Rs. 28437.15 lakh. The details are given in Table-20.

**Table-20: Cost for Implementing Mitigation Measures**

S. No.	Item	Cost (Rs. lakh)
1.	Sanitary facilities in labour camps	135.00
2.	Treatment of Effluents from Crushers	50.0
3.	Treatment of effluents from batching plants	50.0
4.	Treatment of effluent from fabrication units and workshops	50.0
5.	Treatment of effluent from tunneling	50.0
6.	Air Pollution Control Measures	296.31
7.	Noise Control Measures	15.00

S. No.	Item	Cost (Rs. lakh)
8.	Stabilization of quarry sites	408.78
9.	Landscaping and Restoration of Construction Areas	131.60
10.	Stabilization of Muck Disposal Sites	6159.29
11.	Municipal Solid Waste Management	201.980
12.	Hazardous Waste Management	50.0
13.	E-waste Management	50.0
14.	Construction & Demolition Waste Management	50.0
15.	Environmental Management in Road Construction	520.0
16.	River Bank Protection Plan	4041.0
17.	Provision of Free Fuel for labour and technical staff during construction phase	1134.09
18.	Compensatory Afforestation	12170.90
19.	Biodiversity Conservation Plan	450.00
20.	Wildlife protection Plan	814.64
21.	Habitat Improvement for Avi-Fauna	141.00
22.	Development of Hatcheries	334.90
23.	Public Health Delivery System	1132.66
	<b>Total</b>	<b>28437.15</b>

### 12.3 Budget Allocation for implementation of Additional Studies

The cost for implementation of additional measures is Rs.28939.84 lakh. The details are given in Table-21.

**Table-21: Cost for Implementing Additional Measures**

S. No.	Item	Cost (Rs. lakh)
1.	Resettlement and Rehabilitation Plan	11985.97
2.	Local Area Development Plan	6854.0
3.	Catchment Area Treatment Plan	5310.87
4.	Disaster Management Plan	4545.00
5.	Plan for Protection of Cultural Identity of Locals	244.00
	<b>Total</b>	<b>28939.84</b>

### 12.4 Budget Allocation for implementation of Environmental Monitoring Programme

The total cost required for Environmental Monitoring programme during project construction shall be Rs. 162.22 lakh. The details are given in Table- 22 to 24.

**Table-22: Cost for implementing Environmental Monitoring Programme during project construction phase**

Item	Cost per year (Rs. lakh)	Cost (Rs. lakh)
Effluent from labour camps	1.92	16.53
Ambient air quality monitoring	5.76	49.59
Incidence of water related diseases	10.0	86.10
<b>Total</b>	<b>17.68</b>	<b>152.22</b>

**Table-23: Cost for purchase of equipment for Environmental Monitoring Programme during project construction phase**

Item	Cost (Rs. lakh)
Set up of meteorological laboratory	7.0
Purchase of Noise meter	3.0
<b>Total</b>	<b>10.0</b>

**Table-24: total Cost for implementing Environmental Monitoring Programme during project construction phase**

Item	Cost (Rs. lakh)
Environmental Monitoring	152.22
purchase of equipment for Environmental Monitoring Programme	10.0
<b>Total</b>	<b>162.22</b>

**12.5 Budget for Implementation of various measures**

The total budget earmarked for implementation of various measures is Rs. 58687.49 lakh.

The details are given in Table-25.

**Table-25: Summary of Budget earmarked for implementation of various measures**

S. No.	Activity	Budget (Rs. lakh)
1.	Environmental Management Plan	1148.28
2.	Mitigation measures	28437.15
3.	Measures outlined in Additional studies	28939.84
4.	Environmental Monitoring Programme during construction phase	162.22
	<b>Total</b>	<b>58687.49</b>



# THDC INDIA LIMITED



## WAPCOS LIMITED

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