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EXECUTIVE SUMMARY

1. GENERAL

The Nyamjang Chhu Hydroelectric project located in Tawang district of Arunachal Pradesh. It is a run-of-the-river scheme with peaking pondage to harness the hydropower potential of River Nyamjang Chhu. The project will utilize a gross head of about 1057.4 m for a generation of 780 MW in an underground powerhouse. The project is located along the Nyamjang Chhu between Zimithang and Lumla. The diversion site is located near Zimithang having coordinates at latitude 27°43'06" N, longitude 91°43'37" E and the powerhouse is located near confluence of Nyamjang Chhu and Tawang Chhu at latitude 27°31'16" N , longitude 91°41'12" E. The project location map is enclosed as Figure-1.

2. PROJECT DESCRIPION

The project envisages construction of barrage across Nyamjang Chhu River, a head regulator, Feeder Channel, desilting chamber with collection pool & intake, a headrace tunnel, surge shaft, pressure shafts, underground powerhouse and tailrace tunnel. The General Layout Plan is enclosed as Figure-2. The salient features of the Project are given in Table-1.

TABLE-1
Salient features of Nyamjangchhu hydroelectric project

1.	**LOCATION**		
	State	:	Arunachal Pradesh
	District	:	Tawang
	River	:	Nyamjang chhu
	Vicinity	:	Tawang
	Longitude at diversion site	:	91°43'37"
	Latitude at diversion site	:	27°43'06"
2.	**HYDROLOGY**		
	Catchment area at diversion	:	2650 Sq. Km.
	Design Flood (50 year Return period)	:	3400 Cumecs
	Design Discharge		87 Cumecs
3.	**BARRAGE**		
	Length of Barrage	:	174.50 m
	H.F.L	:	2114.90 m
	F.R.L	:	2114.9 m
	Average river bed level	:	2106.20 m
	Max. height of Barrage above Avg. River Bed Level	:	11.20 m
	Design Flood (SPF)	:	3400 Cumecs
3(a). SPILLWAY			
	Type	:	Gated
	No. of Bays	:	11 Nos.
	Length of Bay	:	10.00 m
	Sill level	:	2107.4 m
	Size of gates	:	7.5m(H) x 10m(W)
	Type of gate	:	Vertical lift gates
	Energy Dissipation arrangement	:	Stilling Basin type
3(b). UNDERSLUICE			
	Type	:	Gated
	No. of Bays	:	3 Nos.
	Length. of Bay	:	5.00 m.
	Sill Level	:	2105.9 m
	Size of gates	:	6.3m(H) x 5m(W)

	Type of gates	:	Vertical lift gates
	Energy Dissipation System	:	Stilling Basin.
3(c). HEAD REGULATOR			
	Length	:	46 m
	HFL	:	2114.90 m
	FRL	:	2114.9 m
	MDDL	:	2112.2 m
	Sill level	:	2108.4 m
	Bridge deck level	:	2116.4 m
	No. of bays	:	8 Nos.
	Length of bay	:	4.00 m
	Size of gates	:	6.5 m(H) x 4.0 m(W)
	Type of gates	:	Vertical lift gates
	No. of silt excluder tunnels	:	8 Nos.
	Size of silt excluder tunnels	:	0.75m(H) x 1.5m(W)
4.	**FEEDER CHANNEL**		
	Length	:	600 m
	Total width	:	20.00 m
	No. of channels	:	4 Nos.
	Width	:	4.25 m
	Height	:	6.00 m
5.	**DESILTING ARRANGEMENT**		
	Type	:	Surface basins Hopper type
	No. & Size of desilting basin (LxBxH)	:	8 Nos., 150m x 10.50m x 19m
	Particle size to be excluded	:	0.20 mm and above
	Flow through velocity	:	0.2 m/s
	Flushing velocity	:	4.5 m/sec.
	Dia. of silt flushing Conduit	:	2.0 m
6.	**HEAD RACE TUNNEL**		
	Type and Size	:	Concrete Lined Circular Shaped, 6.20 m Finished Dia.
	Velocity	:	2.88 m/s
	Length	:	23450.0m
	Design discharge	:	87 cumec.
7.	**ADITS**		
	Type	:	D – Shaped
	Adit No.-1	:	7.0mx5.0m, Length =362.0m
	Adit No.-2	:	7.0mx5.0m, Length =322.0m
	Adit No.-3	:	7.0mx5.0m, Length =460.0m
	Adit No.-4	:	7.0mx5.0m, Length =655.0m
	Adit No.-5	:	7.0mx5.0m, Length =439.0m
	Adit No.-6	:	7.0mx5.0m, Length =476.0m
	Adit No.-7	:	7.0mx7.0m, Length =436.0m
	Adit No.-8	:	7.0mx5.0m, Length =980.0m
	Adit No.-9	:	7.0mx5.0m, Length =1088.0m
8.	**SURGE SHAFT**		
	Type	:	Open to sky, Restricted orifice type.
	Size:	:	4.0m, 10.0m & 12.0m Dia.,

			240.0 m high.
	Maximum Upsurge Level	:	2165.20 m
	Minimum Downsurge Level	:	2052.42 m
	Bottom Level	:	1931.40 m
	Top Level	:	2171.40 m
9.	**PRESSURE SHAFT**		
	Type	:	Steel Lined
	Size Main	:	2 No., 3.3m dia, each 2115.0 m long.
	Unit Pressure Shaft	:	6 No, 2.0m dia, each 415.0 m long
	Velocity	:	5.07 m/s
10.	**POWERHOUSE**		
	Type	:	Underground
	Installed Capacity	:	780 MW (6 x 130 MW)
	Size	:	166.2m x 20m x44.5m
	Maximum gross head	:	1057.40 m
	Max Net head	:	1018.40 m
	Min Net Head	:	1014.30 m
	Rated Net head	:	1017.03 m
11.	**TAILRACE TUNNEL**		
	Type	:	Circular shaped
	Size	:	7.0m Dia., 1965.0m Long
12.	**TURBINES**		
	No. & Type	:	6 No., Vertical Shaft Pelton.
	Rated net Head	:	1017.03 m
	Rated discharge	:	87 cumec.
13.	**MAIN INLET VALVE (MIV)**		
	Type	:	Spherical valve
	Diameter	:	2.0 m
14.	**SWITCHYARD**		
	Area	:	40.0m x 30.0m
	Type	:	Surface at EL 1131.4m
15.	**ESTIMATED COST**		
	Completion Cost at May, 2010 price level	:	Rs. 6852.28 Cr.
16.	**POWER BENEFITS**		
	Energy generation in 90% dependable year	:	3430.29MU
17.	**TARIFF**		
	Levelised Tariff	:	Rs. 4.25/Kwh
	First Year	:	Rs. 5.20/Kwh
18.	**CONSTRUCTION PERIOD**		
	Construction Period (including 12 months for pre-construction activities)	:	74 months

The total land required for the project is 254.5526 ha. The details are given in Tables-2 and 3.

TABLE-2
Land requirement for Nyamjang chhu hydroelectric project

S. No.	Component	Village	Private Land (ha)	Community Land (ha)	Total Land (ha)
1	Submergence Area (Left Bank up to Barriage)	Soksen	4.0454	4.5961	8.6415
2	Submergence Area (Right Bank up to Barriage)	Lumpo	0	2.9707	2.9707
3	Submergence Area (River area up to Barriage)	Soksen and Lumpo (50 - 50)	0	27.7369	27.7369
4	Upstream Headworks	Soksen	0	22.051	22.051
5	Head Race Tunnel	Soksen	0	1.079	1.079
6		Kyaleyteng	0	2.158	2.158
8		Shakti	0	8.332	8.332
9		Gispu	0	0.981	0.981
10		Sherbang	0	1.054	1.054
11		Kherteng	0	1.168	1.168
12		Phoomang	0	1.168	1.168
13		Bagar	0	1.168	1.168
14	Adits - 1	Kyaleyteng	0	0.333	0.333
15	Adits - 2	Shakti	0	0.2382	0.2382
16	Adits - 3	Shakti	0	0.3404	0.3404
17	Adits - 4	Shakti	0	0.484	0.484
18	Adits - 5	Sherbang	0	0.324	0.324
19	Adits - 6 (equally in three villages)	Kherteng/Phoo mang/Bagar	0	0.352	0.352
20	Adits - 7	Kherteng/Phoo mang/Bagar	0	0.322	0.322
21	Adits - 8	Kungba	0	0.725	0.725
22	Adits - 9	Kherteng	0	0.805	0.805
23	Tail Race Tunnel	Kherteng	0	1.335	1.335
24	G IB	Kherteng	0	0.3261	0.3261
25	MAT	Kherteng	0	0.5152	0.5152
26	Power House	Kherteng	0	15.5618	15.5618
27	Surge Shaft (equally in three villages)	Kherteng, Phoomang,	0	0.5901	0.5901

S. No.	Component	Village	Private Land (ha)	Community Land (ha)	Total Land (ha)
		Bagar			
28	Pressure Shaft (equally in three villages)	Kherteng, Phoomang, Bagar	0	2.693	2.693
29	Switchyard	Kherteng	0	0.675	0.675
30	Muck disposal Sites M-1	Muchat	0	2.6893	2.6893
31	M-2	Muchat	0	7.459	7.459
32	M-3	Kyaleyteng	0	8.659	8.659
33	M-4	Shakti	0	1.9571	1.9571
34	M-5	Shakti (BTK)	0	2.9283	2.9283
35	M-6	Shakti (BTK)	0	8.0694	8.0694
36	M-7	BTK	0	4.7789	4.7789
37	M-8	BTK	0	5.767	5.767
38	M-9	Shakti (BTK)	0	2.8847	2.8847
39	M-10	Sherbang	0	3.2569	3.2569
40	M-11	Sherbang	0	4.415	4.415
41	M-12	Sherbang	0	3	3
42	M-13	Kherteng	0	3.9238	3.9238
43	M-14	Kumba	0	6.6	6.6
44	M-15	Kumba	0	2.5898	2.5898
45	Colonies	Sherbang	0	7	7
46	Labour Camps (equally in three villages)	Kyaleyteng, Kherteng, Sherbang	0	3	3
47	Workshop,Centerlized store and Fabrication yard	Kherteng	0	4	4
48	Explosive Magazines (2 nos) (50 - 50)	Sherbang / Kyaleyteng	0	1.5	1.5
49	Crusher ,Batching plant and aggregate Storage (2 nos)(50-50)	Kerteng / Shakti	0	12	12
50	Contractor colonies (Temp)equally in three villages	Kherteng/Sherbang/Kyaleyteng	0	4	4
51	Adit Portals (1 to 9),TRT,Cables tunnel Portals (for cover)	respective villages of Adits	0	0.419	0.419

S. No.	Component	Village	Private Land (ha)	Community Land (ha)	Total Land (ha)
52	Storage area at different works sites	Socksen,respective villages of Adits , s.shaft, MAT, GIB &TRT	0	2	2
53	Access Roads to Query 3,4,5,6,7 @ 500 mts each	Socksen, Muchat,Shakti, Sherbang, Lumla	0	3.75	3.75
54	Access Roads to Inlet Portal ADIT 1 (15 mtrs RoW)	Kyaleyteng	0	0.15	0.15
55	Access Roads to Adits - 2, 3	Shakti	0	13.5	13.5
56	Access Roads to Adits - 5	Sherbang	0	2.745	2.745
57	Access Roads to Adits - 6	Kherteng/Phoomang/Bagar	0	5.625	5.625
58	Access Roads to Adits - 7	Kherteng/Phoomang/Bagar	0	1.275	1.275
59	Access Roads to Adits - 8	Kungba	0	1.62	1.62
60	Access Roads to Adits - 9	Kherteng	0	1.65	1.65
61	Access Roads to MuckDumpng 3	Kyaleyteng	0	0.75	0.75
62	Access Roads to MuckDumpng 4	Shakti	0	4.05	4.05
63	Access Roads to Surge Shaft	Kherteng	0	0.375	0.375
64	Access Roads to M.A.T.	Kherteng	1.0875	0	1.0875
65	Access Roads to Cables tunnel	Kherteng	0.75	0	0.75
66	Access Roads to T.R.T	Kherteng	4.2	0	4.2
67	Quarry (Q -2 to Q-7)		0	6	6
	Tctal		**10.0829**	**244.4697**	**254.5526**

TABLE-3
Ownership status of land to be acquired for Nyamjang chhu hydroelectric project

S. No.	Type of land	Area (ha)
1	Private land	10.0829
2	Community land	244.4697
	Total	**254.5526**

3. STUDY AREA

The study area considered for the CEIA study is given as below and shown in Ffigure-3:

- Submergence area
- Area within 10 km of the periphery of the submergence area
- Area to be acquired for siting of various project appurtenances.
- Area within 10 km of various project appurtenances
- Catchment area intercepted at the barrage site

4. FIELD STUDIES

As a part of the EIA study, primary data has been collected by WAPCOS Ltd. for three seasons. However, as a part of TOR clearance, the project proponents were asked to get the field studies conducted by another agency. The project proponents selected RS Envirolink Technologies Private Limited as the other agency, who collected data for three seasons. The details are given in Table-4.

TABLE-4
Details of field studies conducted as a part of CEIA studies

Agency	Season	Months
WAPCOS Ltd.	Monsoon	August-September 2007
	Winter	December 2007 – January 2008
	Summer	April – May 2008
RS Envirolink Technologies Private Limited	Summer	April – May 2008
	Monsoon	July – August 2008
	Winter	November – December 2008

5. ENVIRONMENTAL BASELINE STATUS

The baseline status has been divided into following three categories:

- Physico-chemical aspects
- Ecologcal aspects
- Socio-Economic aspects.

5.1 Physico-chemical Aspects

5.1.1 Meterology

The climate of the project area is characterised by cool and dry climate. Meteorologically, the year can be divided into three distinct seasons. Winter season sets in from the month of October and continues upto February, followed by summer season from March to June. The area receives rainfall under the influence of south-west monsoons over a period of three months from July to September.

5.1.2 Geology

The rocks in the project area can be grouped into two main classes, viz gneiss and quartzite's with schist bands. While the gneisses occupy the upstream half of the site, the quartzite's occur in the downstream half. The gneisses are generally medium to coarse grained and consist of quartz, feldspar and biotite. Augen gneisses also occur occasionally. The biotite content varies and mica rich gneisses are common. Quartzite is fine to medium grained and invariably contains mica that makes it micaceous quartzite. Schist band of 1-5 m thickness are found associated with the quartzite. There are a few exposures of carbonaceous schist in the vicinity of the proposed area of surge shaft.

5.1.3 Seismicity

The north eastern part of the Himalayas is seismically very active. It is located at the junction of three tectonic plates: the Indian plate, the Eurasian plate and the Indo-Burmese plate. These are in constant collision and thus the region is under high tectonic stresses, which are

released in the form of earthquakes. Neo-tectonic activity has rejuvenated the existing tectonic lineaments and developed new cross-faults. Epicenters of almost all the faults are located along the major cross-faults, whereas no activity is observed in the above said major thrusts. About 87 seismic events have been witnessed in a period of 64 years, between 1929 and 1993. As per the Seismic Zoning map of India, the whole North East India falls in zone V.

5.1.4 Landuse pattern

The landuse pattern of the study area has been studied using satellite data and the details are given in Table-5.

TABLE-5
Land use pattern of the study area

Landuse Cover	Area (ha)	Percentage of Study Area (%)
Dense vegetation	42010	60.27
Open vegetation	19519	28.00
Scrubs	4358	6.25
Agriculture land	2813	4.04
Water body	987	1.43
Settlement	21	0.03
Total	**69708**	**100.00**

Major land use category in the study area is forest, which accounts for almost 88.27% of the study area. The other major category is scrubs accounting for about 6.25% of the study area. The agriculture land accounts for about 4.04% of the study area. The area under water body account for about 1.42% of the study area. The area under settlement is about 0.03% of the study area.

5.1.5 Soils

The soil in submergence area is almost neutral in nature, while soil samples downstream of barrage site and powerhouse site are slightly acidic in nature. The Electrical Conductivity ranged from 130 µs/Cm at downstream of powerhouse to 290 µs/cm at downstream of barrage site. The organic matter was observed least in catchment area soil samples. The organic matter and level of various nutrients indicate moderate to high productivity of soils.

5.1.6 Water Quality

The water of river Nyamjangchhu in the study area is soft. The low EC and TDS values indicate the lower concentration of cations and anions. This is also reflected by the fact that the concentration of most of the cations and anions are well within the permissible limit. The fluorides level was lower than the permissible limit (1 mg/l) for drinking purposes. The BOD and COD values are well within the permissible limits, which indicates the absence of organic pollution loading. This is mainly due to the low population density and absence of industries in the area. The marginal quantity of pollution load which enters river Nyamhjangchhu gets diluted. In fact, even for the minimum flow, there is more than adequate water available for dilution. The Total Coliform and Fecal coliform are also low. Thus, It can be concluded that, water quality was observed to be quite good. The concentration of various heavy metals was below the permissible limit specified for domestic use. It can be concluded that water quality was observed to be quite good, as various parameters are well below the permissible limit specified for meeting domestic requirements.

5.1.7 Ambient Air Quality

Based on the findings of the ambient air quality survey, conducted for the summer, post-monsoon and winter seasons, it can be concluded that the ambient air quality is quite good in the area. The values of these parameters were well below the permissible limits specified for residential, rural and other areas. The absence of industries, low vehicular traffic and low population density can be attributed for good ambient air quality in the project area.

5.1.8 Ambient Noise Level

The day time equivalent noise level in post-monsoon, winter and summer seasons at various sampling were well within the permissible limit specified for residential area. The absence of industries, low vehicular traffic and low population density can be attributed for low ambient noise level in the project area.

5.2 ECOLOGICAL ASPECTS

5.2.1 Vegetation

Forest Types

The forest type observed in the Study Area are breifly described in the following paragraphs. Champion and Seth (1968); Rao and Panigrahi (1961); Sahni (1981); Rao and Hajra (1986), etc are the prominent workers who studied forest and vegetation of the region. The forest types observed in the study area are as follows which is based on altitudinal and climatic factors.

Sub- Tropical Forest

These forests occur between 1200m and 1800m. The dominant species are *Pinus wallichiana, Alnus nepalensis, Betula alnoides,* etc. These type of forest mainly found near the Brokan Thang village on the left bank of the river in the catchment area.

Temperate Forest

These forests occur in the form continuous belt between 1800m and 3500 m altitudes. The forest is comparatively open and is further divided into temperate broad leaved and temperate conifer forests.

Temperate Broad Leaved Forest

Temperate broad leaved forest occur between 1800m and 2800 m altitudes. Tresses like *Alnus nepalensis, Rhododendron arboreum, Lyonia ovalifolia, Mallotus philippensis*, etc. are dominant. Climbers are rare where as various epiphytic species of *Agapetes* sp., *Rhododendron* sp., *Vaccinium* sp. are common with several lichens and ferns.

Temperate Conifer Forest

These forests are confined to 2800- 3500 m altitude and experience regular snowfall during winter. The top canopy is dominated by mixed coniferous type that includes Abies pindrow, Pinus wallichiana, etc with some broad leaved species of *Rhododendron arboreum, Lyonia ovalifolia, Engelhardtia spicata, Juglans regia,* etc. This type of forest is observed on the right bank of the river near Ghorsham village and in the catchment area.

Subalpine and Alpine Forest

These forests occur at high altitudes i.e. 3500m - 5500 m and generally lack tree species and mostly observed in the catchment area and on the top of the hills. Subalpine forest is characterized by tree species like *Abies pindrow, Rhododendron* sp. The common shrubs are *Berberis angulosa, Gaultheria nummularis*, *Rubus* sp., *Primula macrophylla*, etc and with some herbaceous species *Arenaria* sp., *Inula cuspidata, Sedum* sp., *Trigonella corniculata*, etc. The alpine zone is above the altitude of 4000 m and remains mostly covered with snow for the major part of the year. The vegetation is very scarce and comprise of shruby *Rhododendron* sp., and herbs like *Aconitum* sp., *Arenaria* sp., *Ranunculus* sp., *Primula sikkimensis*, *Polygonum capitatum*, *Rumex nepalensis*, etc are common.

Secondary Forests

The secondary forests are found along the banks of the rivers where primary forests have been cleared in the past for timber and nearby the villages. The secondary forests are dominated by trees belonging to species *Macaranga denticulata, Alnus nepalensis*, *Lyonia*

ovalifolia, Morus alba, Ficus semicordata and *Schima khasiana*. At many places vegetation is very sparse and shows rock outcrops that are devoid of any plant species.

Grasslands
The grasslands are common near the Nyamstring area on both the banks of the river. Lemon grass (*Cymbopogon flexuosus)* is dominant in this area with some trees like *Ficus semicordata, Toona ciliata, Salix karelinii*, etc. *Emblica officinalis* and *Woodfordia fruticosa* are frequent on both the banks of river.

Floristic composition
As per terrestrial ecological survey, a total of 121 plant species were recorded during floristic survey in the sample sites. A complete list of plant species found in the study area representing Dicots, Monocots, Gymnosperms, Pteridophytes, Bryophytes, Algae and Fungi is given in Annexure-IV. The names of the family and the local names (wherever possible) are also given. The number of plant species belonging to different groups is summarized in Table-6.

TABLE-6
No. of plant species belonging to different groups as per the survey in the study area

Plant Group	Winter	Summer	Monsoon
Angiosperms	92	113	96
Dicots	87	110	94
Monocots	5	3	2
Trees	30	30	30
Shrubs	21	21	21
Herbs	41	49	36
Climbers	3	4	3
Gymnosperms	4	4	4
Pteridophytes	7	7	6
Bryophytes	4		
Algae	7		
Fungi	4		

No threatened category of plant species was encountered during the survey. The area showed no rare / endangered / vulnerable plant species as per IUCN categorization.

5.2.2 Fauna
The wildlife in the project area has been listed based on the observation during the field visit and information collected from the local people. Amongst mammals, the commonly observed species were Leopard (*Panthera pardus*), Wild Dog (*Cuon alpinus*), Jungle Cat (*Felis chaus*), Himalayan Black Bear (*Selenarctos thibetanus*), Assamese Monkey (*Macaca assamensis*), etc. Within avi-fauna, Great Hill Barbet (*Megalaina virens*), Common Myna (*Acridotheres tristis*), Scarlet Minivet (*Pericorocotus flammeus*), Brown Dipper (*Cinchus pallasii*), etc. were reported. Out of 65 faunal species, 6 species fall under different Schedules of the Wild Life Protection Act 1972 (refer Table-7).

TABLE -7
Details of Threatened categories of species found in the project area

Species	Threatened category
Cuon alpinus	Schedule II
Herpestes edwardsii	Schedule II[16
Herpestes urva	Schedule II[16
Macaca assamensis	Schedule II Part I [1A
Trachischium tenuiceps	Schedule IV
Varanus bengalensis	Schedule II

5.2.3 Aquatic Ecology

A total of 7 phytoplankton species were recorded from the project site and their population was high during monsoon season. The phytoplankton communities were dominated by algae**.** Total population was quite low as compared to the rivers in the plains. A total of 6 zooplankton species were recorded from the project site and their population was high during monsoon, winter and summer seasons. Total population was quite low as compared to the rivers in the plains. The zooplankton population was higher in summer season as compared to winter season.

5.2.4 Fisheries

There is no fish landing centre in project area. It was also observed during field visit that no large scale fishing activities are being practiced by the population in and around the project area. During interaction with the locals and fishery department it was confirmed that there are no permanent and fishermen in the project area. However, few locals are involved in fishing activities to augment their income. No family is fully dependent on fishery for earning his living. The fisheries is done mostly for subsistence. The major fish species observed during fisheries survey is given in Table-8.

TABLE-8
List of fish species in project area along with their common names

S. No.	Species	Family
1	*Barilius barna*	Cyprinidae
2	*Botia Dario*	Balitoridae
3	*Chanda nama*	Ambassidae
4	*Channa orientalis*	Channidae
5	*Danio aequipinnatus*	Cyprinidae
6	*Garra gotyla gotyla*	Cyprinidae
7	*Garra lissorhynchus*	Cyprinidae
8	*Glyptothorax* sp.	Amblycipitidae
9	*Hara hara*	Amblycipitidae
10	*Labeo dero*	Cyprinidae
11	*Labeo pangusia*	Cyprinidae
12	*Puntius sarana sarana*	Cyprinidae
13	*Salmostoma bacaila*	Cyprinidae
14	*Schizothorax richardsonii*	Cyprinidae
15	*Tor putitora*	Cyprinidae
16	*Tor tor*	Cyprinidae

5.3 DEMOGRAPHIC PROFILE OF THE STUDY AREA

There are 60 villages belonging to five circles falling within the study area of proposed Nyamjang Chhu H.E. Project. The total human population of these villages is 11,445 of which 10,515 belong to Schedule Tribes which constitutes 91.8 % of the total population. There are 2,693 household in study area with Lumla circle having the highest number (1,216) followed by Zemithang (647), Dudunghar (519), Mukto (195) and Tawang (116).

There are 25 primary schools, 7 middle schools and 2 secondary schools in the study area. There is no senior secondary school or college in the entire study area. Moreover, there is not even a single college in the entire district. Poor educational infrastructure is reflected in the literacy status in the area. Average literacy rate in the study area is 22.8%; village wise rate varies from 0 to 100% and there are two villages (Shorkimeng and Narmaleng) in dudunghar Circle, one village (Thiksi) in Zemithang Circle with entire illiterate population. Gyangong Ani in Tawang circle has highest literacy rate of 100%. Male literacy rate is fairly high as compared to that of female literacy rate.

6. PREDCTION OFIMAPCTS

6.1 Water quality

a) Construction phase

Effluent from labour colony

The peak migrant population is likely to be of the order of 11,200. The quantum of sewage generated due to this population is expected to be of the order of 0.63 mld. The BOD load contributed by domestic sources will be about 504 kg/day. The sewage from construction colonies shall be treated prior to disposal.

Effluent from crushers

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

Effluent from other sources

Substantial quantities of water would be used in the construction activities. With regard to water quality, waste water from construction activities and runoff from construction site would mostly contain suspended impurities. Adequate care shall be taken so that excess suspended solids in the wastewater are removed prior to disposal.

b) Operation phase

Effluent from project colony

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

Impacts on reservoir water quality

In the proposed project, most of the land coming under reservoir submergence is barren, with few patches of trees. These trees too are likely to be cleared before 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 D.O. level in reservoir water is anticipated.

Eutrophication risks

Fertilizer use in the project area is negligible, hence, the runoff at present does not contain significant amount of nutrients. Even in the post-project phase, use of fertilizers in the project catchment area is not expected to rise significantly. Another factor to be considered that the proposed project is envisaged as a run off the river scheme, with significant diurnal variations in reservoir water level. Thus, in project operation phase, problems of eutrophication, are not anticipated.

Sediments

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

Water resources and downstream users

The Nyamjangchhu Hydro Electric Project is a run of river scheme project on river Nyamjangchhu. The diversion of water for hydropower generation will lead to drying or reduction of flow river stretch of about 32 km. The effect will be more pronounced in the lean season. There are no major users of water in the intervening stretches, as river flows through a gorge and requires pumping for use at point of consumption. As a result, there are no major users of water of river Nymjangchhu in the intervening stretch. Thus, no major adverse impacts are anticipated on downstream water users. However, there will be

significant adverse impacts on riverine ecology, which needs to be ameliorated through the release of minimum flow.

Impacts on river bed stability
The extraction of construction material will lead to formation of pits. Normally, deposition of material takes place at sites where velocity reduces on account of flattening of slopes, increase in cross-sectional area. Such sites are used for extraction of construction material. The pits at sites after extraction of construction material wil 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 o this account.

6.2 IMPACTS ON AIR ENVIRONMENT

Ambient Air Quality

Pollution due to operation of construction equipment
The major construction equipment would be operated through electricity. Therefore, fossil fuel combustion would be minimal. Diesel would be used only in contingency. Thus, no significant impact on ambient air quality is expected as a result of operation of various construction equipment.

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

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

6.3 IMPACTS ON NOISE ENVIRONMENT

The operation of construction equipment is likely to have insignificant impact on the ambient noise level. The effect of high noise levels on the operating personnel, has to be considered as this may be particularly harmful. It is known that continuous exposures to high noise levels above 90 dB(A) affects the hearing acuity of the workers/operators and hence, should be avoided. To prevent these effects, it is recommended that exposure period of affected persons be limited as per the maximum exposure period specified by Occupational Safety and Health Administration (OSHA).

6.4 IMPACTS ON LAND ENVIRONMENT

6.4.1 Quarrying operations

River Bed Material for Aggregates
For the construction purpose river bed materials shall be utilized and for that two locations are identified on the downstream of the barrage.

Sand quarries
In the project area there are few locations from where sand of coarse and fine segments can be extracted. The quantity of the river borne sand is not sufficient for the construction of the project and thus to be collected or transported from other locations. The quarrying operations are semi-mechanized in nature. Normally, in a hilly terrain like Arunachal Pradesh, quarrying

is normally done by cutting a face of the hill. A permanent scar is likely to be left, once quarrying activities are over. With the passage of time, the rock from the exposed face of the quarry under the action of wind and other erosion forces, get slowly weathered and after some time, they become a potential source of landslide. Thus it is necessary to implement appropriate slope stabilization measures to prevent the possibility of soil erosion and landslides in the quarry sites.

Operation of construction equipment
The siting of this construction equipment would require significant amount of space. In addition, land will also be temporarily acquired, i.e. for the duration of project construction for storage of quarried material before crushing, crushed material, cement, rubble, etc. Efforts must be made for proper siting of these facilities. The various criteria for selection of these sites would be:

- Proximity to the site of use
- Sensitivity of forests in the nearby areas
- Proximity from habitations
- Proximity to drinking water source

Muck Disposal
As per the existing proposal for the construction of Nyamjangchhu hydroelectric project about 4.04 Mm^3 of muck is to be generated. The total quantity of muck to be generated considering 40% swelling factor is 5.66 Mm^3. It is proposed that 0.702 Mm^3 of muck shall be utilized for backfilling. The quantity of material to be used in construction or protection works 1.05 Mm^3. Hence the balance quantity of muck to be disposed off shall be about 3.91Mm^3. The muck shall be disposed at designated sites.

Acquisition of land
The total land required for the project is 254.5526 ha. A part of this land is required for labour camps, quarry sites, muck disposal storage of construction material, siting of construction equipment, which will be required temporarily and returned once the construction phase is over. Permanent acquisition of land is required for barrage axis, submergence area, project colony, etc. The details of land required for various project appurtenances is given in Tables-2 and 3.

6.5 TERRESTRIAL ECOLOGY

a) Construction phase

Increased human interferences
A large population (11,200) is likely to congregate in the area during the project construction phase. This population residing in the area may use fuel wood (if no alternate fuel is provided). Therefore, alternate fuel should be provided to such population. Further, community kitchens should be provided using LPG or diesel as fuel.

Acquisition of forest land
. The total land requirement for the project is 254.5526 ha of which 244.4697 ha is the community land. A part of the community land also includes forest land as well. For EMP purposes, the entire land to be acquired for the project has been considered as the forest land. As a part of the Comprehensive EIA study, detailed Ecological survey was conducted for three seasons. Based on the findings of the survey, it can be concluded that the density and diversity in the project area to be acquired is quite low. The forests in and around the project area are quite degraded. No rare or endangered species are observed in the land to be acquired for the project.

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

Impacts on migratory routes
The faunal species observed in the project area are not migratory in nature. The proposed submergence area is not the migratory route of wild animals. The construction of the proposed Nyamjangchhu hydroelectric project will form a reservoir of about 39.3491 ha, which is also not reported to be on the migratory route of any major faunal species.

Impacts on avi-fauna
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 39.3941 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. Such conditions are generally ideal for various kinds of birds, especially, water birds. This is expected to increase the avi-faunal population of the area.

b) Operation phase

Impacts due to increased accessibility
During project operation phase, the accessibility to the area will improve due to construction of roads, which in turn may increase human interferences leading to marginal adverse impacts on the terrestrial ecosystem. However, during construction phase, there is an increased probability of poaching and other impacts due to aggregation of labour population. Thus, it is necessary to implement adequate surveillance in the area to ameliorate adverse impacts,

6.6 AQUATIC ECOLOGY

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 0.78 mld of water is required for the workers during the peak construction phase out of which 80% (i.e. about 0.63 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. The average minimum flow during lean season is about 12.3 cumec. However, sufficient water for dilution will be available in Nyamjangchhu to keep the DO of the river to significantly high levels.

b) Operation phase
The completion of Nyamjangchhu 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. Among the biotic communities, certain species can survive the transitional phase and can adapt to the changed riverine habitat. There are other species amongst the biotic communities, which, however, for varied reasons related to feeding and reproductive characteristics cannot acclimatize to the changed environment, and may disappear in the early years of impoundment of water. The micro-biotic organisms especially diatoms, blue-green and green algae before the operation of project, have their habitats beneath boulders, stones, fallen logs along the river, where depth is such that light penetration can take place. But with the damming of river, these organisms may perish as a result of increase in depth.

Operation phase

Impacts due to damming of river

The damming of river Nyamjanghhu due to the proposed hydroelectric project in creation of 39.3941 ha of submergence area. The dam will change the fast flowing river to a quiscent 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 barrage site. The micro and macro benthic biota is likely to be most severely affected as a result of the proposed project.

6.7 IMPACTS ON SOCIO-ECONOMIC ENVIRONMENT

Immigration of labour population

The peak labour force and technical staff required is estimated at about 11,200. Job opportunities will improve in this area. At present most of the population sustains by agriculture and allied activities. The project will open a large number of jobs to the local population both during project construction and operation phases.

7. ENVIRONMENTAL MANAGEMENT PLAN

7.1 Control of pollution from labour camps during construction phase

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

Facilities in labour camps

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

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

Sanitation facilities

One community latrine can be provided per 20 persons. The sewage from the community latrines can be treated in a sewage treatment plant prior to disposal.

Solid waste management from labour camps

For solid waste collection, suitable number of masonry storage vats, each of 2 m^3 capacity should be constructed at appropriate locations in various labour camps. These vats should be emptied at regular intervals and should be disposed at identified landfill sites. Suitable solid waste collection and disposal arrangement shall be provided. A suitable landfill site should be identified and designed to contain municipal waste from various project township, labour colonies, etc.

Provision of free fuel

Project proponents in association with the state government should make necessary arrangements for distribution of kerosene oil and LPG. These fuel would be supplied at subsidized rates to the local/contract laborers for which provision has been kept in the cost estimate.

7.2 ENVIRONMENTAL MANAGEMENT IN ROAD CONSTRUCTION

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

7.3 MANAGEMENT OF MUCK DISPOSAL SITES

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

7.4 RESTORATION PLAN FOR QUARRY SITES

The measures adopted for landscaping of quarry sites are listed as below:

- The top 6-12" of soil will be removed before starting the quarrying activity or any other surface disturbance.
- Top soil will be kept separate and stock piled so that it can be reused after quarrying is over for rehabilitation of sites.
- Garland drains around quarry site shall be constructed to capture the runoff and divert the same to the nearest natural drain.
- Depression and/or craters will be filled by the dumping materials consisting of boulders, rock, gravel and soil from nearby plant/working sites.
- Retaining walls will be constructed at the filled up depressions of quarry sites to provide necessary support particularly where there are moderately steep slopes.
- Concrete guards, shall be constructed to check the soil erosion of the area.
- After the quarrying activities are over, these sites will be splattered with the leftovers of rocks and boulders, which will support growth of mosses and lichens, which will act as ecological pioneers and initiate the process of succession and colonization.
- The depressions/craters filled up with rock aggregates will be covered with top soil.
- Top soil will be further enriched by organic manure and Vesicular-arbuscular mycorrhizal (VAM) fungi. This will help in the process of soil reclamation and the early establishment of juvenile seedlings.
- Revegetation of the dumping sites through 'Integrated Biological and Biotechnological Approach'

7.5 RESTORATION AND LANDSCAPING OF PROJECT SITES

The beautification would be carried out by developing flowering beds for plantation ornamental plant and flower garden. The beautification in the colony area would be carried out by development of flowering beds for plantation of ornamental plant, creepers, flower garden and a small park, construction of benches for sitting, resting sheds, walk way and fountain.

7.6 GREENBELT DEVELOPMENT

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

7.7 PUBLIC HEALTH DELIVERY SYSTEM

A population of about 11,200 is likely to congregate during the construction phase. The labour population will be concentrated at two or three sites. There is no medical facility in the immediate vicinity of the project area. It is recommended that necessary medical facilities be

developed at the project site. It is recommended that the dispensary should be developed during project construction phase itself, so that it can serve the labour population migrating in the area as well as the local population.

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

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

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

7.8 COMPENSATORY AFFORESTATION

The total land to be acquired for the project including submergence area and other project appurtenances is 254.5526 ha. It is proposed to afforest double the amount of forestland being acquired for the project. Thus, a total of (254.5526x 2) 509 ha of land needs to be afforested. Compensatory afforestation will be done by State Forest Department as per the stipulations outlined as a part of forest clearance. In addition, following measures are also recommended:

- Afforestation of open areas
- Habitat improvement for avi-fauna
- Conservation and cultivation of Medicinal Plants
- Ex-gratia payment to the victims of crop damage, cattle lifting and human life loss/injury
- Publicity and Awareness
- Anti-poaching measures

7.9 CONTROL OF AIR POLLUTION

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

7.10 CONTROL OF WATER POLLUTION

Construction phase

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

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

Operation phase

In the project operation phase, a project colony of 50 quarters will be established. The colony will have suitable Sewage Treatment Plant (STP) to treat the sewage generated from the colony

7.11 FISH MANAGEMENT

a) Release of minimum flow

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

invertebrates and fish. In order to avoid the possible loss of aquatic life, minimum flow of water should always be released, for which a separate study is being conducted by CIFRI. Based on the preliminary report of CIFRI, average lean season flow (December to March) has been estimated as 14.71 cumec. The minimum flow shall be 20% of 14.71 cumec, i.e. 2.94 cumec.

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b) Sustenance of Endemic Fisheries

It is proposed to implement reservoir and supplementary stocking programmes for the project. It is proposed to stock the reservoir and river Nyamjangchhu for a length of 10 km upstream and 32 km on the downstream sides The rate of stocking is proposed as 100 fingerlings of about 30 mm size per km. For reservoir area, stocking shall be 1000 fingerlings/ha of 30 mm size. The migratory fish species namely, mahaseer and snow trout can be stocked. The stocking can be done annually by the Fisheries Department, State Government of Arunachal Pradesh.

7.12 NOISE CONTROL MEASURES

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

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

8. CATCHMENT AREA TREATEMNT (CAT) PLAN

Silt Yield Index (SYI) method has been used to prioritize sub-watershed in a catchment area for treatment. The area under very high and high erosion categories is to be treated at the project proponent cost. In the catchment of the proposed nymjangchhu HEP, there is no area under very high erosion category. Hence, CAT plan has been suggested for high erosion category, as a part of the present EIA study, the expenses of which have to be borne by project proponents. The area under high erosion category is 7735 ha, which is about 46.4% of the total catchment. The details are given in Table-9. The cost required for treatment of directly draining catchment is Rs.70.2 million.

TABLE-9
Area under different erosion categories

Category	Area (ha)	Percentage
Very low	2438	14.6
Low	4819	28.9
Medium	1670	10.1
Very High	7734	46.4
High	-	-
Total	**16661**	**100.00**

9. RESETTLEMENT AND REHABILITATION PLAN

Based on the field assessment, it is observed that, in all there are 47 project affected families who are expected to lose land. No family is likely to lose homestead. A total budget of Rs. 28.781 million would be required for implementation of R&R Plan (refer Table-10).

TABLE-10
Budgetary estimate for implementation of R&R Plan

S. No.	R&R Components	Cost (Rupees million)
1.	**Rehabilitation plan**	
	• "land for land" to be the basis – 15 ha of un-irrigated land needs to be identified and disbursed to PAFs	
	• Land development cost	0.150
	• Loss of agricultural production	0.235
	• One time Financial assistance for loss of livelihood	3.525
	• Subsistence allowance	1.175
	• One time financial assistance for "training for development of entrepreneurship"	0.282
	• Scholarship for students	0.564
	• Financial assistance for "loss of customary rights/ usages of forest produce"	2.350
	Sub-Total (Rehabilitation) [1]	**8.281**
2.	**Area Development Activities [2]**	**19.50**
3.	**Monitoring and evaluation set-up [3]**	**1.00**
Grand Total [1+2+3]		**28.781**

10. TRIBAL DEVELOPMENT PLAN

An amount of **Rs. 37.05 million** is being made for implementation of the Tribal Development Plan. This cost is over and above the cost of Resettlement and Rehabilitation and Area Development Activities. The details are shown in Table 11.

TABLE – 11
Budget for Tribal Development Plan

S. No.	Items	Budget (Rs. million)
1	Construction/ Upgradation of existing school to Navodaya Vidyalaya	5.0
2	Construction/ Upgradation of existing school to Ashram school	10.0
3	Purchase of van/ mini-bus for transportation of school going children	3.0
4	Up-gradation of Health Care facility	7.0
5	Development of Transport and Communication facilities	3.0
6	Village grain bank scheme	7.0
7	Voluntary organization working for welfare of scheduled tribes – Hiring of NGO	2.0
	Total	**37.0**

11. SUMMARY OF ENVIRONMENTAL MONITORING PROGRAMME

An Environmental Monitoring Programme should be undertaken during construction and operation phase of the project. The details of environmental monitoring programme are given in Tables - 12 and 13 respectively.

TABLE-12
Summary of Environmental Monitoring Programme during Project Construction Phase

S. No.	Item	Parameters	Frequency	Location
1.	Effluent from septic tanks	pH, BOD, COD, TSS, TDS	Once every month	Before and after treatment from each oxidation ditch
2.	Water-related diseases	Identification of water related diseases, adequacy of local vector control and curative measure, etc.	Three times a year	Labour camps and colonies
3.	Noise	Equivalent noise level (L_{eq})	Once in three months	At major construction sites.
4.	Air quality	SPM, RPM, SO_2 and NOx	Once every season	At major construction sites
5.	Meteorological aspects	Wind direction & velocity temperature humidity, rain	Once every season	At one of the ambient air quality sampling sites

TABLE-13
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	• 1 km upstream of dam site • Water spread area • 1, 3 and 5km downstream of dam site
2.	Effluent from Sewage Treatment Plant (STP)	pH, BOD, COD, TSS, TDS	Once every week	• Before and after treatment from Sewage Treatment Plant (STP)
3.	Erosion & Siltation	Soil erosion rates, stability of bank embankment, etc.	Twice a year	-
4.	Ecology	Status of afforestation programmess of green belt development	Once in 2 years	-
5.	Water-related diseases	Identification of water-related diseases, sites, adequacy of local vector control measures, etc.	Three times a year	• Villages adjacent to project sites

S. No.	Items	Parameters	Frequency	Location
6.	Aquatic ecology	Phytoplanktons, zooplanktons, benthic life, fish composition	Once a year	• 1 km upstream of dam site • Water spread area • 1, 3 and 5 km downstream of dam site
7.	Landuse	Landuse pattern using satellite data	Once in a year	Catchment area
8.	Soil	pH, EC, texture, organic matter	Once in a year	Catchment area

12. COST FOR IMPLEMENTING ENVIRONMENTAL MANAGEMENT PLAN

The total amount to be spent for implementation of Environmental Management Plan (EMP) is Rs.588.2 million. The details are given in Table-14.

TABLE-14
Cost for Implementing Environmental Management Plan

S. No.	Item	Cost (Rs. million)
1.	Compensatory Afforestation, and Bio-diversity conservation	53.15
2.	Catchment Area Treatment	70.20
3.	Fisheries Management	26.46
4.	Public health delivery system	32.27
5.	Environmental Management in labour camp	127.82
6.	Muck management	55.13
7.	Restoration and Landscaping of construction sites	16.05
8.	Environmental management in road construction	120.00
9.	Greenbelt development	1.40
10.	Water pollution control	1.80
11.	Resettlement and Rehabilitation Plan	28.781
12	Energy Conservation measures	5.00
13	Tribal Development Plan	37.00
14.	Environmental Monitoring during construction phase (Refer Table-15)	13.05
	Total	**588.111, say Rs. 588.2 million**

13. COST FOR IMPLEMENTING ENVIRONMENTAL MONITORING PROGRAMME

The cost required for implementation of the Environmental Monitoring Programme is of the order of Rs.7.32 million @ Rs.1.2 million/ year. A 10% annual price increase may be considered for every year. The details are given in Table-15. The cost required for implementation of the Environmental Monitoring Programme at operation phase is of the order of Rs.1.46 million/year. The details are given in Table-16.

TABLE-15

Cost for Implementing Environmental Monitoring Programme during construction phase

S. No	Item	Cost (Rs. million/year)	Total cost for construction period of 6 years with 10% escalation per year (Rs. million)
1	Water quality	0.11	1.04
2	Air quality	0.48	4.56
3	Ecology	0.90	8.54
4	Incidence of water related diseases	0.20	1.90
	Total	**1.69**	**13.05**

TABLE-16

Cost for Implementing Environmental Monitoring Programme during operation phase

S. No	Item	Cost (Rs. million/year)
1	Water quality	0.46
2	Ecology	0.50
3	Incidence of water related diseases	0.20
4	Land use pattern	0.30
	Total	**1.46**