



CISMHE

CENTRE FOR INTER-DISCIPLINARY STUDIES OF
MOUNTAIN & HILL ENVIRONMENT
University of Delhi, Delhi

Environmental Impact Assessment and Management Plan for 1750 MW Demwe Lower HE Project

Executive Summary



Prepared for:



Athena Demwe Power Private Limited,

JULY, 2009

Executive Summary

1.0 INTRODUCTION

The State of Arunachal Pradesh lies between $26^{\circ} 28'$ to $29^{\circ} 30'$ latitudes and $91^{\circ} 30'$ to $97^{\circ} 30'$ longitudes and forms the easternmost state of India and is drained by mighty Siang, Dibang, Lohit, and Bharali rivers to form together the mighty Brahmaputra river which drains through the State of Assam to finally converge into the Bay of Bengal. Its northern limit is demarcated by Indo-Tibet Plateau and Yunan province, the southern limit is defined by the State of Assam, whereas the eastern limit is demarcated by Myanmar and the western limit by Bhutan. The international boundary between India and China is defined by McMohan line. The total geographical area of Arunachal Pradesh is 83,743 sq km. and total population of the state is 1,096,702 (Census of India 2001). The state at present comprises 16 districts with Itanagar as the state capital. The average population density of the state is about 13 persons per sq km and it varies from 4 persons/sq km in Dibang Valley to 42 persons/sq km in Tirap District.

Based on the projections made in the 16th Electric Power Survey, an additional generating capacity of over 100,000 MW needs to be added to ensure "Power on Demand" by 2012. An estimated installed capacity of 58,971 MW has been assessed from the north-eastern sector of India, out of which about 50,328 MW capacity is assessed in Arunachal Pradesh from basins of Dibang, Siang, Subansiri and Lohit rivers, in Arunachal Pradesh but so far a capacity of 423.5 MW only has been developed which is just 0.84 % of the total potential.

The proposed Demwe Lower Hydroelectric Project falls in the foothills of Lohit basin and is proposed on the river Lohit, a tributary of mighty Brahmaputra in Lohit District of Arunachal Pradesh (Refer **Figure 1** for location map and project boundaries; **Figure 2** gives the layout map of the project). The project is located about one km upstream of Brahamkund bridge on NH 52 and falls in Lohit district of the State of Arunachal Pradesh. The project area can be accessed from

Dibrugarh airport, which is about 550 km from Guwahati airport. The project site is about 215 km from Dibrugarh and about 160 km from Tinsukia, the nearest rail head. Brahamkund is the important holy place near the proposed project site. The district head quarter Tezu is about 40 km on hill road from the project site. The project Demwe Upper HEP, a cascade development of Demwe HEP being developing by ADPPL, is about 80 km from the proposed Demwe Lower HE Project.

The Salient Features of the Project

1	Location	
	State	Arunachal Pradesh
	District	Lohit
	River	Lohit
	Access	
	Airport	Dibrugarh - 215 km (Guwahati to Dibrugarh = 550 Km)
	Rail Head	Tinsukia - 160 km
	Road Head	Parasuram Kund – 1 km
	Geographical co-ordinates of Dam Site	
	Latitude (N)	27° 52' 48"
	Longitude (E)	96° 22' 39"
	Map reference	Survey of India topo-sheet 92A/5
2	Meteorology	
	Average Rainfall	3000 mm
	Maximum Rainfall	5000 mm
	Minimum Rainfall	2500 mm
	Atmospheric Temperature	
	Average Maximum Temp.	39°C (at Tezu)
	Average Minimum Temp.	8°C (at Tezu)
3	Hydrology	
	Catchment Area	20,174 sq. km
	PMF	28,500 cumecs
4	Reservoir	
	Maximum Water Level	424.80 m
	Full Reservoir Level	424.80 m
	Minimum Drawdown Level	408.00 m
	Water Spread at FRL	1131 Hectare
	Storage at MWL	516.38 MCM
	Storage at FRL	516.38 MCM
	Storage at MDDL	345.18 MCM
	Live Storage	171.20 MCM

5	Dam	
	Type	Concrete Gravity
	Length at top	474.35 m
	Overflow	219.70 m
	Non-overflow	254.65 m
	Top Width	6.00 m
	Top Elevation	426.80 m
	Maximum Height above deepest foundation	163.12 m
6	Spillway	
	Type	Sluice /Surface Ogee spillway type
	Capacity	32300.00cumecs
	No. Of Gates	Surface Ogee type– 1No. Sluice spillway – 12 Nos.
	Size of Gates	Surface Ogee -12.5m(W)X18.0 m(H) Sluice spillway -8.6m (W) X 11.0 m(H)
	Crest Level	Surface Ogee type -406.80 m Sluice spillway -360.00 m
7	Diversion Tunnels	
	Nos, Size & Shape	5Nos.-14.0 m Horse Shoe shaped on right bank and 1No.-6.00m Horse Shoe shaped on left bank,
	Length	14.0 m – average length of 1100 m 6.0 m – 950 m
	Design Discharge	12600.00 Cumecs
	Invert Level at Tunnel Inlet	EL 300.00 m
8	Power Intake	
	Type and Location	Rectangular forebay type with inclined trash rack on right bank of Lohit River Inclined at 15° to dam axis, adjoining Dam block 19.
	Size	160 m long, 32.57m wide and 48.8 m high
	Design Discharge	2085Cumecs

9	Pressure Shafts	
	Nos., Diameter and type	5 Nos. 10.0 m Dia, underground parallel @ 36m c/c
	Length	571 m (average) including 175.92 m vertical shaft
	Liner	Steel liner of varying thickness of 28 mm to 36 mm
10	Power House	
	Type and Location	Surface powerhouse on right bank of Lohit River about 650 m downstream of dam axis
	Design Discharge	1729 cumecs at design head
	Design Head	112.00 m (net)
	Size	PH Hall: 200.57 m (l) x 28m (w) x 50 m (h)
	Type of Turbine and no. of units	Vertical Francis, 5 units of 342 MW each + 1 unit of 40.0 MW
	Installed Capacity	1750 MW
	Turbine Centre Line Level	EI. 291.90 m
	Service Bay Level	EI. 306.60 m
	Minimum Tail Water Level	EI. 297.90 m
11	Tailrace	
	Details	Open channel, 186.2 m wide, 130 m long
12	Power Generation	
	Installed Capacity	5 X 342 MW +1 X 40 MW = 1750 MW
	Design Energy: Annual generation in 90% Dependable Year at 95% plant availability	6398 Million Units

The main objective of the present study is to carry out the Comprehensive Environmental Impact Assessment (EIA) for the proposed Demwe Lower HEP to meet the Environmental clearance criteria of Ministry of Environment and Forests, Government of India.

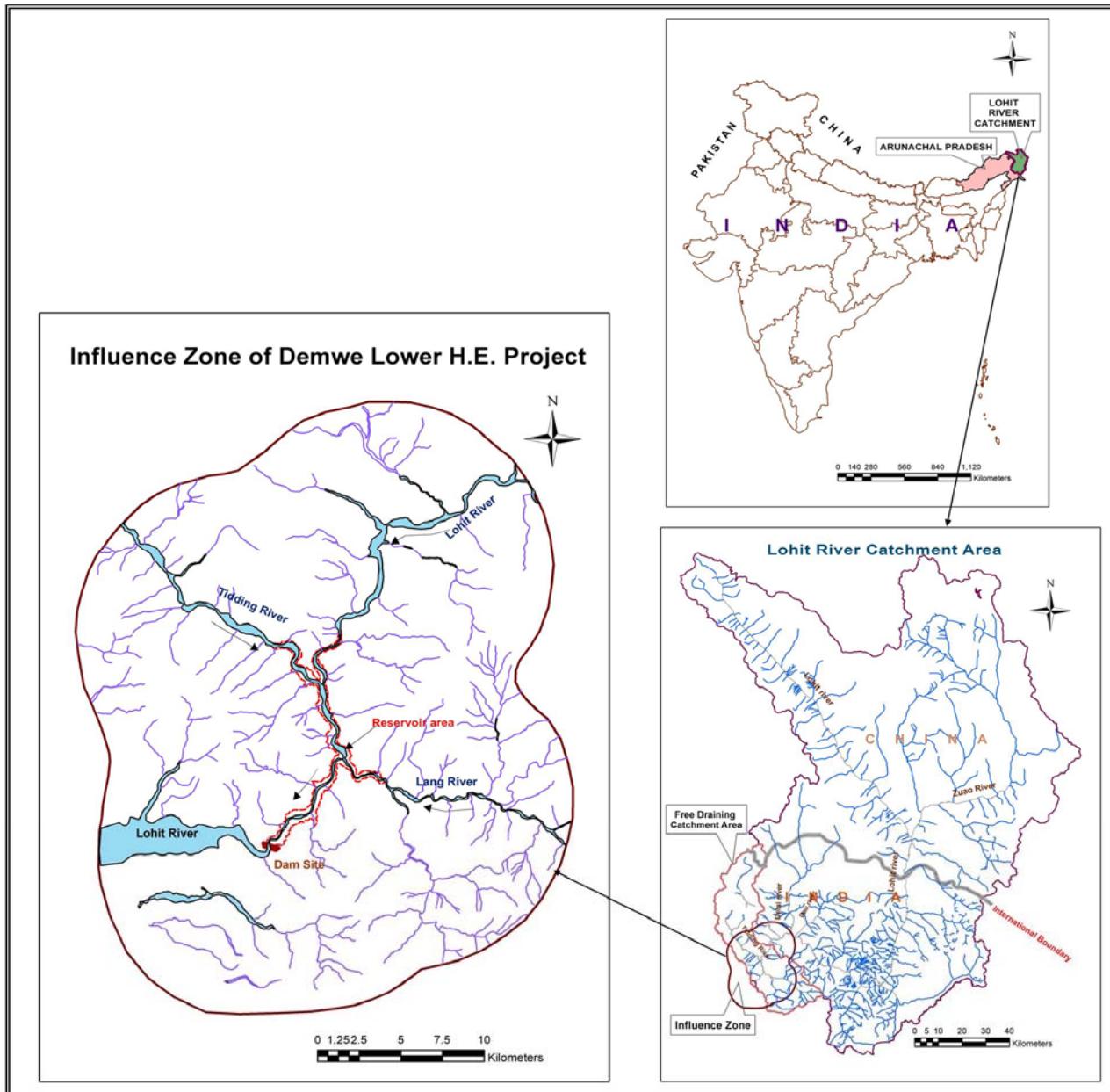


Figure 1: Location map of Demwe Lower hydroelectric project and project boundaries.

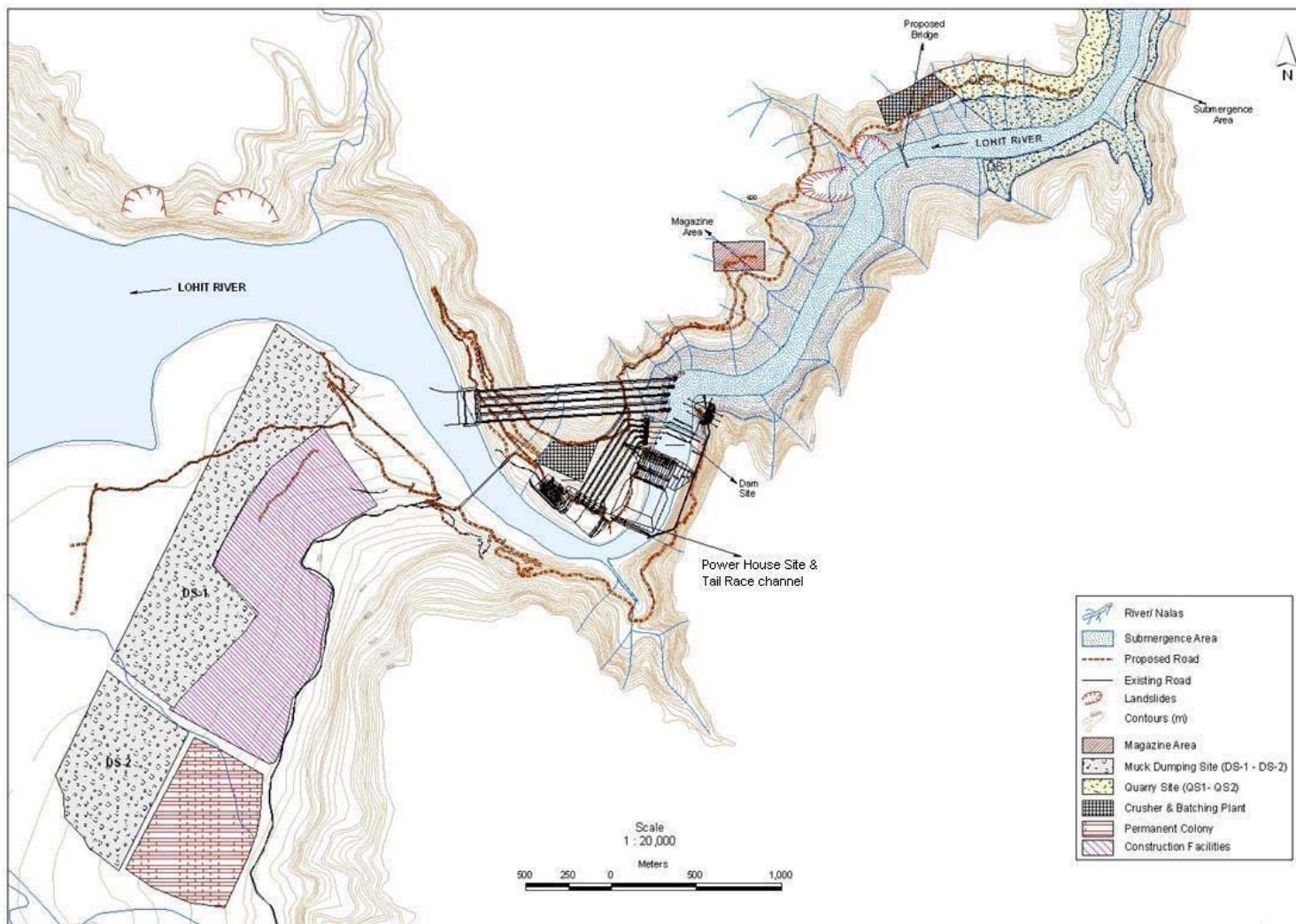


Figure 2: Layout map of Demwe Lower Hydro Electric Project

1.2 ENVIRONMENTAL BASELINE DATA

The data has been compiled for Land Environment; Water Environment; Air Environment; Noise Environment; Ecological Environment and Socio-economic Environment. Primary data related to the environmental attributes like air, noise level, water quality and soil was collected from field studies for Winter, Monsoon and Summer seasons whereas for Land Environment baseline data set has been generated through RS/GIS. A structured questionnaire was used for collection of primary information on socio-economic aspects. Public perception regarding project construction, benefits and impacts were also taken into consideration. Ecological information was collected from field studies as well as secondary sources. **Figure 3** presents the location map for the sampling sites in the influence zone including the project area.

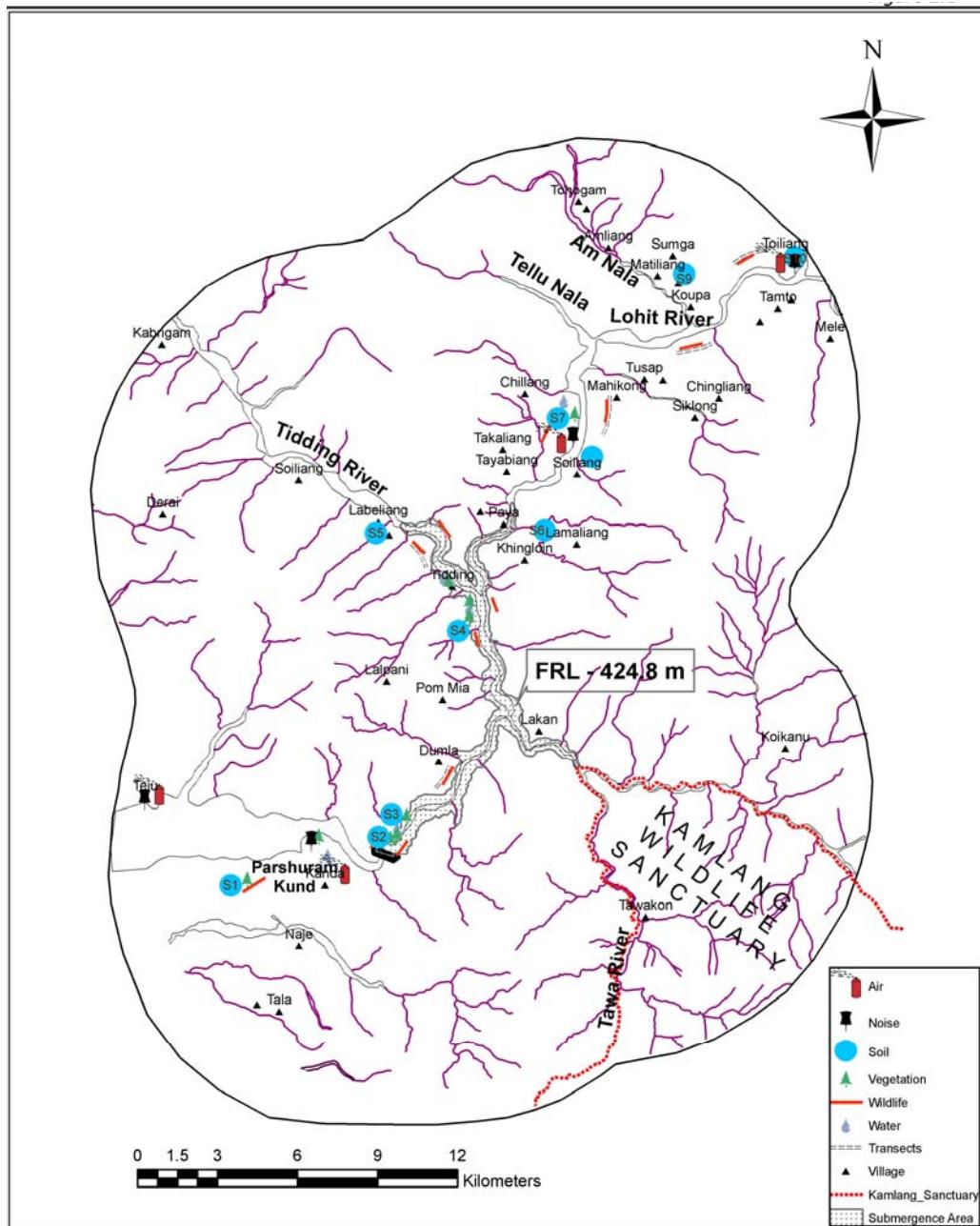


Figure 3: Sampling Locations in 10 km radii Influence Zone of Demwe Lower HE Project

1.3 LAND ENVIRONMENT

To begin with the baseline data sets, initial information from available literature, reports, government offices and project proponents were collected regarding locations, climate, geology, etc. The influence zone demarcation within 10 km radius has been done with respect to reservoir rim of Demwe Lower dam as well as Dam site. A base map was developed to demarcate the submergence zone and influence zone of the Demwe Lower HEP. Subsequently detailed information on the road network, settlements & their demography, etc. was collected. As a part of the study, detailed field studies on aspects related to land use and land cover, physiography, soil type, etc. of the influence zone and free draining catchment area including submergence zone were also conducted (Refer **Figure 4** for base line data sets of influence zone).

1.3.1 Topography

The catchment and influence zone for proposed Demwe Lower HEP lies in Mishmi Hills region inclusive of foothill regions of Lohit Basin and varies from lowest elevation of 302 m to maximum elevation of 6,882 m amsl. Geomorphologically, the catchment area is rugged with lofty ridges of mountainous terrain, which are generally aligned in northwest - southeast direction, and are mostly dissected by Nallahs and deep ravines and the mountain slopes are usually steep. The cross-valley profiles of Lohit River and its major tributaries suggest that these channels were primarily glacial valleys, which have been modified by fluvial action. The drainage pattern of the area is complex with the presence of dendritic, trillis and rectangular patterns. The drainage pattern is mainly controlled by structural features like joints, fold axes, faults and other lineaments. Therefore, river Lohit flows mainly through major and narrow structural valleys bounded by steep slopes. River channels are turbulent waterfalls and rapids are present along the channels. The terrain is extensively dissected by Lohit river and its tributaries, and therefore, the ridge crests are sharp.

1.3.2 Geology

The rock formations exposed in the reservoir area constitute parts of the Lohit Group, Plutonic Complex, Tidding Ophiolite Unit and Mishmi Crystalline. The lithotectonic units generally trend in NW-SE direction and dip towards NE. Lohit Thrust and Tidding Suture are two main tectonic features in the area. Lohit thrust trends NW-SE and is present in the upstream of the Tidding Suture. This zone demarcates the tectonic contact between the Tidding and Mishmi Formations (Nandy, 1976). In this thrust zone the younger granitoid suite of rocks underlain chlorite-biotite mica schist. Tidding suture runs parallel to the Tidding river and the reservoir extends about 4 km along this zone. All the tectonic units along the Tidding suture trend NW-SE and dip due NE and the amount of dip becomes steeper from west to east towards the Tidding Ophiolite. The Serpentinised Peridotites occurring more towards the top of the Ophiolitic succession. This zone is highly thrusted representing upthrusting of deeper level Peridotite over the shallow level basaltic sequence. The components of the project will be set up over the gneissic rocks, which belong to Bomdila Group. The Yang Sang Chu and Tidding formation rocks are exposed at the tail of the reservoir. The lithounits present in the reservoir area generally trends NW-SE with moderate to steep dip towards north. In the upstream of the Dam axis rocks of Central Crystalline Group composed of feldspathic augen gneiss, porphyritic gneiss and quartzitic gneiss are exposed along the course of Lohit River and its major tributaries namely Tidding and Lang rivers. At the confluence of Tidding river with Lohit river, thin bands of crystalline limestone are exposed at an elevation of 530 m. Further upstream, along the Lohit river channel, chlorite-biotite-actinolite schist with bands of interbedded felspathic micaceous quartzite and kyanite staurolite schist are exposed. The ophiolite sequence is overlain by chlorite- mica schist, which extends up to the Lohit Thrust. Upstream of the Lohit Thrust granitoid suit of rocks are exposed. The river valley in the portion of submergence is water tight due to presence of impervious rocks in most part of the reservoir.

1.3.3 Seismicity

The Demwe Lower H.E. project site in district Lohit of Arunanchal Pradesh 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: General Provisions and Buildings. The occurrences of earthquakes in Lohit district and surrounding region are largely associated with Naga Thrust, Mishmi Thrust, Tidding Suture, Lohit Thrust, Main Boundary Thrust, and Eastern Boundary Thrust.

1.3.4 Slope

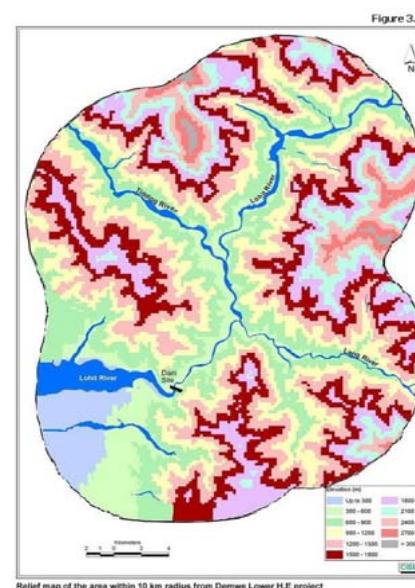
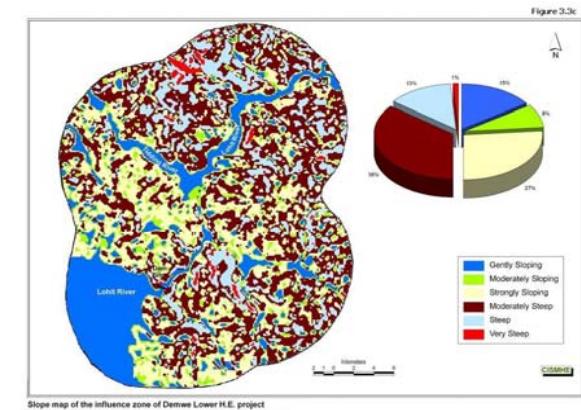
The slope plays a great role in the loss of soil and water from an area and influences its land use capability. Together with the nature and texture of soil, it also determines the erodibility of the soil. In accordance with the classification developed by All India Soil & Land Use Survey (AISLUS) the different classes of slopes identified in the study area are gentle slope (upto 15%), moderate slope (15% to 30%), moderately steep (30% - 50%), strong slope (above 50%), and very steep slope (more than 80%). There is hardly any zone that can be categorized as level or nearly level.

1.3.5 Soils

Rocks are the parent material from which the soil is formed. Weathering of this parent material by the natural forces such as heat, rain, ice, snow, wind and other environmental factors leads to soil formation. The total area considered for the analysis of soil types and soil quality is 1,21,453 ha for the free draining catchment and 83,361 ha in case of 10 km influence zone, which includes the project activity sites. The soils of the area under discussion are comprised of 26 soil series associations (28 units) belonging to 13 soil groups and sub groups in the total Catchment area. Soils from power house site and dam site are loamy and clayey skeletal with high moisture content, water holding capacity and organic matter. Such characteristics are generally attributed to the lesser erodibility of the soils. Soils from riparian areas are gravelly loam, gravelly clay loam and gravelly silty clay loam, well drained and are moderately erosive.

1.3.6 Land Use Pattern

Land use and land cover patterns are important in environmental impact assessment study from the point of view that land use describes the present use such as agriculture, settlement etc. and land cover describes the material on it such as forest and their types, pasture/grazing land vegetation, rocks or building etc. The proposed dam site is located upstream of the Parasuram kund on Lohit river. The land use/ land cover study for the project area has been carried out for the free draining catchment area, influence zone area covering 10 km from the dam site and the submergence area of the dam based on FRL of the reservoir. Among the different land use/ land cover classes of influence zone, the dense forest covers 47.57 % and the open forest covers 28.75% of the area. A part of the area (8.62%) has degraded forest because Jhum/Shifting cultivation. The scrub lands cover only 6.45% area. Most part of the area along the left bank of Lohit river in the downstream of Parsuram Kund, where project offices, colonies and muck disposal sites have been proposed are lands covered with scrubs. Cultivation and settlements are mostly present along the right bank of Lohit river and in the southwestern part of the area on the left bank of Lai river and are spread over 1635.43 ha land which amounts to 1.96% of the project impact area. Because the Lohit river and its major tributaries Tidding, Dau, Dalai and Lai have wide channels the sand/channel deposits along these channels cover 3.96 % of the project impact area. The landslides occur occasionally on the ridge tops, along steep valley channels and along the roads in the entire impact zone and are spread over only 319.86 ha, which amounts to 0.38 % of the project impact area. The river/ water bodies cover 1.76% of the area. In the northern part of the area, the ridge tops are capped with snow, which covers only 0.55% of the area.

**False Color Composite****Relief****Slope**

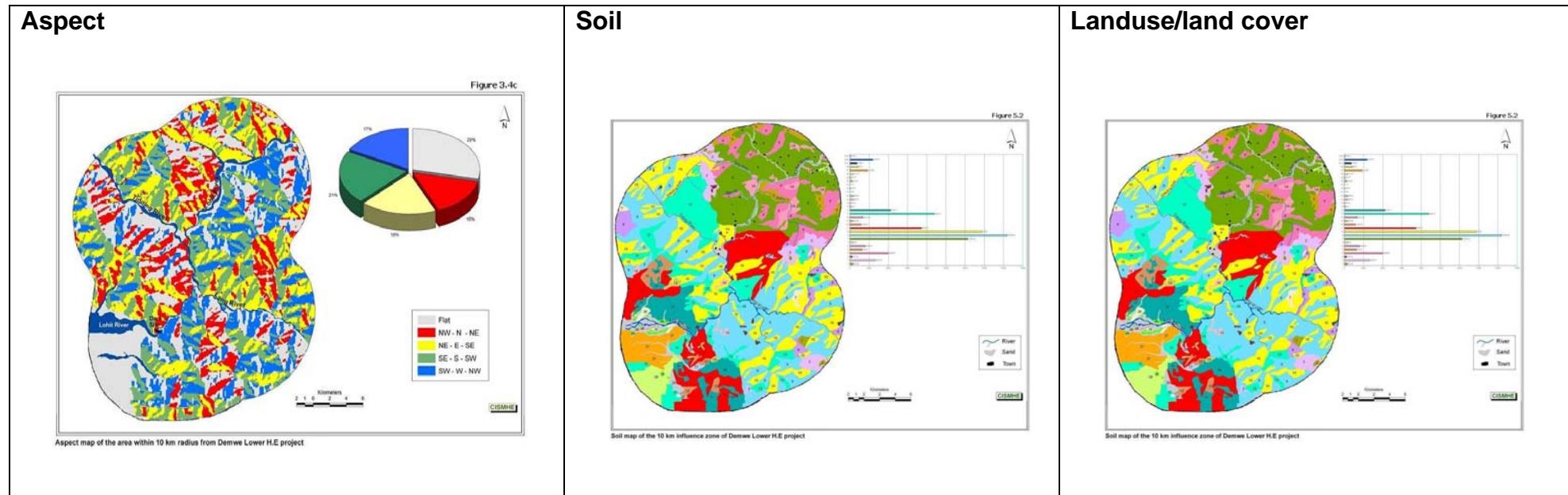


Figure 4: FCC, Relief, Slope, Aspect, Soil, Landuse/land cover type maps for Demwe Lower HEP Influence Zone area.

1.3.7 Water Environment

The domestic, irrigation and other daily needs of water in the project area are met with surface water source, available in plenty in the form of perennial springs and streams. Surface water test results show that most of the parameters are within desirable limits of Bureau of Indian Standard (BIS). The physical and chemical properties of water quality of project area are presented below.

Physical and chemical characteristics of Lohit river and its tributary Tidding in Demwe Lower HEP area.

Parameters	Monsoon				Winter				Pre- Monsoon			
	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
Water discharge (cumec)	2050	-	-	-	463	-	-	-	-	-	832	-
Water current velocity (m/s)	1.71	1.66	1.45	3.17	1.64	1.37	0.87	1.54	2.04	1.84	1.61	2.43
Turbidity (ntu)	98	96	53	13	1	1	1	1	2	3	3	3
Water temperature ($^{\circ}$ C)	18	18	18.5	19.5	14	13.5	12	13	14	14	14.3	14.5
E. Conductivity (μ S/cm)	94	102	114	114	130	120	110	140	60	50	60	70
Total Dissolved Solids (mg/l)	57	62	72	72	90	80	100	100	30	20	20	40
pH	8.66	8.5	8.32	8.17	7.61	7.56	7.56	7.39	7.95	7.92	7.95	7.67
Dissolved Oxygen (mg/l)	9.87	10.05	10.36	8.31	10	10.73	10.57	10	9.83	9.99	9.09	9.42
Total Hardness (mg/l)	37	37	36	37	48	48	52	60	40	40	36	40
Total alkalinity (mg/l)	37.2	36.12	35	35.06	34.7	34.56	34.2	38.9	50	40	50	50
Chloride (mg/l)	6.1	6.1	6	6	2.03	2.03	2.03	2.03	7.6	8	8	8
Nitrate (mg/l)	ND	ND	ND	ND	0.45	0.42	0.42	0.45	0.1	0.1	0.1	0.1
Phosphate (mg/l)	0.22	0	0.031	0.03	0.03	0.041	0.042	0.04	ND	ND	ND	ND
Silicate (as SiO ₂), mg/l	-	-	-	-	8.8	9.1	9.5	9.3	2.91	2.6	2.08	2.08

W1 = Parasuram Kund (Left Bank); W2 : Dam site (Right Bank); W3 : Lohit- Tidding Confluence (Right Bank); W4 : Tidding river (Right Bank)

1.3.8 Air Environment

Four Ambient Air Quality Monitoring locations were identified and monitored within the influence zone. The level of suspended particulate matter (SPM), respirable particulate matter (RSPM), NO₂ and SO₂ were recorded in the ambient air using respirable dust sampler (Envirotech APM 460 BL) with gaseous sampling attachment (Envirotech APM 411 TE). Air Quality test results indicate

that the air pollution level in the project area is within the Ambient Air Quality Standard.

Air Quality in the proposed Demwe Lower H. E. project area

Location	SOX, $\mu\text{g}/\text{m}^3$			NOX, $\mu\text{g}/\text{m}^3$			TSPM, $\mu\text{g}/\text{m}^3$			RSPM, $\mu\text{g}/\text{m}^3$		
	W	S	M	W	S	M	W	S	M	W	S	M
Tezu	3.6	3.8	3.4	3.9	3.6	3.7	58.56	64.92	55.74	26.98	31.29	26.94
Mompani	1.74	1.69	1.59	1.09	1.01	0.89	54.95	60.18	46.62	25.17	26.98	21.98
Hayuliang	1.89	1.74	1.99	1.21	1.13	0.92	92.18	98.52	65.92	40.12	44.17	30.16
Parasuram kund	3.53	3.87	3.59	1.03	1.36	1.25	84.24	96.23	73.12	42.23	49.04	38.35

W-Winter, S-Summer, M-Monsoon

1.3.9 Noise Environment

The noise level in the influence zone ranged from 17.00 dB at Mompani to 80.12 dB at Tezu in summer season. The high noise level at Tezu can be attributed to the relatively high vehicle density. There is no point source of noise in the region. At all the proposed locations, the recorded noise level is less than prescribed by CPCB.

Sound/ Noise level standards as per CPCB

Location	Av. Sound level in (db)		
	Winter	Summer	Monsoon
Tezu	79.68	80.12	79.19
Mompani	16.98	17.1	25.29
Hayuliang	76.18	77.71	78.1
Parasuram Kund	74.43	73	76.92

1.4 BIOLOGICAL ENVIRONMENT

The vegetation of the valley remarkably varies due to various microclimatic and ecological factors. In the entire valley of the catchment, the area is either covered by dense forest along the ridges or degraded open forests interspersed with agricultural fields in lower reaches. Field study was carried out for floral and faunal diversity assessment for which the study area has been classified in to

three categories: (i) Free-draining catchment of Demwe Lower HE project covering 1214.53 sq km (i.e. catchment area between Demwe Lower HEP & Demwe Upper HE project), (ii) Influence Zone area, that is the area in the region within 10 km radius from the project site and reservoir margins (833.61 sq km), where the impacts can possibly be visualized and (iii) the Project Study Area (SA) which is spread over 15.90 sq km (1589.97 ha) land and covers the area where various project components will be set up including reservoir area covering 11.31 sq km (1131 ha).

1.4.1 Vegetation

The objective of the study was to prepare an inventory of flora, listing of rare, endangered, economically important, and medicinal plant species and to determine frequency, abundance and density of different vegetational components. The project area covers tropical semi-evergreen forest comprising of Assam alluvial plains and Sub-Himalayan light alluvial semi-evergreen forest in lower reaches. The vegetation in these forests (in lower foothills of the project area) comprises tropical plains and riverine semi-evergreen plant species. In the mid hills sub-tropical wet hill forest occurs, while towards higher elevations wet hill temperate, dense mixed coniferous and sub-alpine and alpine forest are prevalent. In the entire valley of the catchment, the area is either covered by dense forest along the ridges or degraded open forests interspersed with agricultural fields in lower reaches. The forests present in the catchment area have been grouped into different forest types following the classification of Champion & Seth (1968), Negi, (1989, 1996), Chowdhery (1996) and Muddgal & Hajra (1999). To understand the community structure, vegetation sampling was carried out in five zones of the influence zone area. During a reconnaissance survey in Sept. 2007 and October 2008, five zones viz., Proposed dumping/colony site, Powerhouse site, Dam site, Submergence site and Upstream of Submergence area were selected for vegetation structure analysis on the basis of the presence of forest patches in the area. Within each of the five zones, a total of seven sampling sites were selected (one each at proposed dumping/colony site, Powerhouse site, Dam site and two each in Submergence

area and Upstream of Submergence area). At each of the sampling site, trees and shrubs were represented by twenty quadrates, and herbs were represented by forty quadrates. The vegetational data collected in the field survey was assessed by doing phytosociological analysis. In the present field survey of the Lohit valley forming catchment of Demwe Lower dam, a total number of 170 species of plants were recorded under the ecological investigation during different sampling seasons. Out of which 48 were trees, 22 shrubs, 11 climbers and 89 herbs. The ground vegetation comprised of ephemeral, annual, and perennial species of grasses, sedges, legumes and non-legume forbs. The main uses of these species comprise timber, fodder, firewood, fiber and medicine. Many of them were nitrogen fixers which are mostly preferred in agroforestry for increasing the soil fertility. Besides above uses, the plants which are useful for ornamental value, edible fruits and bee forage were also listed. The studies indicate that a total of 6 species comes under conservation status in Influence Zone of Demwe Lower hydroelectric power project based on available literature. Of them 1 species in vulnerable category, 1 species fall under endangered category and 4 species fall under Rare category respectively and none of them were sighted during primary survey. Vulnerable species comprises of *Dioscorea deltoidea* and the endangered species *Acer oblongum* var. *microcarpum* and the *Begonia burkillii*, *Calanthe manii*, *Paphiopedilum wardii*, *Phoenix rupicola* falls in the indeterminate rare category.

1.4.2 Fauna

The fauna of eastern Himalaya is mainly governed by the species of southern China, Indo-china and Indo-Malaya regions. The north part of Eastern Himalaya is close to palaearctic region in the faunal composition. A large numbers of mammals, birds, reptiles and fish species of Arunachal Pradesh, easternmost part of Himalaya are similar to the North-East states of India. A three level study was carried out to describe the faunal elements in the region starting from general understanding of faunal elements based on available literature and Working Plan of the Forest Department apart from consideration to Management Plan of Kamlang Wildlife Sanctuary. Subsequently, faunal elements of influence

zone area, comprising of 10 km radius of project sites (dam site and tail of the reservoir), is described with the help of secondary sources and primary survey both. The fauna of project sites (dam site, submergence area, colony area, etc.) was studied with the help of primary surveys. The results of analysis revealed that the free draining catchment area has rich diversity in fauna. A total of 50 species of mammals, 69 species of birds, 34 species of reptiles, 45 species of butterflies were found in the free draining catchment area. Out of these total species; a total of 30 species of mammals are common in the influence zone and catchment areas, 15 are restricted to influence zone area and 4 species are found only in the catchment areas. About 45 species of birds from the project areas were recorded during the surveys, of which 28 species were sampled from the sampling sites and of the 45 species of butterflies, about 30 species were recorded from sampling sites.

1.4.3 Aquatic Ecology & Fisheries

Lohit is one of the largest rivers of Arunachal Pradesh and rich in ichthyofaunal diversity. Ichthyofauna of lower stretch of Lohit river comprises of 48 species of 16 families. Cyprinidae is largest family represented by 21 species. Out of these reported species, during the primary fish catches carried out in the Demwe Lower HEP area, a total of 13 fish species were recorded. Out of them 4 belong to Vulnerable category; 2 are Low Risk- near threatened category whereas remaining 7 do not fall in any conservation category. The proposed Demwe lower dam would block the migration of fish species like *Tor putitora*, *Acrossocheilus hexagonolepis* etc. There are possibilities of damages of spawning grounds in downstream and upstream stretches on account of inundation, frequent water level fluctuation and change in the physical, chemical and biological characteristics of river water.

1.4.4 Protected Area

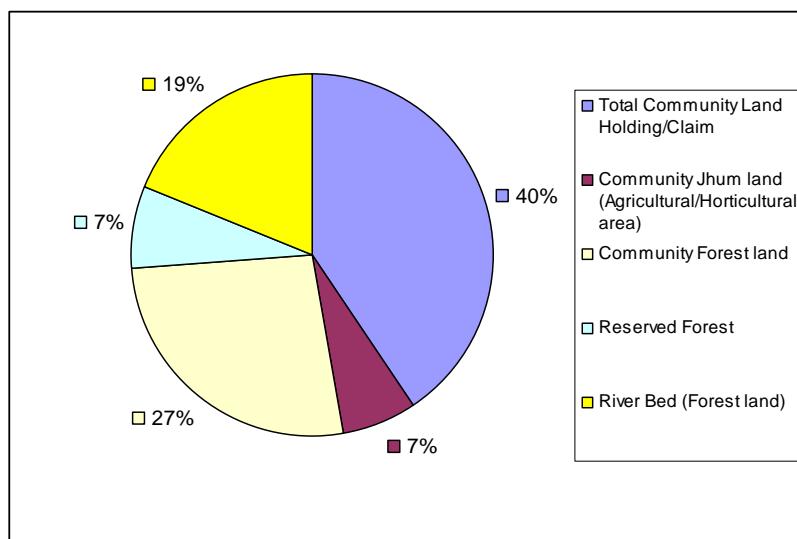
The Kamlang Wildlife Sanctuary is one of the 12 protected areas of Arunachal Pradesh raised for the protection and conservation of the biodiversity of the State. The location of Kamlang Wildlife Sanctuary falls within the 10 km radius

from the reservoir tip of the Demwe Lower H.E. Project. Around 80.36 sq km area of the Sanctuary (only 10.26 % of the total area of the Wildlife Sanctuary) falls within the 10 km radius from the reservoir of the project. The minimum distance from main river Lohit to the Sanctuary is around 4.12 km along the Lang river. In order to avoid disturbance within the Kamlang Wildlife Sanctuary, the Demwe H.E. project has earlier been bifurcated in two projects namely Demwe Lower H.E. project and Demwe Upper H.E. Project. The FRL/MWL of Demwe Lower was fixed in such a way that no submergence occurs in the Kamlang Wildlife Sanctuary. None of the project component including submergence area is falling in the KWLS and the proposed dam site of Demwe Lower HEP is located at an aerial distance of about 9.3 km from Sanctuary. In order to address the fauna and flora of the protected area, Kamlang Wildlife Sanctuary Management Plan has been consulted. The people living inside and outside the Sanctuary area are totally dependent on forest and forest produce. They have been practicing shifting cultivation in many parts of the Sanctuary that are now Reserve forests. Many households have developed excellent orange orchards around the Sanctuary area.

1.5 SOCIO-ECONOMIC ENVIRONMENT

The construction of the 1750 MW Demwe Lower hydroelectric project is of extreme economic importance to Arunachal Pradesh because it has the opportunity to earn a great deal of revenue by exporting its hydroelectric power to other power deficient states of the country. The Demwe Lower Hydroelectric Project requires total land of 1589.97 ha.

S.NO	Land Classification	Land, Ha
1	Total Community Land Holding/Claim	1087.05
a	Community Jhum land (Agricultural/Horticultural area)	174.05
b	Community Forest land	720.25
c	Reserved Forest	192.75
2	River Bed (Forest land)	502.92
	Grand Total	1589.97

Figure 5: Breakup of Land details

1.5.1 Project Affected Families (PAF)

Considering the legal position and community rights into consideration, a property survey was undertaken by the Government of Arunachal Pradesh in the project area from March 2008 to October 2008 time period at the request of the project proponents. Based on the property survey findings, it was observed that such land belongs to the Project Affected Families of 22 revenue villages within 3 administrative circles. Only five villages, viz. Paya, Chipragam, Dingliang, Tidding and Lakoa are revenue villages whereas remaining villages (Chaigadiliang, Pumla, Dumla, Tyulliang, Challing, Taseliang, Kangkhai, Langmeh, Netoh, Pram, Langliong, Rangam, Bajiliang, Dowamma, Aoliang, Haloiang and Tangam) are considered as hamlets. The families residing in these hamlets also have residence in other revenue villages. Additionally, a socio-economic door to door survey was carried out to document the socio-economic profile of the PAFs.

The area of Demwe Lower Hydroelectric Project lies in the Lohit –Anjaw districts of Arunachal Pradesh. The social milieu of this region comprises of tribals namely Mishmis, Khamptis, and a section of Padams and of the Singphos. There are three main groups of the Mishmis, viz. Idu, Miju or Kaman and Digaru or Taraon.

1.5.2 Population

Total population of the project affected families is 1349 and they belong to 204 households. Sex ratio among the PAFs is 939. All project affected persons are Scheduled tribe, which belong mainly to Tayang and Thalai communities of Miju and Digaru Mishmis. Maximum number of PAPs comes from the Kangkhai village followed by Rangam and Tyulliang.

1.5.3 Education and Employment

Average literacy rate among the projected affected families is 63.05% with significantly high in male population About 21.3% of the total population of affected families has got education up to primary level; it decreases to 0.44% in the post graduation level.

1.5.4 Assets

A total of 235 houses, 14 shops and 4 cattle sheds are owned by the Project Affected families, however, none of these structures are on the piece of land that is proposed to be acquired or comes under submergence. The number of trees belonging to individuals likely to be affected is 9116.The project affected families have a large number of livestock holding. A total of 2632 animals are reported with the project affected families.

2.0 ENVIRONMENTAL IMPACTS

The section summarizes the likely impacts of the proposed construction of Demwe Lower HEP, its possible impact on the surrounding environment during construction and operational phases.

2.1 Land Environment

Very few impacts of construction phase are permanent and majority of the environmental impacts attributed to construction works are temporary in nature, lasting mainly during the construction phase or quite often little beyond the construction period.

2.2 Change in land use pattern and pressure on land forms

In summary, 1589.97 ha of land will be required by proposed Demwe Lower Hydroelectric Project. At the same time change in existing land use pattern and pressure on land forms may likely occur due to the immigration of labour population and operation of construction equipment.

2.3 Soil Pollution

During the construction phase, a total 101.18 lakh cum of muck will be generated from excavation for different appurtenant structures like diversion tunnel, dam, adits, infrastructure works and power house complex. About 40% of the muck generated from overburden excavation, amounting to 20.00 lakh cum will be utilized as aggregate for concrete and 4.2 lakh cum will be used in the Cofferdam. The volume of the remaining muck from overburden amounts to 34.28 Lakh cum and that from rock amounts to 42.70 Lakh cum. After adding a swelling factor of 25% for overburden material and 60% for excavated rock, the total muck volume that requires to be rehabilitated is 111.17 Lakh cum. Two dumping sites of 150 ha area with the capacity of 112.62 Lacs cum have been identified on plain area near Parasuramkund on the left bank of Lohit river to rehabilitate the generated muck. Disposal of the remaining quantity of muck may change soil property and causes soil pollution. Besides it, during peak construction phase, congregation of labour force is likely to create problems of sewage disposal, solid waste management and felling of trees for meeting fuel requirements, etc. These aspects need to be addressed in the form of suitable labour camp facilities including fuel and sanitation facilities.

2.4 Landslides

A total of 28 landslides of different magnitude and activity are present in the area. However, only 6 landslides are located in the critical zone between EI 365m to EI 424.8m, which will be vulnerable to the fluctuation in the water level with the live storage as well as during the flushing out operations twice in a year. These active landslide zones will be treated to make the reservoir rim stable.

2.5 Soil Erosion

Any groundbreaking activity for construction works, whether permanent or temporary, would require removal of vegetation cover from ground and accelerate the soil erosion. During operational phase the obvious impacts are change in land use pattern due to submergence and increase in seismicity.

2.6 Aquatic Environment

The construction of Demwe Lower dam would lead to the formation of a run-of-the-river reservoir to cater to diurnal peaking requirements. The regulated flow of water from the reservoir would take place. However, if for some reasons the release of water is stopped, the immediate downstream aquatic fauna might be affected. However, it needs to be mentioned here that about 35 cumecs water would be continuously released from the dam by operating a separate 40MW unit to ensure uninterrupted water supply to downstream reach. This continuous release would also ensure aquatic life survival in the downstream reaches. In any case owing to the dam-toe power house scheme, no length of the river reach would remain dry in any part of the year.

2.7 Water Quality

Impacts on water quality during construction may occur due to water pollution downstream by Soil erosion, Wash water from plant and machinery and sewage disposal. During operation stage, the discharge of the water from the impoundment can strongly influence the quality of water downstream. The major water quality parameters likely to be affected are velocity, water temperature, dissolved oxygen, nutrient transport, and turbidity. During the 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/septic tank facilities and other infrastructural facilities, the problems of water pollution due to disposal of sewage are not anticipated.

A major short-term water quality issue is related to the flooding of forest. If not cleared, the drowned organic matter will decay during the first few years after impoundment and could result in the release of obnoxious water that is lethal for fish and aquatic animals. Removal of vegetal cover for construction work gives rise to erosion hazard and resulting in movement of enormous quantities of soil and rock to the reservoir. In the case of reservoir based projects, the quantum of sediment/silt accumulated is enormous; however the provision of silt flushing arrangements in the project design helps in getting rid of silt.

2.8 Terrestrial Flora

Increased human activity in the area will increase the biotic pressure on the forest. Hence, to minimize such impacts, fuel management not only for the labour force but for the villagers as well needs to be formulated. During construction phase; large quantity of dust is likely to be entrained due to the movement of vehicles and other construction work. However, such ground level emissions do not travel for long distances but may reduce photosynthetic activity of near by plants .To reduce the quantity of dust, the green belt management plan is proposed under the proposed Demwe Lower Hydroelectric Project.

From loss of endangered, threatened and rare plant species point of view, it has been documented that total 6 species of entire catchment area fall in these category and none of them were recorded from the submergence zone and project area of Demwe Lower HEP. Moreover, all the species are reported in the nearby forests/region as well. However, still to maintain and even strengthen the biodiversity (flora and fauna), it is proposed to improve the habitat of the forests in the influence zone. The proposed project envisages acquisition of 1589.97 ha.

2.9 Fauna

Based on the faunal survey, it is noted that within the project area, none of the species under threat categories was recorded from the project area; however a few of them are reported from the influence zone and nearby located Kamlang Wild Life Sanctuary. To maintain and even strengthen the faunal biodiversity of the nearby located KWLS, comprehensive biodiversity management plan needs

to be formulated taking due cognizance of recommendations of State Biodiversity Board.

It would be worthwhile to mention here that most of the submergence lies within the gorge portion in the foothills of Lohit catchment, where, the river Lohit itself acts as a barrier to the movement of wildlife even in the pre-project stage. Thus, the execution of the proposed project is not expected to cause any adverse impact on wildlife movement.

2.10 Aquatic Ecology

During the construction phase of Demwe Lower Hydroelectric Project, the aquatic ecosystem and biodiversity is not expected to alter considerably as the water of river Lohit will remain in its original course. During the operation phase of the project, the migration of fish species is going to be obstructed by the high dam, which will definitely affect the population of these species. In order to maintain the population density of these species in the upstream reaches, efforts must be made to explore the probability of fish farm and hatcheries in the upstream section of the project especially.

2.11 Noise Environment

Construction activities are expected to produce noise levels at source in the range of 80-140 dB (A) and the personnel operating the machines and the workers stationed close to the machines are prone to exposure of high levels of noise. Careful planning of machinery operation and scheduling of operations can however reduce the noise levels. Absence of sensitive receptors around the project results into no significant impact.

2.12 Air Quality

Dust levels may slightly increase during construction, however, the impact on ambient air quality will not be significant, since the dust generated is confined to the proposed project area and as it will be taken care of by adopting suitable control measures as described in EMP.

2.13 Socio-Economic Environment

The major problem associated with any hydroelectric project is displacement and dislocation of a large number of populations. The people who are evacuated to new places have to suffer some social problem because they have to start their life from the beginning. Improper resettlement and rehabilitation is the root cause of discontentment and alienation among PAFs. The rehabilitation Action Plan needs to be formulated sensitively and sensibly so that after a reasonable transition period, the displaced persons improve, or at least regain their previous standard of living, earning capacity and production levels.

About 3000 people are likely to work during peak period of activity and during operational phase some of the technical staff will be stationed for operation and maintenance of the project. Thus the project would provide substantial direct employment and in addition to these, more people would be indirectly employed for allied activities.

The region surrounding the dam location has its own historical background due to famous ‘Parasuram Kund’. It is; therefore, felt that the area offers tremendous potential for tourism development as well. Considering this suitable plan needs to be formulated to open up new avenues for higher economic returns to the locals of the area.

The total power that will be generated will be 1750 MW from Demwe Lower project. The added availability of power in the national power grid will help the nation and the state to progress in a big way. Hydroelectric projects are considered to be the hub of socio-economic development for the region in which they are located. A number of marginal activities spin off benefits and jobs would be available to the locals in the project which will subsequently increase the economic status of the local people. Besides these benefits Demwe Lower Hydroelectric Project will surely ensure the development of area through introduction of roads, hospitals, school colleges, tourism activities, etc.

Present infrastructure is either likely to be upgraded or new infrastructure is set up with the implementation of the new project. Basic infrastructures required to be developed are roads, health facilities, educational facilities etc.

3.0 ENVIRONMENT MANAGEMENT PLANS

Based on the detailed evaluation of the likely impacts on various environmental parameters, detailed EMPs for the project have been prepared and presented, which defines actions to be undertaken during the construction and operation phase of the project. The mitigative measures for minimization of adverse impacts along with stage wise land reclamation strategy, afforestation (green belt development/plantation) programme and their implementation have been incorporated in the chapter on environmental management plan.

3.1 Catchment Area Treatment

The Catchment Area Treatment (CAT) plan highlights the management techniques to control erosion in the catchment area of a water resource project. The life span of a reservoir is greatly reduced due to erosion in the catchment area. Adequate preventive measures are thus needed for the treatment of catchment for its stabilization against future erosion. Catchment Area Treatment Plan has been formulated for free draining catchment i.e. up to the tail water levels of proposed upstream Upper Demwe HE project on Lohit River. In the present study `Silt Yield Index' (SYI), method has been used. In this method, the terrain is subdivided into various watersheds and the erodibility is determined on relative basis (**Figure 6**). SYI method is widely used mainly because of the fact that it is easy to use and has lesser data requirement. Moreover, it can be applied to larger areas like sub-watersheds, etc.

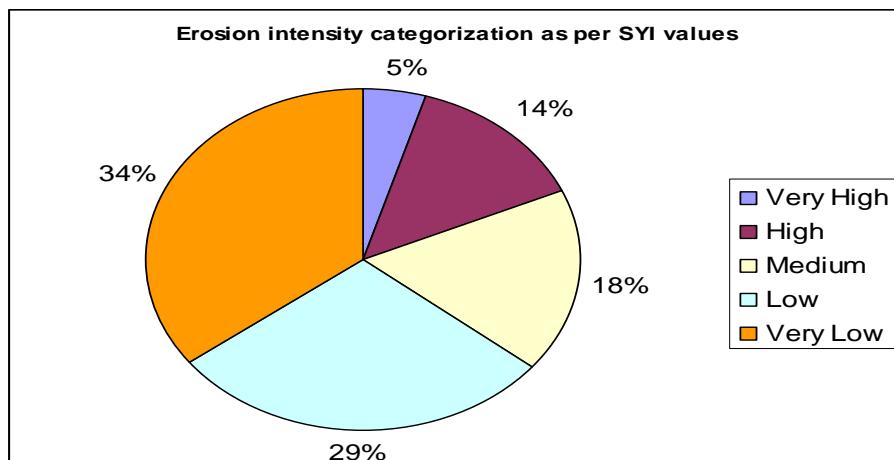


Figure 6: Erosion Intensity Categorization as per SYI values

Overall financial provision for CAT Plan under Engineering, Biological measures, other provisions, administrative changes and contingencies is for **Rs. 3312.00 lakh.**

3.2 Resettlement and Rehabilitation Plan

Baseline status of socio-economic environment in respect of Demwe Lower project was evaluated for population status, social and cultural environment, land holdings and other parameters. Based on the baseline data, a comprehensive Resettlement and Rehabilitation (R&R) plan for the Demwe Lower Hydroelectric Project has been worked out. In order to formulate the R&R plan, the guideline issued by the Arunachal Pradesh State Government under its R & R policy and the recommendations of National Rehabilitation and Resettlement Policy for Project Affected Families – 2003 and the draft National Policy for the Scheduled Tribes, Govt of India which outlines measures for Local Area Development Plan (LADP) have been considered. The affected families would be compensated for acquisition of their land in accordance with the local norms applicable for such acquisition. It is also obvious that such compensation would never render sufficient to compensate the indirect losses to the local people. It is felt strongly that the local population of the project area deserves certain incentives towards their social upliftment, so that they feel themselves an integral part of the overall development. Thus, in case of Demwe Lower HEP, it was felt that R & R plan

needs some careful considerations to strike a balance between preservation of tribal identity, culture and values, protecting the tribes from being swamped by mainstream lifestyles, while increasing and ensuring their access to mainstream education, health care and income generation so that the quality of their life is improved.

The socio-economic survey revealed that the total number of project affected families is 204. Total land required for the various project components viz. dam structure, power house structure, submergence, colony development etc. is 1589.97 ha. It includes community land holding/claim of 1087.05 ha of which 652.18 ha falls under submergence and 434.87 ha is required for various project components. The communities' livelihood depends on the 1087.05 ha land to be acquired, therefore, rightful and rehabilitation compensation will be provided for the same land. In the case of Demwe Lower (1750 MW) HE project, no immovable asset is being either acquired or submerged i.e no resettlement, however, some of the communities are losing their land holding partially. In this project, most of the project components are located at one place as it is a dam toe power house project.

3.2.1 Compensation of Land for Project Affected Families

The project components are located in the Lohit district with the reservoir extending partly in the Anjaw district of Arunachal Pradesh. No households are likely to lose their homestead due to the proposed project. No families are being landless as only small land of the community holding is being acquired. The village communities have expressed support to the project. All the tribal communities who are losing the land would be compensated as detailed below:

1. Reserve Forest Land - Rs 78,000 per ha
2. USF/Community Forest Land - Rs 1,56,000 per ha + 25 % NPV
3. Community Jhum Land/Community Land - Rs 1,75,000 per ha + 30 % Solatium of land value
4. Cost of Crops in Hilly area - Rs 1,00,000 per ha

5. Cost of Crops in Plain area - Rs 1,20,000 per ha

R&R package for the project affected families of proposed Demwe Lower H.E. project

Particulars	No. of PAF	Amount (in Rs.)
A) Total Cost of Land Value	204	15,52,17,540
B) Cost of Trees		7,97,450
C) Scheduled Tribe family grant	204	1,02,00,000
D) Vulnerable Person Grant	60	1,80,00,000
E) Free Electricity grant	204	1,22,40,000
F) Livelihood grant	204	2,00,00,000
G) BPL Family grant	204	102,00,000
Grand Total		22,66,54,990

3.2.2 Proposed Financial Outlay for Local Area Development Plan

The influence zone of the Demwe Lower HEP is considered an abode for Mishmi tribes, having uniqueness in culture and customs. The area is sparsely populated. The Mishmis have traditional right on the forest produce and practice shifting cultivation. The proposed infrastructure development has been suggested keeping in view the cultural complexity and sensitivity of the area. The required infrastructural facilities are related to organization of Training Programs, distribution of Merit Scholarships and Marriage grants, supporting Income Generation Schemes, creating Education Facilities and Bus Stops/ Rain Shelters, Construction of Footpaths, Support Services for Agricultural and Horticultural Activities, creation of Women Technology Park, protection of Cultural Heritage and Old Monuments, Assistance and Training to Fishermen, development of Communication Facilities, Community Welfare Centers and Transportation and Recreation Facilities, etc. For various measures a total outlay of Rs. 8390.46 Lakhs plus Rs 50 Lakhs for monitoring committee is therefore proposed under Local Area Development Programme. However, it is important to

mention here that the budgetary provisions under various heads are tentative and the co-ordination committee may reallocate the funds as per actual needs. Out of the above, since compensation for land & trees would be exclusively met out from the land compensation grants under DPR, the total package for R&R and LADP under EIA/EMP amounts to 9146.96 lakhs.

3.3 Biodiversity Management Plan

Flora:

The catchment and the influence zone of Demwe Lower HEP has a large array of diversity in timber, fuel, food, fodder, vegetables and medicinal plants which are naturally or artificially growing in the region. After the extensive field survey, the categorization of conservation status based on Red Data Book suggests that a total of 6 floral species comes under conservation status in the entire catchment and influence zone. Out of them 4 species are Rare and 1 species each of Endangered and Vulnerable category.

Fauna:

The catchment and the influence zone of Demwe Lower HEP reports 16 varieties of mammalian species out of which 12 species as categorized as Schedule I under Wildlife Protection Act and 1 each in schedule III and IV and also considering the vicinity of the Kamlang Wildlife Sanctuary harboring wide variety of faunal species.

To conserve these RET category of the floral species and schedule faunal species of the surrounding area, Biodiversity management plan is proposed. Under this plan, several conservation measures are proposed for which the total cost is estimated to be Rs. **892.41** Lakhs. The project authorities will provide the funds for Biodiversity Management Plan of Demwe Lower H.E. project in Arunachal Pradesh for five years along with Wildlife Management Plan. The implementation of Wildlife Management Plan shall be in line with the guidelines of the Kamlang Wildlife Sanctuary and all the rules of the protected area shall be applied in the course of the project operation.

3.4 Green Belt Development Plan

To mitigate the environmental impacts arising during project construction require the development of green belt in the project area. In the proposed Demwe Lower H.E. Project, the area taken for the development of green belt around the reservoir is around 2887.8 ha. This area has been divided into three layers for plantation of plant species depending upon the microclimatic condition that will develop after creation of the reservoir in the region. A total of **Rs. 91.45 Lakhs** is proposed for this purpose.

3.5 Reservoir Rim Treatment Plan

A detailed survey was carried out along the periphery of the submergence zone of Demwe Lower Hydroelectric project to delineate the zones of weaknesses (telus cones, stream network draining to the reservoir and the existing landslides). Identification of all such factors revealed that the reservoir rim of Demwe Lower dam is characterized by around 30 landslides. Reservoir rim treatment is basically framed to abolish the probability of sliding of any material due to natural factors or due to anthropogenic factors during the drawdown period of project operation. Accordingly, the landslides which are active, if not supported, may bring down lot of debris to the reservoir. Engineering and biological measures are proposed for the treatment of reservoir rim and a provision of **Rs 840.72 Lakhs** is proposed in the budget.

3. 6 Restoration of Construction Areas and Landscaping

Demwe Lower H.E. Project will involve construction of colonies for staff and laborers, roads linking to various components of project, offices, workshops, etc. Total area likely to be affected due to these activities is around 1590 ha. This land also includes areas likely to be disturbed due to quarries, dam construction and powerhouse site. At present, the proposed project area is covered with open/dense forest particularly at dam and power house site. The proposed colony area and office complex at present is covered with secondary forests. This existing landscape will be totally modified or changed due to proposed project. It is, therefore, important that after the project work and related activities

are over, these disturbed areas are restored to bring them back to their similar or near to similar pre-construction condition or in improved state. It will be essential for the project authorities to restore the area to its natural/ original state after completion of the project. For the restoration and landscaping of the colony and other disturbed regions in the project, a budget of **Rs. 240.88 Lakhs** is proposed in the management plan.

3.7 Disposal and Rehabilitation of Muck

The proposed Demwe Lower HE project is likely to generate large volume of muck, of which some quantity will be utilizable and the remaining muck volume needs to be rehabilitated at appropriate dumping sites in a technically and ecologically sound manner. During the construction phase, a total 101.18 lakh cum of muck will be generated from excavation for different appurtenant structures like diversion tunnel, dam, adits, infrastructure works and power house complex. About 40% of the muck generated from overburden excavation, amounting to 20.00 lakh cum will be utilized as aggregate for concrete and 4.2 lakh cum will be used in the Coffer dam. The volume of the remaining muck from overburden amounts to 34.28 Lakh cum and that from rock amounts to 42.70 Lakh cum. After adding a swelling factor of 25% for overburden material and 60% for excavated rock, the total muck volume that requires to be rehabilitated is 111.17 Lakh cum. Two dumping sites (DS1 and DS2) have been identified and these dumping sites are situated about 3 to 4 km from the construction area. Total land requirement for these sites is 150 ha. The muck rehabilitation plan involves both engineering and biological measures that depend on the terrain and eco-climatic conditions. Stability of the loosely held muck requires appropriate method of consolidation and biological measures so that the muck is not easily eroded leading to subsequent ecological problems. The total cost requirement for the purpose of rehabilitation of muck is **Rs.7000 lakhs**.

3.8 Fishery Management Plan

Fish farm and hatcheries are proposed for fish management and to maintain the aquatic diversity. The fishery development has been aimed towards the

conservation of threatened species and economic upliftment of the region. A fish hatchery is the centre of ova production. It helps in propagating the ova of required species to different water bodies. A hatchery can play an important role in the conservation of threatened species and sustenance fishery. In order to conserve the vulnerable species of Lohit river, which would undergo through stresses due to proposed Demwe Lower H.E. project, 3 hatcheries are proposed for the indigenous species alongside the reservoir or the tributaries. The species, viz. *Tor putitora*, *T. tor*, *Acrossocheilus hexagonolepis*, *Labeo rohita*, *L. dero*, *Schizothorax richardsoni*, *Schizothoraicthys progastus* are suggested for the hatchery unit, however, fishery department can use the hatchery unit for other species. A provision of Rs. **456.33** Lakhs including Administrative cost has been made for the same. It is proposed to utilize expertise of local state government department in the implementation of the scheme.

3.9 Health Management Plan

Public Health Delivery System facilities will be provided for labours as well as project affected families for which a provision of **Rs. 1186.76** Lakhs has been proposed for Public Health Delivery System under Local Area Development Programme.

3.10 Subsidized Fuel Management Plan

Conggregations of a labour force along with villagers are likely to create pressure on forest resource on the area which will imbalance environmental matrix of the area. In this regard subsidy on LPG connection is proposed. As far as project proponents and their contractors are concerned, supply of subsidized fuel to the labours should be ensured. The overall cost works out to be Rs **229** Lakhs for these measures.

3.11 Solid Waste and Sanitation Management Plan

Improper Solid Waste Management causes all types of pollution: air, soil, and water. After proper understanding of locations of labour camps, residential areas, hospitals, office complex, etc. Provisions for solid waste management facilities

are made for safe collection, transportation and disposal of solid waste for which about Rs. **128.58** Lakhs is kept in the estimate. During construction phase of the project, congregation of labour force will generate 10,08,000 litre per day sewage. Therefore, it is proposed to commission adequate number of septic tanks for treatment of sewage. To ensure that the sewage from the labour camps do not pollute the river water. It is estimated that about 48 community latrines and 42 septic tanks need to be constructed.

3.12 Disaster Management Plan

Disaster is anticipated due to failure of the dam either by technical flow in its design or because of extreme flow in the river or because of some natural calamity/catastrophe like earthquake and may create havoc/huge destruction in the downstream area. Whatever may be the reason of failure, it is very clear that the destruction is expected mainly due to the flooding caused by water stored in the reservoir. Therefore, keeping in view the adverse effects of dam failure, it is imperative to assess the flows expected in the downstream reaches and prepare a relevant disaster management plan, well in advance to minimize the loss of life and property. **HEC-RAS version 4.0** model has been used for the dam break analysis. The flood wave is expected to inundate the downstream stretch of about 58 km approximately in 6.68 hours. This means that very little time would be available for execution of any rescue and/or evacuation plan. Therefore, the Disaster Management Plan has been devised mostly for preventive measures.

Monitoring: The project authorities (ADPPL) should prepare an effective Dam Safety Plan including dam safety surveillance and monitoring scheme. This should also include rapid analysis and interpretation of instrumentation and different observation data along with periodic inspection, safety reviews and their evaluation.

Communication System: An efficient communication system is absolutely essential for the success of any disaster management plan. This has to be

worked out in consultation with local authorities. A provision of **Rs. 251.88 lakhs** has been made for different measures in Disaster management plan.

3.13 Compensatory Afforestation Scheme

Degraded forestland has been selected for Compensatory Afforestation for Demwe Lower HEP as non forestland is not available for the purpose. Thus, Compensatory Afforestation will be undertaken over twice of the surface forest land involved in the project i.e. $1409 \times 2 = 2818$ ha. Total Financial provision of around **Rs. 40.00 crore** has been made for Compensatory Afforestation for Demwe Lower HEP. The total time period for implementation of Compensatory Afforestation is 10 years out of which six years of time period will be required for raising of plantation and maintenance of plantation will be done for next four years. The Compensatory Afforestation will be implemented by the State Forest Department.

3.14 Environmental Monitoring Plan

The Environmental Monitoring will be required during construction and operational phases for: Social Welfare, Water Quality and Public Health, Catchment Area Treatment Measures; and Air Quality and Noise Level. In this regard a monitoring committee consisting of member from Ministry of Environment & Forests, Gol, State Forest Department, Pollution Control Board, District Administration of Lohit, and Representative of Project Proponent may be constituted to evaluate the efficacy of works being implemented. It is further strongly felt that the agency associated with formulation of EIA/EMP study should also be involved in the monitoring of EMPs implementation. This will help in better implementation of treatment suggested. A provision of **Rs 154.03 Lakhs** has been made for environmental monitoring plan.

OVERALL COST OF ENVIRONMENTAL MANAGEMENT PLANS

S. No.	Item of work	Cost in Lakhs
1	Catchment Area Treatment Plan	3312.00
2	Reservoir Rim Treatment Plan	840.73
3	Bio-diversity Conservation Plan	892.41
4	Greenbelt Development Plan	91.45
5	Landscaping & Restoration Plan	240.88
6	Muck Disposal Plan	7000.00
7	Fish Management Plan	456.33
8	Rehabilitation & Resettlement Plan and Local Area Development Plan including Public Health Delivery	9146.96
9	Public Health Delivery Plan	Booked under R&R and LADP (1186.76)
10	Subsidized Fuel Management Plan	229.00
11	Solid waste management and sanitation facilities	128.58
12	Disaster management plan	251.88
13	Environmental Monitoring Plan	154.03
14	Compensatory Afforestation	4000.00
	Grand Total	26744.26