WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED

(A Government of West Bengal Enterprise)

VOLUME- III: EMP REPORT

TURGA PUMPED STORAGE PROJECT

(Previously known as Purulia Pumped Storage Extension Project on Turga Nala)

(4 X 250 MW)

APRIL 2016

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INTRODUCTION

1.1 INTRODUCTION

The Turga Pumped Storage Project on Turganala is located in Purulia district of West Bengal. This is one of the four Pumped Storage Schemes initially identified by erstwhile WBSEB (now known as WBSEDCL). The Turga Pumped Storage Scheme envisages utilization of the waters of the river Turga in Ayodhya hills for peak power generation on a Pumped storage type development. The coordinates of Upper Dam site are 23°12'47"N and 86°04'20"E. Likewise, coordinates of the lower Dam site are 23°11'49''N and 86°04'13"E. The project site is approachable by a jeepable road taking off from Balarampur – Baghmundi state highway. The nearest rail head is located at Barabhum and nearest airport is located at Ranchi. The project location map is enclosed as Figure-1.1.

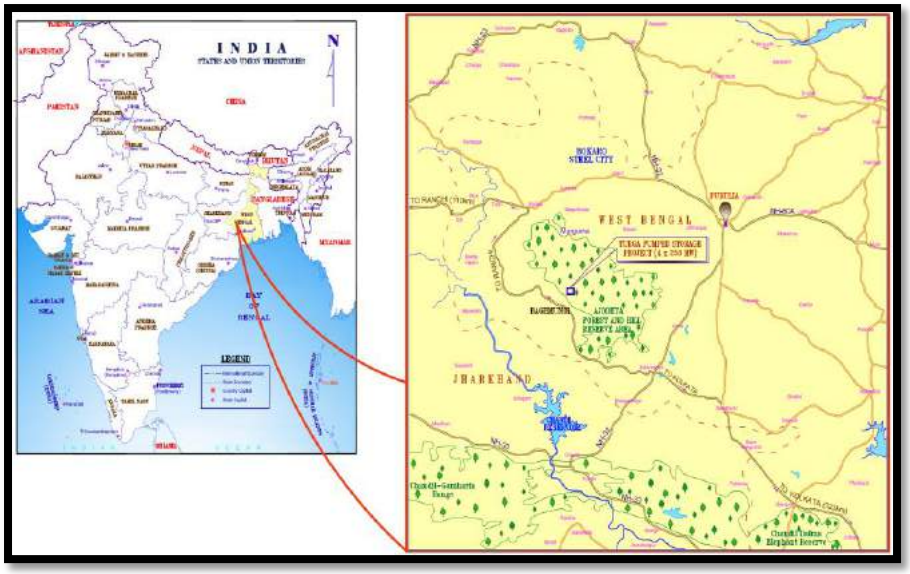


Figure-1.1 Project Location Map

1.2 PROJECT PROFILE

The Turga Pumped Storage Project envisages utilization of hydro potentiality of Ajodhya Plateau, an extension of Chhota Nagpur Plateau. The project envisages the construction of Upper Dam (C.A. 8.29 Sq. Km) across TurgaNala, a tributary of Subarnarekha river and a water conductor system with an underground Power House on the downstream of Upper Dam and a Lower Dam having intermediate catchment of 4.37 sq. km (total C.A. 12.66 sq. km).

The Project is a Close Loop type Pumped Storage Scheme. It comprises two reservoirs at two different levels (the difference of water levels of the reservoirs will represent the effective "head" of the Project) and water conductor system will connect the two reservoir through an underground power house. During peak hours power will be generated by depleting the water reserve of the upper reservoir which will pass through the waterway and the generator and turbines installed at the power house and will be stored in the Lower Reservoir. During off peak hours the excess power from thermal stations will be fed back to pump the water from Lower Reservoir to Upper reservoir through power house where generators and turbines will then act as motors and pumps respectively. The same cycle of operation will be repeated during peak and lean period.

Since the Upper and Lower reservoirs of Turga Pumped Storage Project (Turga PSP) has limited effective storage capacity equivalent to five (5) hours of generation at full rated output, it is not possible for Turga PSP to operate on weekly or seasonal basis. Therefore, the Project is deemed to be operational on daily basis.

1.3 SALIENT FEATURES

The salient features of Turga Pumped Storage Project are given in Table-1.1.

Table-1.1: Salient Features of Turga Pumped Storage Scheme

1. LOCATION	
Country **State** **District**	India West Bengal Purulia
River	TurgaNala a tributary of Subarnarekha River
Dam Axis (Upper)	Left Bank Latitude $23^0$12' 47.2" & Longitude 86^0 04' 19.9" E 405064.831 , N 2567415.095(UTM) Right Bank Latitude $23^0$12' 46.2" & Longitude 86^0 03'54.16" E 404332.556 , N 2567391.165(UTM)
Dam Axis (Lower)	Left Bank Latitude $23^0$11' 48.8'' & Longitude 86^0 04' 12.5" E 404843.406 , N 2565619.006(UTM) Right Bank Latitude $23^0$11' 50.7'' & Longitude 86^0 03' 41.9" E 403973.742 , N 2565682.666(UTM)
Access to the Project	
	i) Kolkata to Chandil along 380km

Road	NH 33 via Jamshedpur ii) Chandil to Balrampur along NH 32 30km iii) Balrampur to Patherdhi along State-Highway 30km iv) Patherdhi to Project Site (Upper dam) 10km **Total 450 km**
Airport	Ranchi
Railhead (with unloading facilities)	Barabhum Railway Station (30km from project site) on the Howrah Purulia Broad Gauge Line of South **Eastern railway** 335km from Howrah via Adra 320 km from Howrah via Tatanagar
Port	Haldia, Kolkata
2. PROJECT	
Type	Pumped Storage Project (Closed Loop Type)
Power	1000MW
Installed Capacity	4 X 250 MW
Peak Operating duration	5 hours daily
3. HYDROLOGY	
Catchment Area	
Upper Dam	8.29 km^2
Lower Dam	12.66 km^2
Average Annual Rainfall in Basin	1334 mm
Average annual Run-off	
Upper Reservoir	4.51 Mm^3
Lower Reservoir	6.88 Mm^3
75% Dependable Run-off	
Upper Reservoir	3.68 Mm^3
Lower Reservoir	5.63 Mm^3
90% Dependable Run-off	
Upper Reservoir	2.93 Mm^3
Lower Reservoir	4.47 Mm^3
Maximum Design Flood (PMF)	
Upper Reservoir	280 m^3/s
Lower Reservoir	428 m^3/s
Annual Average Sediment Load	1045m^3 /Km^2/yr
4.0 CIVIL STRUCTURE	
4.1 UPPER RESERVOIR	
FRL	464.00 m
MDDL	441.40 m (With irrigation Storage depleted) 444.40 m(For Pumped storage Generation)
Pondage at FRL	21.6 Mm^3
Pondage at MDDL(at 441.40m)	5.9 Mm^3

Pondage at MDDL(at 444.44m)	7.4 Mm^3
Live Pondage	14.2 Mm^3
4.2 LOWER RESERVOIR	
FRL	316.5 m
MDDL	280.4 m
Pondage at FRL	18 Mm^3
Pondage at MDDL	3.8 Mm^3
Live Pondage	14.2 Mm^3
4.3 UPPER DAM	
Type	Rock fill with **Central impervious core**
Top of Dam	EL 467.5 m
Accepted Foundation Elevation	EL 404 m
Length of Dam at top	732 m
Max. Height of Dam	63.5m
Top width of dam	10.00 m
4.4 SPILLWAY ARRANGEMENT	
Type	Over Flow Ogee Type on Left Bank(Concrete)
Crest Elevation	EL 464.0m at FRL
MWL	EL 466m
Design Flood	280 m^3 /s
No. of Bays	4 Bays , 13m wide each
No. of Piers	3 Piers, 2 m wide each
Waterway	58 m
4.5 DIVERSION CUM BOTTOM OUTLET ARRANGEMENTS	
Type	Tunnel on left bank
Diversion Flood	109 m^3/s
Length & Diameter	691m , 4m (Concrete Lined)
Invert Level of DT at Inlet	EL 410.0m
Invert Level of DT at Outlet	EL 408.0m
Bottom Outlet	
Length & Diameter	Same as Diversion Tunnel will act as Bottom Outlet
Invert of Bottom Outlet at Inlet	EL 423.5m
Invert of Bottom Outlet at Outlet	EL 408.0m
Deletion Time	27 hrs(Approx.)
4. 6 MAIN LOWER DAM	
Type	Concrete Gravity
Top of Dam	EL 320m
Foundation Elevation	EL 256 m
Length of Dam at top	872 m

Max. Height of Dam	64 m
No. of OF blocks	4 nos, 18m wide each
No. NoF Blocks	40 nos, 20m wide each
Top width of dam	10.00 m
4.7 LOWER SADDLE DAM	
Type	Rock fill with central impervious core
Top of Dam	EL 320.0 m
Foundation Elevation	EL 270 m
Length of Dam at top	595 m
Max. Height of Dam	50.0 m (from Bed level)
Top width of dam	10.00 m
4.8 SPILLWAY ARRANGEMENT	
Type	Over Flow Ogee Type
Crest Elevation	EL 316.5 m at FRL
MWL	EL 318.53m
Design Flood	428 m3 /s
No. of Bays	5 Bays , 15m wide each
No. of Piers	4 Piers, 3 m wide each
Total Waterway	87 m
4.9 DEPLETION SLUICE	
Location	In Block No. 38
Size	1.5m(W) X 2.0(H)
Crest Elevation	EL 270m
Gate Chamber	7.7m(L)X 6m(W)X 5m(H)
Depletion Time	97 hrs.
4.10 DIVERSION ARRANGEMENT	
Coffer Dam with overflow spillway	Rockfill with earthen Core
Bed Level	EL265m
FRL/MWL	EL280m/283.5m
Diversion Flood	167 m^3/s
Height of Coffer Dam	20m
Spillway Crest	EL 280m
Spillway crest Length	35m
4.11 Power Intake	
Type H x W x No. x Line	Horizontal Type with anti-vortex lubbers 12.0m x 13.0m x 3 nos x 2 lines
4.12 Headrace Tunnel (Intake Tunnel)	
D x L x line	D 9.0 m x L 618.11 m x 2 lines
4.13 Penstock (Steel Lining)	

D x L x line After Bifurcation	D 9.0 m x L 224.37m x 2 lines D 6.4 m- D 4.4 m x L 73.73 m x 4 lines
4.14 Tailrace Tunnel	
Tailrace Tunnel No1 Tailrace Tunnel No2	D 7.0 m x L 126.90 m x 1 line D 7.0 m x L 114.40 m x 1 line D 10.0 m x L 419.14 m x 1 line D 7.0 m x L 102.90 m x 1 line D 7.0 m x L 89.40 m x 1 line D 10.0 m x L 402.77 m x 1 line
4.15 Tailrace Outlet	
Type H x W x No. x Line	Horizontal Type with anti-vortex lubbers 12.0m x 13.0m x 3 nos x 2 lines
4.16 Powerhouse	
-Type -Four Fixed Speed Pump/Turbine units -One Variable Speed Pump/Turbine unit + Three Fixed Speed Pump/Turbine units	Type; Underground Bullet shape L 160.00m x B 25.00 m x H 53.00 m L 160.00 x B 25.00 m x H 55.00 m
4.17 Transformer Room	Type;
Type L x B x H	Underground Bullet shape L 139.17 m x B 16.00m x H 16.00m
4.18 Switch Yard	
Type W x B	Type; Open air Type W 165 m x B 50 m at EL 340 .00 m
5.0 Hydro-mechanical Equipment	
5.1 Intake Equipment	
Intake Trashrack Intake Maintenance Gate Intake Gate	3 sets x 2 lines, W 13.0m x H 12.0m Vertical lift fixed wheel type steel gate 2 sets W 7.0m x H 9.0m Vertical lift fixed wheel type steel gate2 sets W 7.0m x H 9.0m
5.2 Steel Penstock	
- Type of penstock - Type, number of bifurcation - Inside diameter Before bifurcation After bifurcation - Total length	Embedded type welded steel penstock Internal reinforced type bifurcation 2sets 9.0 m (main pipe) 6.4~4.4 m (branch pipe) 975.7 m/lane (824.2 m : main pipe) (75.7 m/75.7 m: branch pipe to unit No.1(3), No.2(4))
5.3 Steel Liner of Tailrace	

Tunnel	
- Number of lane - Type of steel liner - Type, number of junction - Inside diameter Before junction After junction - Total length	4 lanes Embedded type welded steel liner Internal reinforced type junction 2 sets 7.0 m (brunch pipe) 10.0 m (main pipe) 213.8 m (No.1), 164.4 m (No.2)
5.4 Draft Equipment	
- Quantity - Type of gate - Clear span - Clear height	4 sets High pressure slide type steel gate (Bonneted gate) with transition pipe 5.60 m 5.60 m
5.5 Tailrace Equipment	
Tailrace Trashrack Tailrace Gate	3 sets x 2 lines, W 13.0m x H 12.0m Vertical lift slide type steel gate 2 sets W 8.00 m x H 10.00 m
5.6 Bottom Outlet Equipment of Lower Dam	
Bulkhead Gate Auxiliary Gate Main Gate	Slide Type Steel Gate (Stoplog) 1 set W2.49m x H3.34m High Pressure Slide Type Steel Gate 1 set W 1.50m x H 2.00m High Pressure Slide Type Steel Gate 1 set W 1.50m x H 2.00m
5.7 Bottom Outlet Equipment of Upper Dam	
Trashrack Stoplog Auxiliary Gate Main Gate	Vertical Fixed Type Steel Trashrack 1 set W 4.0 m x H 4.0 m Slide Type Steel Gate 1 set W 4.0 m x H 4.0 m High Pressure Slide Type Steel Gate 1 set W 1.45m x H 1.80m Jet Flow Gate 1 set W 1.80m x H 1.80m
6.0 Electromechanical Equipment	
6.1 Pump Turbine	
Type	Francis type, vertical shaft reversible pump-turbine
Number of unit	Four (4) units
Effective head at normal static head	146.4 m

Maximum Turbine Output at normal effective head	255,500kW , 280,600kW (10% Overload)
Maximum Pump Input	285,000 kW
Maximum Turbine Discharge	197.0 m^3/s
Maximum Pump Discharge	196.7 m^3/s
Revolving Speed	187.5 rpm
6.2 Generator-Motor	
Type	Three (3) phase, alternating current synchronous, generator-motor, vertical shaft, rotating field, enclosed housing, rim-duct air-cooled and semi-umbrella type
Number of unit	Four (4) units
Rated Capacity	Generator; 306MVA Motor (output); 255 MW
Power Factor	Generator; 0.90 (lagging) Motor; 0.95 (leading)
Rated Voltage	18.0kV
Rated Current	2,574A
Rated Frequency	50 Hz
Rated Revolving Speed	187.5 rpm
Over Load Capacity	110 % rated capacity
6.3 Main Power Transformer	
Type	Indoor, oil-immersed, 3 single phase transformers with on-load tap changer (OLTC) for pumping operation
Number of unit	4 units
Rated Capacity	330 MVA
Rated Voltage	Primary; 18 kV Secondary; 400 kV adjustable range of the secondary voltage: -5% to +10%(3kV/tap)
Connection	Primary: Delta Secondary: Wye
Neutral Grounding System for Secondary Winding	Solidly Grounded
Basic Impulse Insulation Level (BIL)	Primary: 95 kV Secondary: 1,425 kV Neutral Secondary: 38 kV r.m.s(power frequency)
6.4 Generator-Motor Circuit Breaker	
Type	Indoor, Metal-enclose, SF6 gas blast and single pressure type
Number of Unit	Four (4) units
Rated Voltage	24 kV
Rated Normal Current	11,000 A
Rated Short Circuit Breaking	80 kA

Current	
6.5 Gas Insulated Switchgear	
6.5.1 Circuit Breaker	
Type	400 kV Gas Insulated Switchgear (GIS)
Number of Feeder	Nine (9) feeders including two (2) feeders for future expansion of transmission lines
Rated Voltage	420 kV
Rated Normal Current	2,000 A
Rated Short Time (2 sec) withstand Current	50 kA
Rated Lighting Impulse withstand Voltage	1,425 kV
6.5.2 Rating Disconnecting Switch	
Rated Voltage	420 kV
Rated Normal Current	2,000 A
Rated Frequency	50 Hz
Rated Short Time (2 sec) withstand Current	50kA
Rated peak withstand Current	100 kA
Rated Lighting Impulse withstand Voltage	1,425 kV
6.5.3 Current Transformer	
Rated Primary Current	2,000A
Rated Secondary Current	1 A
Rated Frequency	50Hz
Rated Lighting Impulse withstand Voltage	1,425 kV
6.5.4 Rating Voltage Transformer	
Rated Primary Voltage	400 kV/√3
Rated Secondary Voltage	110 V/√3
Rated Frequency	50 Hz
Rated Lighting Impulse withstand Voltage	1425 k V
6.6 Diesel Engine Generator	
Number of Unit	Two (2) units
Rated Capacity	1,000 kVA
6.7 EOT Crane	
Type	Indoor, Low speed type Electric Overhead Traveling Crane
Number of Unit	Two (2) units
Rated Capacity	250 ton (Main hoist), 50 ton and 10 ton

Span	24 m	
Lift Fixed Speed / Variable Speed	10.2 m / 11.2 m	
6.10 Project Cost (Price Level December 2014)		
	Option -I (4-fixed speed type)	**Option -II (3-fixed speed type + 1-variable speed type)**
Cost of Civil Works	2414.97	2442.46
Cost of E & M Works	1869.13	2070.07
Cost of Transmission Works	6.31	6.31
Total Cost of The Project	**4290.41**	**4518.84**
6.11 Project Benefit's		
	Option -I (4-fixed speed type)	**Option -II (3-fixed speed type + 1-variable speed type)**
FIRST YEAR TARIFF	Rs 6.52 / KWH	Rs 6.77 / KWH
LEVELISIED TARIFF	Rs 5.85 / KWH	Rs 6.07 /KWH
6.12 Economic Evaluation		

	Evaluation Index	Evaluation Criteria	Evaluation
NPV	Option 1: Rs 3387 Crore Option 2: Rs 3209 Crore	> 0	Acceptable
B / C	Option 1: 1.63 Option 2: 1.58	> 1	Acceptable
EIRR	Option 1: 28.2 % Option 2: 26.3 %	> Opportunity cost of capital (12 %)	Acceptable

1.4 LANDUSE

The total land required for the project is 292.0 ha. The details are given in Table-1.2.

Table-1.2: Land requirement for proposed project

S. No.	Component	Area (ha)
1.	Upper Reservoir submergence at FRL	87.10
2.	Lower Reservoir submergence at FRL	49.00
3.	Dam site and other structure	13.90
4.	Quarry Site	32.00
5.	Construction facility	15.00
6.	Clay core Area	20.00
7.	Roads	10.00
8.	Stockpile area for construction material, etc.	30.00
9.	Other miscellaneous requirement	35.00
	Total	**292.00**

As per the present status, about 234 ha of land is Forest land and the remaining (58 ha) is non-forest government land and /or Private Land. Out of 58 ha of non-forest government land

and /or Private Land, 34 ha of land will be transferred from I& W Directorate, Government of West Bengal to Turga Pumped Storage Project. Remaining 24 ha of land to be arranged temporarily on leased basis.Appropriate compensation measures as per ownership status has been suggested as a part of the Environmental Management Plan.

1.5 OUTLINE OF THE REPORT

The document for the Comprehensive EIA study for the proposed Turga Pumped Storage Project has been presented in four volumes. The details are given as below:

- Volume-I presents the Environmental Impact Assessment (EIA) Study
- Volume-II covers the Social Impact Assessment (SIA) Study
- Volume-III outlines the Environmental Management Plan (EMP) Report
- Volume-IV outlines the Public Hearing Proceedings Report

The present document (Volume-III) outlines the findings of the Environmental Management Plan for the proposed Turga Pumped Storage project.

Chapter-1 gives an overview of the Turga Pumped Storage Project.

Chapter-2: outlines the Catchment Area Treatment Plan for the Turga Pumped Storage project. A combination of engineering and biological measures have been suggested as a part of Catchment Area Treatment Plan.

Chapter-3: outlines the Biodiversity Conservation and Management plan.

Chapter-4: presents the plan tominimize the impacts on fish population due to the proposed Turga Pumped Storage Project.

Chapter-5: presents the Greenbelt Development Plan.

Chapter-6 :outlines the measures proposed to control water, air and noise pollution during construction phase.

Chapter-7: presents a plan for disposal of solid waste disposal generated from labour camps and colonies during construction phase, and the water supply and sanitation facilities proposed to be developed in labour colonies.

Chapter-8: covers Public Health Delivery system which shall be developed by to cater for the need of labour population migrating in the project area during construction phase.

Chapter-9: delineates measures for disposal of muck generated during construction of various project appurtenances.

Chapter-10:outlines the plan for Restoration, Stabilization and Landscaping of Quarry Sites.

Chapter-11: outlines measures suggested for landscaping and restoration and of construction areas.

Chapter-12: suggests measures for Environmental Management during road construction.

Chapter-13: outlines the energy conservation measures to be implemented during project construction as well as operation phases.

Chapter-14: Thechapter outlines the Fire Protection Plan.

Chapter-15: delineates the Disaster Management Plan.

Chapter-16: covers the Environmental Monitoring Programmefor implementation during project construction and operation phases.

Chapter-17: outlines the cost required for implementation of various measures outlined as a part of Environmental Management Plan and Environmental Monitoring Programme.

Chapter-18: gives the disclosure of Consultants.

CHAPTER-2

CATCHMENT AREA TREATMENT PLAN

2.1 INTRODUCTION

It is a well-established fact that reservoirs formed by dams on rivers are subjected to sedimentation. The process of sedimentation embodies the sequential processes of erosion, entrainment, transportation, deposition and compaction of sediment. The study of erosion and sediment yield from catchments is of utmost importance as the deposition of sediment in reservoir reduces its capacity, and thus affecting the water availability for the designated use. The eroded sediment from catchment when deposited on streambeds and banks causes braiding of river reach. The removal of top fertile soil from catchment adversely affects the agricultural production. Thus, a well-designed Catchment Area Treatment (CAT) Plan is essential to ameliorate the above-mentioned adverse process of soil erosion.

Soil erosion may be defined as the detachment and transportation of soil. Water is the major agent responsible for this erosion. In many locations, winds, glaciers, etc. also cause soil erosion. In a hilly catchment area, as in the present case, erosion due to water is a common phenomenon and the same has been studied as a part of the CAT Plan. Soil erosion leads to:

- Loss in production potential
- Reduction in infiltration rates
- Reduction in water-holding capacity
- Loss of nutrients
- Increase in tillage operation costs
- Reduction in water supply

The 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.

The proposed project has two dams, upper dam and lower dam. The catchment area intercepted at the upper dam site and lower dam site is 8.29 km^2 and 12.66 km^2

respectively. The sub-watersheds in the catchment area considered for the present study are given in **Figure-2.1**

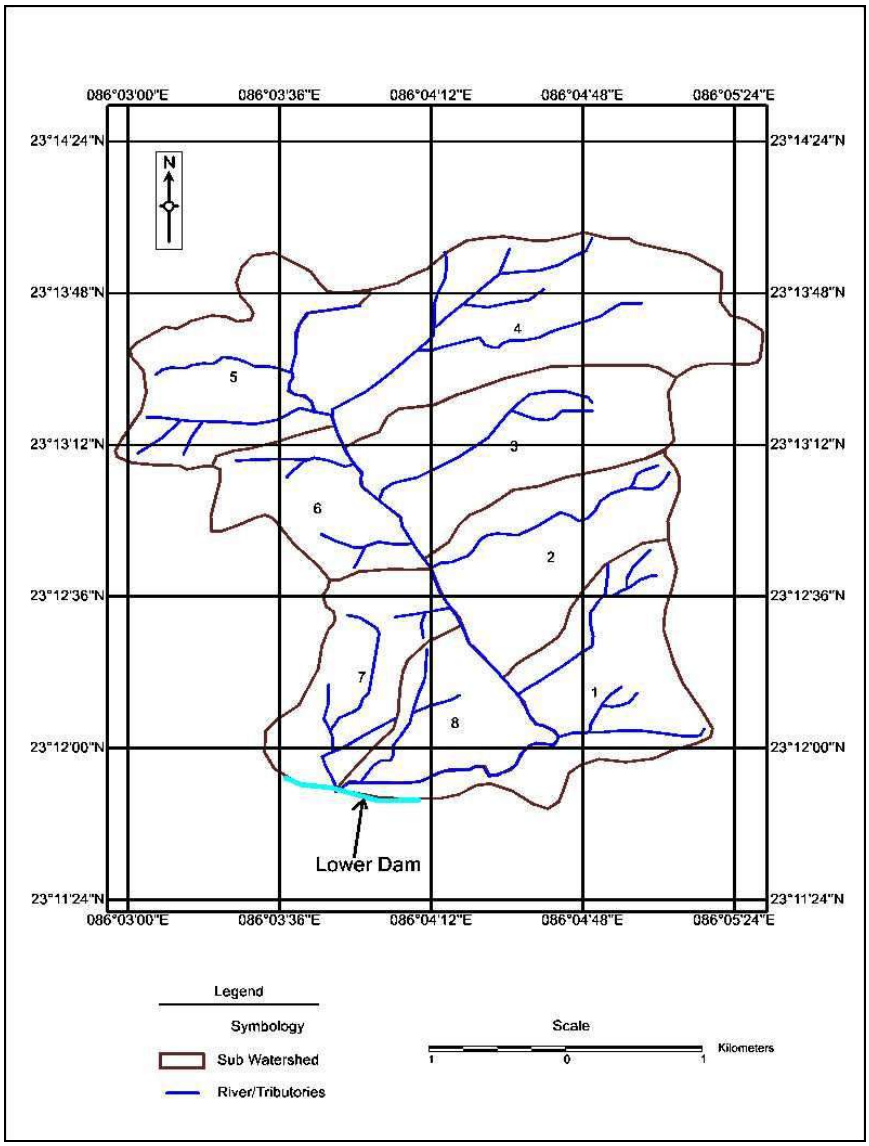


Figure-2.1: Sub-watersheds for catchment area for Turga HEP

The catchment area treatment involves

- Understanding of the erosion characteristics of the terrain and,
- Suggesting remedial measures to reduce the erosion rate.

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. SYI provides a comparative erodibility criteria of catchment (low, moderate, high, etc.) and do not provide the absolute silt yield. 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.

2.2 APPROACH FOR THE STUDY

A detailed database on natural resources, terrain conditions, soil type of the catchment area, socio-economic status, etc. is a pre-requisite to prepare treatment plan keeping in view the concept of sustainable development. Various thematic maps have been used in preparation of the CAT plan. Geographic Information System (**GIS**) is a computerized resource data base system, which is referenced to some geographic coordinate system. In the present study, real coordinate system has been used. The GIS is a tool to store, analyze and display various spatial data. In addition, GIS, because of its special hardware and software characteristics, has a capacity to perform numerous functions and operations on the various spatial data layers residing in the database. GIS provides the capability to analyze large amounts of data in relation to a set of established criteria. In order to ensure that latest and accurate data is used for the analysis, satellite data has been used for deriving land use data. Ground truth studies, too, have been conducted.

The various steps, covered in the study, are as follows:

- Definition of the problem
- Data acquisition and preparation
- Output presentation

The above mentioned steps are briefly described in the following paragraphs:

2.2.1 Definition of the Problem

The requirements of the study were defined and the expected outputs were finalized. The various data layers of the catchment area to be used for the study are as follows:

- Slope Map
- Soil Map
- Land use Classification Map
- Current Management Practices
- Catchment Area Map.

2.2.2 Data Acquisition and Preparation

The data available from various sources has been collected. The ground maps, contour information, etc. were scanned, digitized and registered as per the requirement. Data was prepared depending on the level of accuracy required and any corrections required were made. All the layers were geo-referenced and brought to a common scale (real co-ordinates), so that overlay could be performed. A computer program using standard modeling techniques was used to estimate the soil loss. The formats of outputs from each layer were firmed up to match the formats of inputs in the program. The grid size to be used was also decided to match the level of accuracy required, the data availability and the software and time limitations. Ground truthing and data collection was also included in the procedure.

For the present study, one Resources at-LISS III (path 106, row 056 dated 26.04.2013) digital satellite data was used for interpretation and classification. The data has been procured in raw digital format and has been geo-referenced using Survey of India topographical sheets with the help of standard data preparation techniques in standard image processing software. The interpretation of geo-referenced satellite data has been done using standard enhancement techniques, ground checks and experiences of qualified professionals. A detailed ground truth verification exercise has been undertaken as a part of field survey to enrich the image interpretation process. The classified land use map of the catchment area intercepted at Upper and Lower dam sites, considered for the study, is shown as **Figure-2.2** The land use pattern of the catchment area is summarized in **Table- 2.1.**

Derived contours from topographical maps were used for preparation of Digital Elevation Model (DEM) of the free draining catchment area and to prepare a slope map. The first step in generation of slope map is to create surface using the elevation values stored in the form of contours or points. After marking the catchment area, all the contours on the topographical maps were derived. The output of the digitisation procedure was the contours as well as points contours in form of x, y & z points. (x, y - location and z - their elevation). All this information was in real world co-ordinates (latitude, longitude and height in meters above sea level).

Table -2.1: Land use classification for free draining catchment at diversion site

Land use/Land cover	Area (ha)	Area (%)
River/ Water body	6	0.47
Vegetation	830	65.56
Agricultural Land	80	6.32
Barren Land/Rocky outcrops	162	12.80
Scrub	176	13.90
Settlements	12	0.95
Total	**1266**	**100.00**

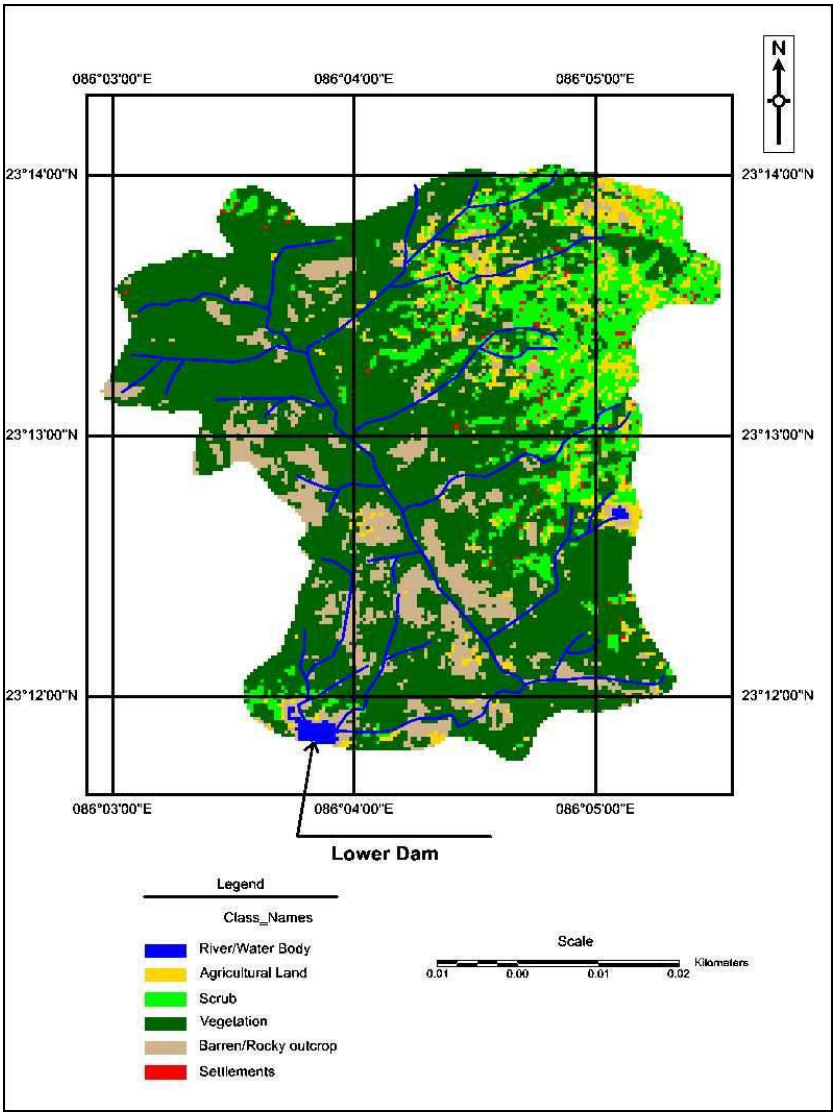


Figure-2:2 Classified imagery of catchment area for Turga HEP

A Digital Terrain Model (DTM) of the area was then prepared, which was used to derive a slope map. The slope was divided in classes of slope percentages. The slope map is enclosed as **Figure-2.3.** The Area under different slope categories are given in **Table-2.2**

Table 2.2: Area under various slope categories

Slope categories (%)	Area (ha)	Area (%)
0-10	807	63.73
10-20	392	30.96
20-30	56	4.46
30-40	11	0.85
>40	-	-
Total	**1266**	**100.0**

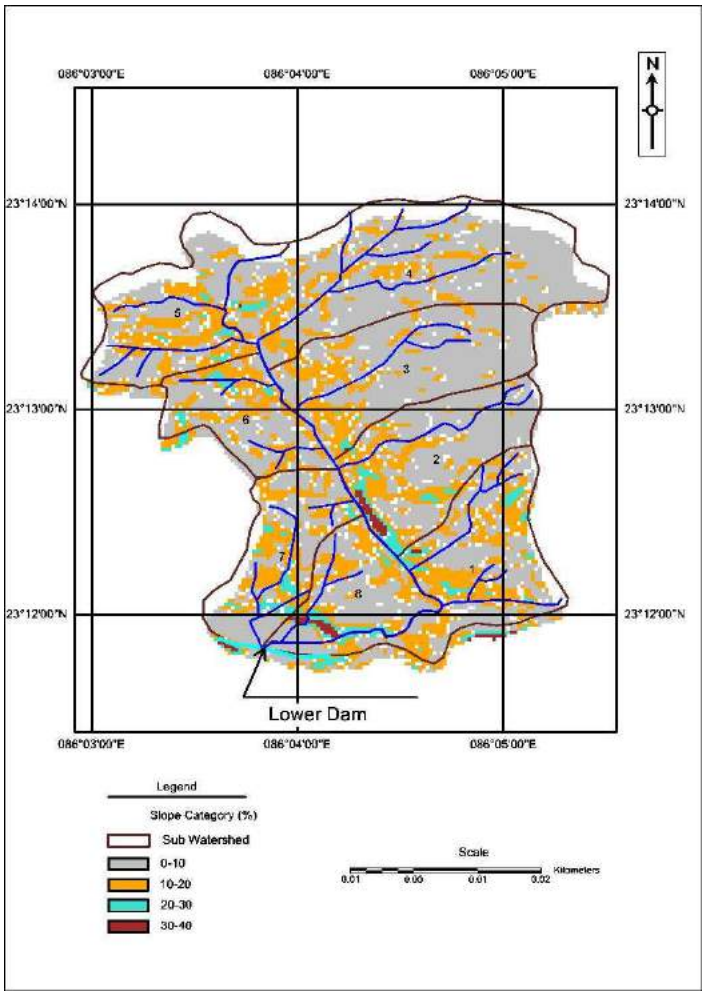


Figure-2.3: Slope Map of catchment area for Turga HEP

2.3 ESTIMATION OF SOIL LOSS USING SILT YIELD INDEX (SYI) METHOD

In `**Silt Yield Index' (SYI)**, method, the terrain is subdivided into various watersheds and the erodibility is determined on relative basis. SYI provides a comparative erodibility criteria of catchment (low, moderate, high, etc.) and do not provide the absolute silt yield. 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.

The SYI model, considering sedimentation as product of erosivity, erodibility and arial extent was conceptualized in the All India Soil and Land Use Survey (AISLUS) as early as 1969 and has been in operational use since then to meet the requirements of prioritization of smaller hydrologic units within river valley project catchment areas.

The erosivity determinants are the climatic factors and soil and land attributes that have direct or reciprocal bearing on the unit of the detached soil material. The relationship can be expressed as:

Soil erosivity = f (Climate, physiography, slope, soil parameters, land use/land cover, soil management)

2.3.1 Silt Yield Index

SYI is defined as the Yield per unit area and SYI value for hydrologic unit is obtained by taking the weighted arithmetic mean over the entire area of the hydrologic unit by using suitable empirical equation.

2.3.2 Prioritization of Watersheds/Sub-watersheds

The prioritization of smaller hydrologic units within the vast catchments is based on the SYI of the smaller units. The boundary values or range of SYI values for different priority categories are arrived at by studying the frequency distribution of SYI values and locating the suitable breaking points. The watersheds/ sub-watersheds are subsequently rated into various categories corresponding to their respective SYI values.

The application of SYI model for prioritization of sub-watersheds in the catchment areas involves the evaluation of:

- Climatic factors comprising total precipitation, its frequency and intensity,
- Geomorphic factors comprising land forms, physiography, slope and drainage characteristics,
- Surface cover factors governing the flow hydraulics and
- Management factors.

The data on climatic factors can be obtained for different locations in the catchment area from the meteorological stations whereas the field investigations are required for estimating the other attributes. The various steps involved in the application of model are:

- Preparation of a framework of sub-watersheds through systematic delineation
- Rapid reconnaissance surveys on 1:50,000 scale leading to the generation of a map indicating erosion-intensity mapping units.
- Assignment of weightage values to various mapping units based on relative silt-yield potential.
- Computing Silt Yield Index for individual watersheds/sub-watersheds.
- Grading of watersheds/sub-watersheds into very high, high, medium, low and very low priority categories.

The area of each of the mapping unit was computed and silt yield indices of individual sub-watersheds were calculated using the following equations:

2.3.3 Estimation of Silt Yield Index

To calculate SYI, the methodology developed by All India Soil & Land Use Survey (Department of Agriculture, Govt. of India) has been followed, where each erosion intensity unit is assigned a weightage value. When considered collectively, the weightage value represents approximately the relative comparative erosion intensity. A basic factor of K = 10 was used in determining the weightage values. The value of 10 indicates a static condition of equilibrium between erosion and deposition. Any addition to the factor K (10+X) is suggestive of erosion in ascending order whereas subtraction, i.e. (10-X) is indicative of deposition possibilities.

Delivery ratios were adjusted for each of the erosion intensity unit. The delivery ratio suggests the percentage of eroded material that finally finds entry into reservoir or river/ stream. Area of each composite unit in each sub-watershed was then estimated.

SYI was calculated using following empirical formula:

$$SYI = \frac{\Sigma (Ai * Wi) * Di * 100}{Aw}; \quad \text{where } i = 1 \text{ to } n$$

where

Ai = Area of i^{th} unit (EIMU)
Wi = Weightage value of i^{th} mapping unit
n = No. of mapping units
Aw = Total area of sub-watershed.
Di = Delivery ratio

Delivery ratios are assigned to all erosion intensity units depending upon their distance from the nearest stream. The criteria adopted for assigning the delivery ratio are as follows:

Nearest Stream	Delivery Ratio
0 - 0.9 km	1.00
1.0 - 2.0 km	0.95
2.1 - 5.0 km	0.90
5.1 - 15.0 km	0.80
15.1 - 30.0 km	0.70

The SYI values for classification of various categories of erosion intensity rates are given in **Table 2.3.**

Table 2.3: Criteria for erosion intensity rate

Priority categories	SYI Values
Very high	> 1300
High	1200-1299
Medium	1100-1199
Low	1000-1099
Very Low	<1000

The erosion category of various watersheds in the catchment area as per a SYI index has been estimated. The objective of the SYI method is to prioritize sub-watershed in a catchment area for treatment.

2.4 WATERSHED MANAGEMENT – AVAILABLE TECHNIQUES

Watershed management is the optimal use of soil and water resources within a given geographical area so as to enable sustainable production. It implies changes in land use, vegetative cover, and other structural and non-structural action that are taken in a watershed to achieve specific watershed management objectives. The overall objectives of watershed management programme are to:

- Increase infiltration into soil;
- Control excessive runoff;
- Manage & utilize runoff for useful purpose.

Following Engineering and Biological measures shall be suggested for the catchment area treatment depending upon the requirement and suitability:

a. Afforestation

- Normal Afforestation
- Enrichment Plantation
- Development of nurseries
- Pasture Development
- Vegetative Fencing
- Social Forestry

b. Soil & Water Conservation

- Check Dam
- Drainage line treatment

c. Research Training and Capacity Building

- Training and Capacity Building of Staff and communities
- Site Specific research

e. Infrastructure Development

- Holistic Support to Staff
- Operational Support to Staff
- Maintenance of Departmental Buildings and inspection paths

2.5 CATCHMENT AREA TREATMENT (CAT) PLAN

In the present report, CAT Plan as per the slope, land use pattern, soil characteristics has been suggested based on the prioritization of sub watersheds using SYI method. The objective of the SYI method is to prioritize sub-watershed in a catchment area for treatment. The erosion category of various watersheds in the catchment area as per a SYI index is given in **Table-2.4.** The details are shown in **Figure-2.4**. The area under different erosion categories is given in **Table-2.5.** The CAT plan has been suggested for Sub-watersheds with high erosion category.

Table-2.4: Erosion intensity categorization as per SYI classification

Watershed number	Area (ha)	SYI value	Category
W1	172	1210	High
W2	155	1220	High
W3	185	1142	Medium
W4	301	1136	Medium
W5	146	1156	Medium
W6	97	1208	High
W7	118	1148	Medium
W8	92	1214	High
Total	**1266**		

Table-2.5:Area under different erosion categories

Category	Area (ha)	Area (%)
Low	-	-
Medium	750	59.24
High	516	40.76
Total	**1266**	**100.00**

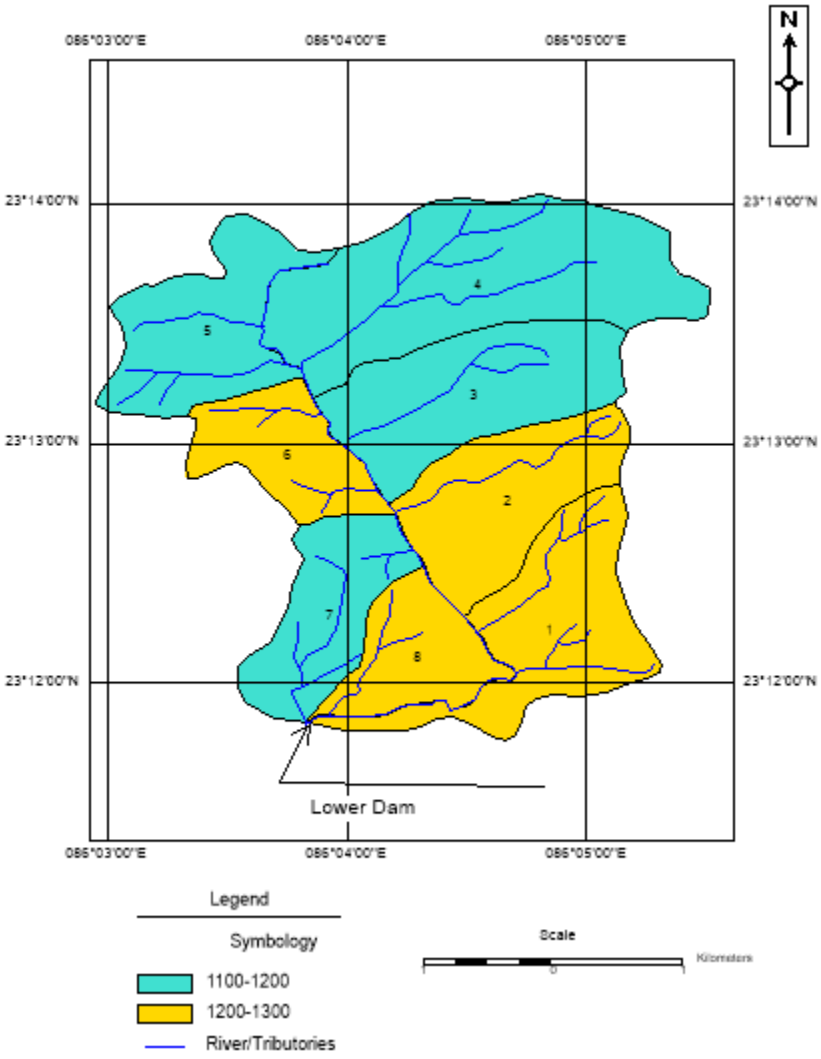


Figure-2.4: Prioritisation of Sub Watersheds for catchment area for Turga HEP

The area under high erosion category has to be treated by the project proponents, which accounts for about 42% of the total free draining catchment area. Sub-watershed wise proposed treatment measures are depicted in **Figure 2.5.** It is proposed that treatment measures shall be implemented by the Forest Department, State Government of West Bengal. CAT plan will be implemented within two years.

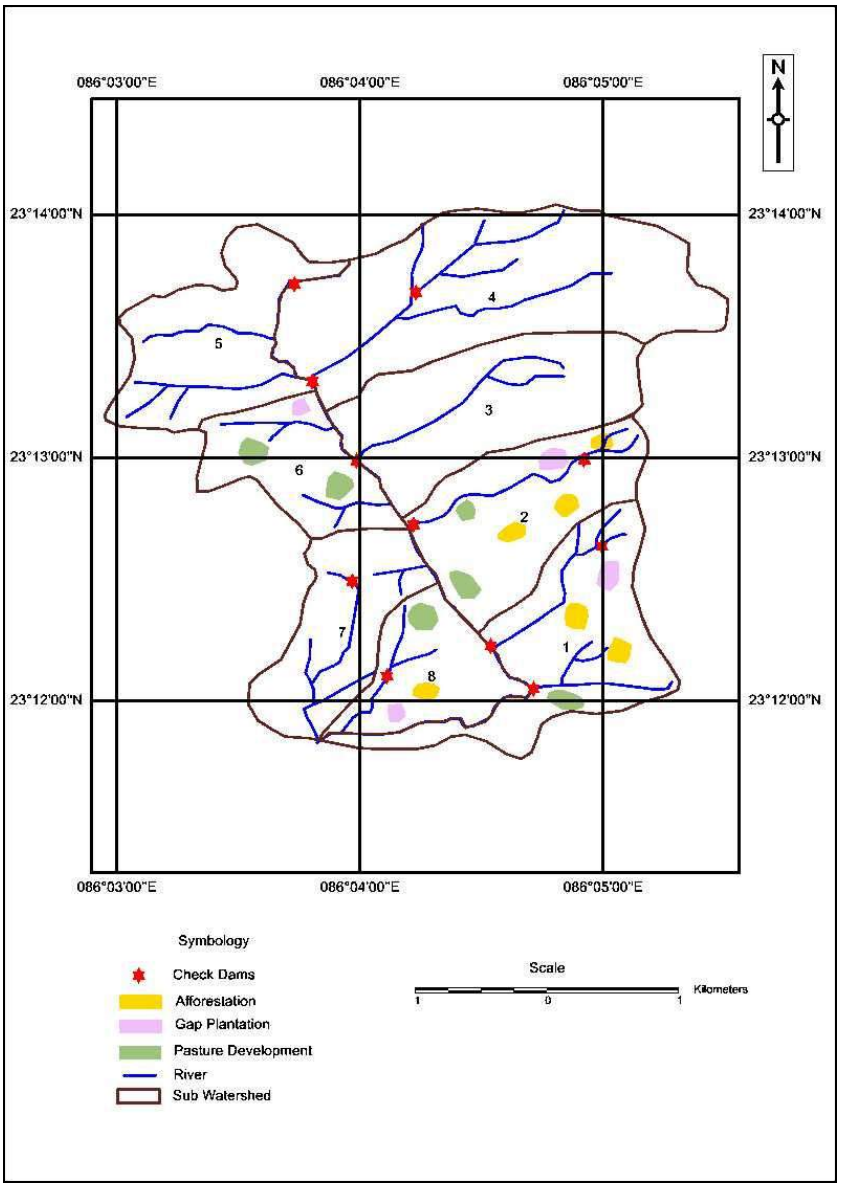


Figure-2.5: CAT Measures for catchment area of Turga HEP

2.6 CATCHMENT AREA TREATMENT MEASURES

2.6.1 Afforestation

An amount of Rs. 170.85 lakh has been earmarked for various afforestation measures. The details are given in Table-2.6.

Table-2.6: Cost Estimate for implementation of Afforestation measures as a part of CAT Plan

S. No.	Item	Unit Rate (Rs.)	Unit	Target	
				Physical	Financial (Rs. lakh)
1.	Afforestation	1,80,000/ha	ha	15	27.0
2.	Maintenance of afforestation area	12,000/ha	ha	15	1.8
3.	Enrichment Plantation	60,000/ha	ha	40	24.0
4.	Pasture development	30,000/ha	ha	20	6.0
5.	Nursery development	10,00,000/ no.	no.	2	20.0
6.	Vegetative fencing	65,000/km	km	5	3.25
7.	Watch and ward for 2 years average 10 persons per month	12,000/man-month	Man-months	240	28.8
8.	Rim Plantation	Lumpsum			50.0
9.	Social Forestry	Lumpsum			10.0
	Total				**170.85**

2.6.2 Soil & Water Conservation Works

An amount of Rs. 58.5 lakh has been earmarked for various Soil & Water Conservation measures. The details are given in Table-2.7.

Table-2.7: Cost estimate for implementation of Soil & Water Conservation measures as a part of CAT Plan

S. No.	Item	Unit Rate (Rs.)	Unit	Target	
				Physical	Financial (Rs. lakh)
1.	Check Dams	3,50,000	Nos.	11	38.5
2.	Drainage line treatment				20.0
	Total				**58.5**

2.6.3 Silt Observation points

One silt observation location for regular monitoring of silt load coming in tributaries of sub-watersheds falling under high category have been suggested. This would ensure monitoring efficacy of implementation various treatments measures suggested as in CAT plan. Monitoring would be undertaken for a period of 10 years including 2 years

for CAT plan implementation period. An amount of Rs. 115.3 lakh has been earmarked for this purpose. The details are given in **Table-2.8.**

Table-2.8: Cost earmarked for establishing Silt Observation points

S. No.	Parameter	Cost (Rs. lakh)
1	Cost of one laboratory – Rs 5,00,000/- for silt analysis per laboratory	5.0
2	One observation hut (@ Rs 5.0 lakh/site)	5.0
3	Cost for hiring services of one person (Average salary- Rs 10,000/- for 10 years) considering 10% escalation per year	19.1
4	Cost for hiring services of supervisor one person (Average salary Rs. 20,000/- for 10 years) considering 10% escalation per year	38.2
5	Consumables for the measurement Rs. 3.0 lacs per year for next 10 years, considering 10% escalation per year	48.0
	Total	**115.3**

2.6.4 Research Training and Capacity Building

An amount of Rs. 50 lakh has been earmarked for Training & Capacity building of forest staff as well as local community through State Forest Training Institutes and reputed organizations.

2.6.5 Infrastructure Development

The total budget kept for infrastructure development for Forest Department during the implementation of CAT Plan is Rs. 65.0 lakh. The details are given in Table-2.9.

Table-2.9: Summary of cost for infrastructure development for Forest Department

S. No.	Component/Item	No.	Unit Rate (Rs. lakh)	Total Cost (Rs. lakh)
1	Vehicle Including operation and maintenance	2 No.	10.0	20.0
2	GPS equipment	3 No.	3.0	9.0
3.	Maintenance of Departmental buildings			16.0
6.	Maintenance of Forest roads/inspection paths			20.0
	Total			**65.0**

2.7 COST ESTIMATES

The cost required for implementation of various measures is Rs. 409.65 lakh. The details are given in Table 2.10.

Table-2.10: Cost earmarked for implementation of CAT plan

S.No.	Activity	Amount (Rs. lakh)
1	Afforestation	170.85
2	Soil & Water Conservation Works	58.5
3	Silt Observation Points	115.3
4	Infrastructure Development	65.0
	Total	**409.65**

2.8 SCHEDULE FOR IMPLEMENTATION OF CAT PLAN

It is proposed to implement the CAT Plan in 2 years. The year wise implementation of physical and financial targets is given in Table-2.11.

Table-2.11: Year-wise implementation schedule for CAT Plan

S. No.	Activity	Year I		Year II		Total	
		Phy.	Fin. (Rs. lakh)	Phy.	Fin. (Rs. lakh)	Phy.	Fin. (Rs. lakh)
A.	**Biological Treatment Measures**						
i)	Afforestation	7 ha	12.6	8 ha	14.4	15 ha	27.00
ii)	Maintenance of afforestation area	-	-	-	1.8	-	1.8
iii)	Enrichment Plantation	20 ha	12.0	20 ha	12.0	40 ha	24.0
iv)	Pasture Development	10 ha	3.0	10 ha	3.0	20 ha	6.0
v)	Nursery Development	2 No.	20.0	-	-	2 No.	20.00
vi)	Vegetative Fencing	3 km	1.95	2 km	1.30	5 km	3.25
vii)	Watch and ward	80 man-months	9.64	160 man-months	19.2	240 man-months	28.84
viii)	Rim Plantation	-	25.00	-	25.00	-	50.00
ix)	Social Forestry	-	5.0	-	5.0	-	10.00
	Sub-Total (A)		**89.19**		**81.7**		**170.85**
B.	**Soil & Water Conservation Works**						
i)	Check Dams	6	21.0	5	17.5	11.0	38.50
ii)	Drainage line treatment		10.0		10.0	-	20.00
	Sub-Total (B)		**31.0**		**27.5**		**58.5**
C.	**Silt Observation Points**						
i)	Setting of one laboratory	1 No.	5.0	-	-	1 No.	5.00
ii)	One observation hut	1 No.	5.0	-	-	1 No.	5.00

S. No.	Activity	Year I		Year II		Total	
		Phy.	Fin. (Rs. lakh)	Phy.	Fin. (Rs. lakh)	Phy.	Fin. (Rs. lakh)
	at each site						
iii)	*Cost of hiring one person (Average Salary Rs. 10,000/- for 10 years) considering 10% escalation per year	-	1.20	-	1.32	-	2.52*
iv)	*Cost of hiring one supervisor (Average Salary Rs. 20,000/- for 10 years) considering 10% escalation per year	-	2.40	-	2.64	-	5.04*
v)	*Consumables (Rs. 3.0 lac per year for next 10 years and considering 10% escalation per year)	-	3.0	-	3.3	-	6.3*
	Sub-Total (C)		**16.6**	**-**	**7.26**	**-**	**23.86***
D.	**Infrastructure Development**						
i)	Vehicle including O&M	2 No.	20.0	-	-	2 No.	20.00
iv)	GPS	3 No.	9.0	-	-	3 No.	9.00
v)	Maintenance of Departmental Buildings	-	8.0	-	8.0	-	16.00
vi)	Maintenance of Forest Roads/Inspection Pattern	-	10.0	-	10.0	-	20.00
	Sub-Total (E)		**47.0**	**-**	**18.0**	**-**	**65.0**
	Grand Total	**-**	**259.79**	**-**	**196.46**	**-**	**318.21**

**** Note: Cost of CAT Plan in Table-2.10 is 409.65 lakh and cost in Table-2.11 is 318.21 lakh. The difference is due to the fact that salary of manpower which has been taken for 10 years in Table-2.10, and in Table-2.11 salary for manpower has been taken for 2 years only.***

CHAPTER-3

BIODIVERSITY CONSERVATION AND MANAGEMENT PLAN

3.1 INTRODUCTION

The proposed Turga Pumped Storage Project will not lead to acquisition of National Park, Sanctuary, Biosphere Reserve, or any other protected area. A detailed floral and faunal survey was carried out in the project area to assess the presence of various floral and faunal species. The rare and endangered species likely to be affected by the project were also assessed.

Conservation is the sustainable use of natural resources, so that it is preserved for future generation as well. Natural conservation involves proper management of natural wealth, places that sustain these resources besides the human pressure that affect the resources. The present chapter outlines the Bio-diversity Conservation Plan including plan for conservation of rare and endangered species as well.

The Forest Department of West Bengal is responsible for conservation and Management of forests in the state. The objective of the compensatory afforestation is to make up for the loss of forest land proposed to be diverted for construction of the proposed Turga Pumped Storage Project. The other objectives are to combat soil erosion, afforestation and last but not least to maintain and improve the ecological and environmental balance.

3.2 AFFORESTATION

The Indian Forest Conservation Act (1980) stipulates:

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

The total land required for the project is 292 ha, of which 234 ha forest land. About 234 ha of Non-forest land would be acquired for compensatory afforestation purpose. The unit cost of afforestation on forest land is Rs. 96,200/ha. The cost for afforestation of 234 ha is Rs. 225.12 lakh. In addition to above the project proponent will pay for the NPV, which shall be estimated by the Forest Department. The indigenous species shall be used for afforestation, which shall be selected in consultation with the Forest Department. The species recommended for greenbelt are given in Table-3.1.

3.3 BIODIVERSITY CONSERVATION

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

- Conservation of Avi-fauna
- Wildlife protection measures
- Training & Publicity Programmes

3.3.1 Conservation of Avi-fauna

Forests are vital for the survival, foraging, breeding and nesting of avifauna. Natural forests provide a variety of food materials to the birds not only in the form of nectar of flowers, fruits, seeds etc. in the trees, shrubs, herbs and grasses but they also contain a large number of insects eaten by birds. In the forests, food is always available for the faunal component. Although most floral species flower during spring through summer but fruit maturation and seed ripening takes place in them throughout the year. Therefore, first strategy of improvement of habitat for birds is avoiding nest predation or brood parasitism through maintenance of large contiguous forest tract. These areas have the ability to support the largest number of forest interior birds and will also be more likely to provide habitat for area sensitive species. It is more practicable to protect the existing forest area rather than creating new forest area.

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

Features of a Nest Box:

The characteristic features of nest box are listed below and is depicted in Figure-3.1.

- Untreated wood (Jamun, mango, pine, cedar or fir)
- Thick walls (at least ¾ inches)
- Extended, sloped roof
- Rough or grooved interior walls
- Recessed floor, coated with primer and paint
- Drainage holes
- Ventilation holes
- Easy access for monitoring and cleaning
- Sturdy construction
- No outside perches

The entrance hole should have a 2 inch diameter and 6 inch depth from entrance hole. Nest boxes are placed on trees at height from 10-12 ft. Such nest boxes designs have been used

with success. The nest boxes shall be located in vicinity to reservoir and other water bodies in the study Area.

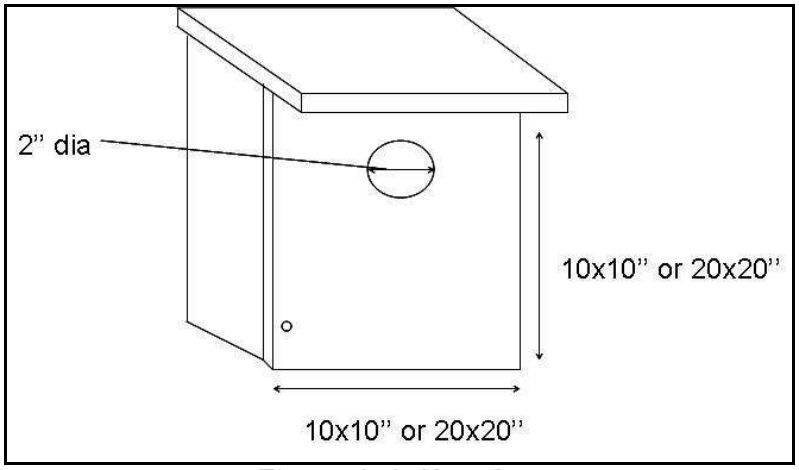


Figure-3.1: Nest Box

It is proposed that one qualified person be hired for a period of five years.

Other Measures

With the change in nature of landscape, its aquatic and terrestrial vegetation will change the habits of the aquatic birds. The aquatic culture i.e. both floral and faunal environments will change to the large extent e.g. in the initial years of the reservoir water storage. The other measures recommended for improvement of habitats are:

- Fodder and wild fruit plantation for wild animals and for roosting, breeding and hiding cover for migratory birds etc.
- Annual bird count of migratory birds by involving locals and bird experts.
- Removal of weeds and rehabilitation with local fruit bearing species in gaps.
- Anti-grazing drive in draw down area to protect the bird breeding areas in proximity to reservoir during breeding season.
- Construction of watch towers

An amount of Rs. 62.76 lakh shall be earmarked for habitat improvement of avi-fauna in the study area. The details are given in Table-3.1.

Table-3.1:Cost of habitat improvement for avi-fauna in the study area

S. No.	Particulars	Amount (Rs. lakh)
A	**Non-recurring Cost**	
1	Cost of nests of different sizes (10"x10" to 20"x20"; average cost Rs. 2000 per wooden box) and installation in the area along the green belt (200 Nos)	4.0

S. No.	Particulars	Amount (Rs. lakh)
2	Repair and maintenance of the nests	0.8
3.	Fodder and wild fruit plantation for wild animals and for roosting, breeding and hiding cover for migratory birds etc.	10.0
4.	Annual bird count of migratory birds by involving locals and bird experts.	8.0
5.	Removal of weeds and rehabilitation with local fruit bearing species in gaps.	8.0
6.	Anti-grazing drive in draw down area to protect the bird breeding areas in breeding season	5.00
	Sub-Total (A)	**35.8**
B	**Recurring Cost (for 5 years)**	
1	Salary for one qualified person @ Rs. 30,000 per month for implementation and data collection including 10% escalation	21.96
2	Contingencies (including avifaunal biodiversity awareness programme for the local inhabitants)	5.0
	Sub-Total (B)	**26.96**
	Total (A+B)	**62.76**

3.3.2 Wildlife Protection Measures

Anti-poaching Measures

There are no ecologically sensitive areas around the project sites. However, forests at the site and in the study area serve as a habitat for wildlife. Due to construction activities and increased human interferences, as a result of immigration of large labour population and their family members, some adverse impacts may take place on wildlife during construction phase; the increased human interferences can have adverse impact on wildlife in and around the project area.

It is recommended that check posts are installed along the following sites to prevent anti-poaching activities. In view of this it is recommended that 4 check posts be developed. The location of these check posts could be:

- Near Upper dam site
- Near Lower dam site
- Near Labour camp-1
- Near Labour camp-2

Each check posts will have 3 guards to ensure that poaching does not take place in the area. One range officers will supervise the guards of various check posts. The check post shall have appropriate transportation and communication facilities. Other infrastructure, like areas and communities, etc. too shall be provided.

The measures proposed for wildlife protection are outlined in the following paragraphs.

Purchase of anti-poaching kits: To capture and translocate wild animals out of human habitations or agricultural lands, various trapping equipments pertaining to anti-poaching activities are needed. For this an amount of Rs. 20 lakh has been earmarked. The anti-poaching kits will include equipments for self defense of the staff as well.

Infrastructure Development: This includes anti-poaching huts, rock shelters development and residential quarters for forest guards. For effective monitoring, one watch tower is also proposed to be established at an identified place having high pressure of biotic interference. The basic amenities for the field staff shall be provided to enable them to do effective patrolling in the areas. For watch tower and accommodation an amount of Rs. 30 lakh has been earmarked.

Purchase of Survey equipment and Vehicles: In order to improve network and vigilance it is required to procure communication equipment like walkie talkie, IT infrastructure to document and develop a database, altimeters, G.P.S., spotoscope, binoculars, video as well as digital still cameras are essential. Purchase of field vehicle will help in increased vigilance. For better communication and purchase of survey equipment an amount of Rs. 20 lakh has been earmarked.

Construction of Check posts: To improve vigilance for anti-poaching, better protection, enforcement for control grazing practices, control-grazing-cum-anti poaching check posts shall be constructed. An amount of Rs.25 lakh has been earmarked for this purpose.

Wildlife Protection Force

A team of forest personnel and guards shall be deployed for works under forest & wildlife protection plan and an amount of Rs. 90.62 lakh has been earmarked for this purpose. The details are given as below:

Salary

- Guards (12 nos.) @ Rs.8000 per month — Rs. 11,52,000
- One range officer @ Rs.20000 per month — Rs. 2,40,000
- Total cost for one year — Rs. 13,92,000
  Cost for 63 months — Rs. 90.62 Lakhs
  (Assuming 10% increase per year)

An amount of Rs. 185.62 lakh has been earmarked for implementation of various measures as a part of Wildlife Protection Plan. The details are given in Table-3.2.

Table-3.2: Measures for implementation of Wildlife Protection Plan

S. No.	Particulars	Amount (Rs. lakh)
	Non-recurring	
1	Anti Poaching Kits	20.00
2	Infrastructure	30.00
3	Survey equipment & vehicle	20.00
4	Check posts	25.00
	Sub-Total (A)	**95.00**
	Recurring	
5	**Salary for wildlife protection force**	**90.62**
	Sub-Total (B)	**90.62**
	Total (A+B)	**185.62**

3.3.3 Training & Publicity Programmes

Under this programme, the following activities are proposed:

- Training shall be imparted to the school teachers in the project area for introduction of environmental education among the school children and exchange of knowledge on environment and ecology in village schools.
- Publishing of research documents, pamphlets, brochures, hoardings
- Advertisement of hazardous effect of fire through press, sign boards and public meetings will form the important activities under this component.

An amount of Rs. 10 lakh has been earmarked for this purpose.

3.4 BUDGET

A total provision of Rs. 483.50 lakh has been earmarked for biodiversity conservation. The details are given in Table-3.3.

Table-3.3: Estimated cost of Biodiversity Conservation and Management Plan implementation

S.No.	Particulars	Cost (Rs. lakh)
(A)	Compensatory Afforestation Plan	225.12
	Sub-total (A)	**225.12**
(B)	**Biodiversity Conservation & Management Plan**	
1	Habitat improvement for avi-fauna	62.76
2	Wildlife protection	185.62
3	Training and Publicity Programmes	10.00
	Sub-total (B)	**258.38**
	Total (A+B)	**483.50**

CHAPTER-4

FISHERIES MANAGEMENT PLAN

4.1 FISHERIES STATUS

Turga is a small river with shallow bottom, therefore, hardly harbours small species like *Barilius bendelisis*, *Chela cachius*, *Puntius* spp. and *Nemacheilus* spp. Some of the species like *Labeo rohita*, *L. calbasu*, *Catla catla*, *Cirrhinus mrigala*, *Anabas testudineus, Badis badis*, etc have been introduced in the existing reservoir of I&W Dte. Govt. of West Bengal. The list of fish species observed in the Study Area is given in Table-4.1.

Table-4.1: Fish species composition in Study Area

S. No.	Scientific Name	Vernacular Name	Distribution	IUCN Status
	Cyprinidae			
1	*Labeo rohita*	Rohu	Irrigation Dam Reservoir	LC
2	*Labeo calbasu*	Rohu	Irrigation Dam Reservoir	LC
3	*Cirrhinus mrigala*	Mrigal	Irrigation Dam Reservoir	LC
4	*Gibelion catla*	Catla	Irrigation Dam Reservoir	LC
5	*Puntius sophor*	Puthi	Irrigation Dam Reservoir/ Turga River	LC
6	*Puntius chola*	Puthi	Irrigation Dam Reservoir/ Turga River	LC
7	*Puntius ticto*	Puthi	Irrigation Dam Reservoir/ Turga River	LC
8	*Garra spp.*	Garra fish	Irrigation Dam Reservoir	LC
9	*Barilius bendelisis*	Korong	Study Area	LC
10	*Chela cachius*	-	Study Area	LC
	Ambassidae			
11	*Chanda / Parambassis ranga*	Glassy fish	Irrigation Dam Reservoir	LC
	Balitoridae			
12	*Nemacheilus sp.*	-	Study Area	-
13	*Nemacheilus montanus*	-	Study Area	-
	Cobitidae			
14	*Lepidocephalus guntea*	-	Study Area	LC
	Cichlidae			
15	*Oreochromis mossambicus*	Cichlids	Irrigation Dam Reservoir	LC
	Channidae			
16	*Channa punctatus* (Bloch,1793)	Snake head	Irrigation Dam Reservoir	LC
	Gobiidae			
17	*Glossogobius giuris*	-	Irrigation Dam Reservoir	
	Anabantidae			
18	*Anabas testudineus*	Koi	Irrigation Dam Reservoir	DD
	Notopteridae			
19	*Notopterus notopterus*	Pupda	Irrigation Dam Reservoir	LC
	Nandidae			
20	*Badis badis*	Dum	Irrigation Dam Reservoir	LC

S. No.	Scientific Name	Vernacular Name	Distribution	IUCN Status
	Mastacembelidae			
21	*Macrognathus aral*	Bam	Irrigation Dam Reservoir	

LC = least concerned, DD = data deficient

During post monsoon season, a total of 6 species were observed from different sites. *Puntius* sophore, *Puntius ticto* and *Macrognathus aral* or bam eel were landed from the downstream of the reservoir with the help of local fishermen. *Chela cachius* and *Barilius bendelisis* were found to inhabit Turga nalla.

In summer season, maximum number of catch belonged to *Oreochromus mosambicus*, followed by Puntius sp –small barbs and other trash fishes like Indian Glassy fish.

In monsoon season a total of 5 species were observed from the downstream of reservoir, Turga nalla and reservoir. Fish fauna of middle stretch comprised of *Garra* species, *Macrognathus aral* and *Puntius* sophore. Turga nallah harboured *Nemacheilus montanus* and *Puntius* sp. Other species listed in Table-4.1 were reported to inhabit reservoir and other wetland of Baghmundi division.

During field investigation, local fishermen using different gears were found to land fish from the outlet of Irrigation Dam Reservoir of lower dam during post-monsoon, summer and monsoon seasons. The catch size ranges from 0.4 to 1.2 kg for two hours fishing. Fishermen used cast net to land fish.

As per the Fisheries Department atleast two societies known as Baghmundi Thana FCS Ltd exist in the Baghmundi division. Under these societies, many fishermen are registered. In addition, Paddy fishery in the Baghmundi area was also observed during the field studies.

4.2 SUSTENANCE OF RIVERINE FISHERIES

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, considered to maintain a minimum flow to ensure survival and propagation of invertebrates and fish.

For Turga Pumped Storage Project, the Environmental Flows for Upper and Lower Reservoir are given in Tables-4.2 and 4.3 respectively.

Table-4.2: Recommended Environmental Flows for Upper Reservoir

Month/Season	Flow in 90% DY (MCM)	Percentage of inflow as Environmental Flow	Environmental Release (MCM)
June	0.11	30%	0.03
July	0.38	30%	0.11
August	0.02	30%	0.006
September	1.55	30%	0.47
October	0.56	30%	0.17
Monsoon (Total)- **(A)**	2.63	30%	0.786
Non-Monsoon (Total)- **(B)**	0.29	25%	0.0725
Annual (A+B)	**2.92 MCM**		**0.8585, say 0.86 MCM**

Table-4.3: Recommended Environmental Flows for Lower Reservoir

Month/Season	Flow in 90% DY (MCM)	Percentage of inflow as Environmental Flow	Environmental Release (MCM)
June	0.17	30%	0.05
July	0.58	30%	0.17
August	0.04	30%	0.01
September	2.37	30%	0.71
October	0.86	30%	0.26
Monsoon (Total)- **(A)**	4.01	30%	1.20
Non-Monsoon (Total)- **(B)**	0.44	25%	0.11
Annual (A+B)	**4.45 MCM**		**1.31 MCM**

It is considered to release the environmental flow from very beginning of the construction of both the Dams, so that environmental and ecological aspects can be maintained properly in that area. The existing irrigation and drinking water requirements during filling period of reservoirs shall be met by diverting water from other sources e.g., Bamni nala.

4.3 MANAGEMENT OF HABITAT

The management of reservoirs is based on the stocking–cum capture fishery technique. The formation of fish population in reservoir is basically from the parental population of the inundated river and watershed areas. It is usually characterised by strengthening of lacustrine species and decline in riverine species as a result of change from riverine to lacustrine condition which do not favour them. The management techniques involve :

- Introduction of selected varieties of carps from extraneous sources, so as to develop a carp dominated fishery through self-propagation as well as regular stocking.
- A rational system of exploitation based on the concept of fishing effort and population dynamics of the fish stock.

- Conservation measures e.g. regulation of mesh size, imposition of size limits, observance of closed season, ban on destructive methods of fishing etc.
- Preservation, transport and marketing of fresh fish.

The initial trophic burst stage is the most critical stage of management. The reservoir is amenable for stock manipulation or correction during these initial crucial years by selective stocking with greater emphasis on fishes of short food chain (phytophagus) and close to primary producers like Indian major carps viz, Catla, Rohu and Mrigal.

The Indian major carps are stocked as they find the environment suitable for growth and production, and their compatibility and non-cannibalistic trait, high fecundity and breeding success, etc. For better utilization of the unutilized fraction of food (phytoplankton, zooplankton, benthos, periphyton, detritus, etc.) stocking of *L. calbasu, L. fimbriatus, L. bata*.

4.3.1 Impacts of Stocking

Stocking in the medium and large reservoirs could be considered as successful only when the stocked fish are recaptured. Indian experience of stocking medium and large reservoirs suggests that by and large, the stocking becomes effective only when the stocked fishes propagate themselves. Moreover, this breeding population can be built-up only if the stocking is resorted to during the early phase of the reservoir formation.

4.3.2 Stocking Density

Decision regarding number of fingerlings to be stocked in any impoundment are vital and depends upon the potential of the biotope. A number of methods are in vogue for calculating the stocking rate. Huet (1960) provided a general stocking formula, which can be applied universally irrespective of the size of the reservoir. The fish yield can be estimated from the primary productivity studies or trophodynamic models. While estimating the percentage loss, chances of survival of the stocked fish in the light of predator pressure, escapement through the outlets and over fishing are to be taken into consideration:

$$\text{Stocking rate (No./ha.)} = \frac{\text{Total yield (in kg./ha.)}}{\text{Individual growth rate of fish in kg.}} + \text{loss (\%)}$$

A desired balance between the stocking rate, population density and growth is to be maintained with enough flexibility so as to swing it to suit the changes in the environmental factors.

4.3.3 Fish Seed Requirement

Based upon experience gained in the past, a stocking rate of 300 fingerlings per ha. (above 100 mm.) for reservoir has been proposed in the initial years of development. The total requirement of advanced fingerlings will thus be 0.44 lakh (100 mm.).

The submergence area of the Upper and Lower Reservoir is 146.05 ha. In order to attain this target, the requirement of fish seed of different sizes have been worked out as under:

(i) Requirement of advanced fingerlings:

Stocking @ 300 advanced fingerlings / ha. (100 mm.)

146.05 ha x 300 = 0.44 lakh

(ii) Requirement of standard fingerlings:s (50 mm.) at 80% survival

$$\frac{0.44 \times 100}{80} = 0.55 \text{ lakh}$$

(iii) Requirement of fry (25 mm.) at 60% survival

$$\frac{0.55 \times 100}{60} = 0.92 \text{ lakh}$$

(iv) Requirement of spawn = 0.92*100/40 = 2.291 lac, say 2.3 lakh

REQUIREMENT OF REARING SPACE

(i) Nursery area : 0.5 ha.
(ii) Rearing area for fry to standard fingerlings (50 mm.) @ of 3.00 lakhs / ha. Thus requirement for 2.3 lakh fingerlings x shall be about 1 ha.
(iii) Advanced fingerlings ponds @ 8 lakh / ha.= 0.3 ha.

If for S.No. (i) and (ii) two crops are taken the rearing area will be further reduced as under :

N.P. = 0.5

R.P. = 0.25

Total : 0.75 ha.

Brood Stock Ponds: Adequate provision for maintenance of brood stock should also be made, preferably in close vicinity of the hatchery. In addition to the above rearing space, for raising advanced fingerlings, 0.3 ha of advance fingerling ponds would be needed. These grow out ponds should be managed and operated as far as possible with peoples participation for which necessary technical expertise will be provided by State Fisheries Department. Some of the

village ponds situated along the periphery of the reservoir could also be used for raising advanced fingerlings. This will generate additional income to the locals.

The Schematic Diagram for Proposed Hatchery is enclosed as Figure-4.1.

4.3.4 Organisation of Fishermen and Training

Fishermen in India, belong to the lower socio economic segment of the population, are mostly illiterate and chronically indebted to the middlemen. Hence, socio-economic reforms for 'welfare of Fishermen' is an essential aspect for the all round development of fisheries in India. The primary societies are basically producer societies engaged in fishing activities. The apex body will provide credit and supplies to the primaries and market their catch. They will also arrange for the infrastructures needed for storage, transportation of fish, welfare of the fishermen etc. and distribute bonus / dividend to the primaries in addition to payment of catching charges of fish. It is proposed to bring about 50 fishermen in the cooperative sector.

These fishermen will be imparted training in fishing techniques and operation of boats, handling, storage and transport of fish etc. They will also be provided with productive assets to pursue their vocation.

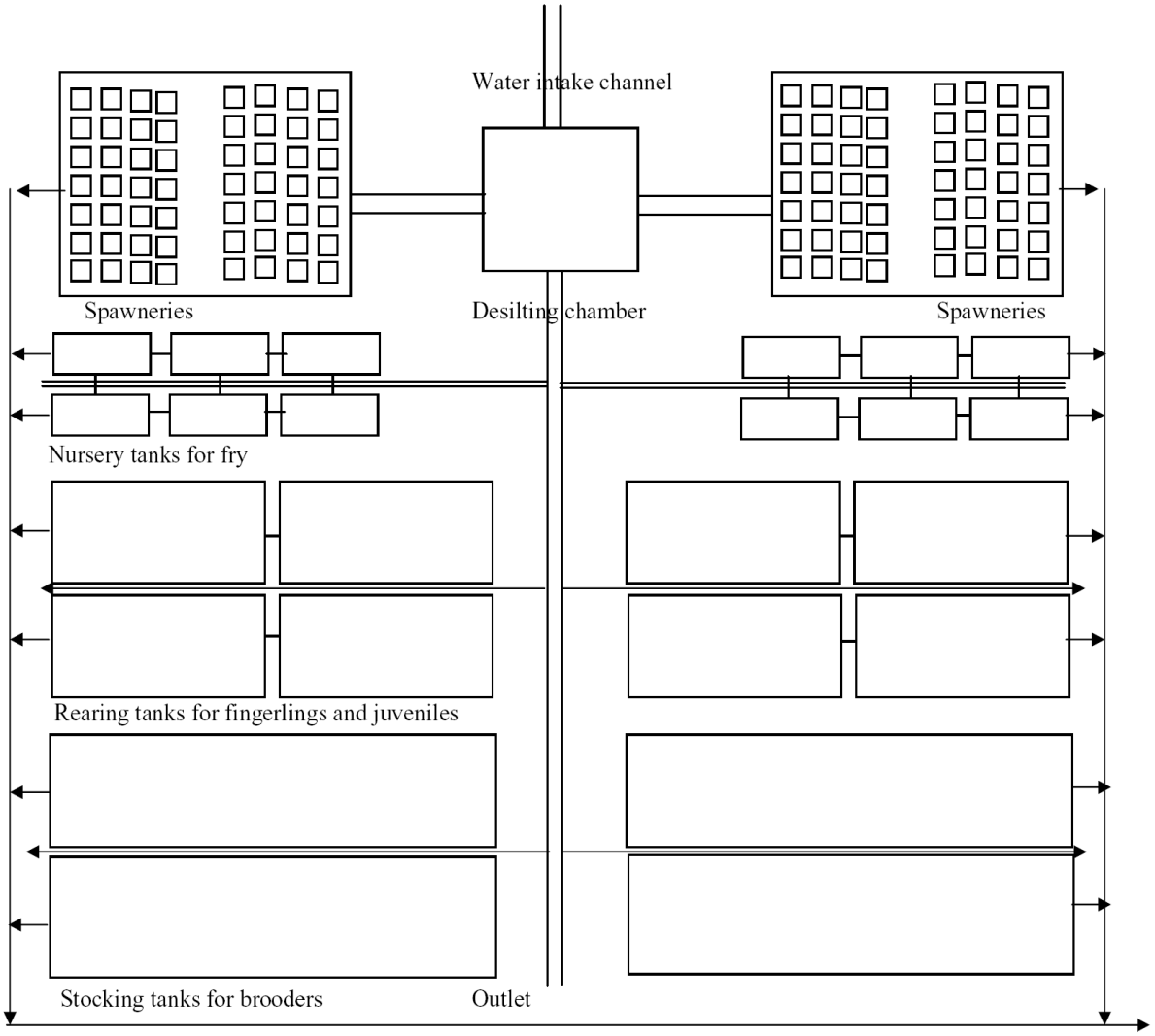


Figure-4.1: Schematic Diagram for Proposed Hatchery

4.3.5 Fish Production Potential

If the optimum rate of stocking is maintained from the very beginning, commercial fishing could be taken up 3 years after initiation of the stocking programme. During this period, the endemic fish population shall be available for partial exploitation. On full development, a fish yield of 50 kg. per ha. is envisaged with an annual production of about 7.0 metric tonne.

4.3.6 Infrastructure Facilities

Fishing Nets

Under the project each fisherman will be provided with 20 kg. of finished nylon nets with floats etc. The nets could be supplied in 2 years @ 10 kg/yr. Boat seines/drag nets could be

operated in selected large shallow areas from where trees, stumps, etc. have been removed flush to the ground.

Fishing Boats

For the proposed project, it is proposed to provide one fishing boat for every 2 fishermen.

Transport Vehicles

Mini Truck

One mini truck of 1 Ton capacity is proposed for transportation of fish from the landing centres/packing centres to local marketing points. It will also be used for transportation of ice and packing materials, and transportation of iced fish to railway station. It will be also used for hatchery needs and transportation of fish seed to stocking sites.

Jeep with Trolley

One jeep with trolley is proposed for inspections, supervision, transportation, patrolling purposes, etc.

Post-Harvest Facilities

The post harvest facilities will consist of two fish handling sheds, one Ice Plant –cum cold storage of 1 ton capacity, one Ice crushing machines and 100 stockable crates.

4.3.7 Conservation and Management Fisheries Rules

It is proposed to formulate reservoir fishing rules, which would include regulation of mesh size, restrictions on catching of major carps below certain size and weight, observance of closed season etc.

Closed Season

Under the existing rules fishing is restricted from 16 June to 15 August each year which is the breeding season of major carps and also certain cat fishes.

Regulation of Mesh Size

Regulation of mesh size will be enforced to protect destruction of spawners and juveniles particularly during closed season. Restrictions on minimum size of important fishes like Catla, Rohu, etc. will also be imposed.

Motivation and Awareness

During the last decade or so, it has been observed that the conservation rules for Natural Resource Management (NRM) could be enforced properly with peoples' participation and emphasis is laid on community conserved Bio-diverse Areas. For this, apart from Motivation and Awareness creation involvement of fishing community in the fishery development process is essential.

4.4 COST ESTIMATES

The total cost estimates of the project works out to Rs. 88.7 lakh. The details are given in Table-4.4.

Table-4.4: Cost estimate for implementation of fisheries management plan

S. No.	Items	Cost (Rs. Lakh)
1	**Assistance to fishermen**	
A	Fishing nets, floats etc. @ Rs. 10000/- per fisherman for 50 fishermen.	5.0
B	Boats: @ one boat for 2 fishermen, total 25 boats @ Rs. 20,000/- each.	5.0
C	Training expenses @ Rs. 2000/- per fisherman for 50 fishermen.	1.0
	Sub Total (1)	**11.0**
2	**Survey and identification of fishermen and organisation of societies.**	2. 0
	Sub Total (2)	**2.0**
3	**Stocking of fingerlings :**	
	Construction of hatchery (composite fish farm) including farm equipments, approach/ internal roads etc.	30.0
	Sub Total (3)	**30.0**
4	**Fish transport and marketing :**	
A	Mini Truck - 1 No.	5.0
B	Jeeps with trolly – 1 No.	7.5
	Sub Total (4)	**12.5**
5	**Post Harvest facilities :**	
A	Fish handling sheds – 2 Nos.	15.0
B	Ice Plant (1 Ton) with Cold storage – 1 No	15.0
C	Ice-crushing machine (Elec.– cum – diesel) –1 Nos.	2.0
D	Stockable crates - 100 Nos.	1.20
	Sub Total (5)	**33.20**
	Total	**Rs.88.70 lakh**

CHAPTER 5

GREENBELT DEVELOPMENT PLAN

5.1 INTRODUCTION

The forest loss due to the reservoir submergence and construction of other project appurtenances shall compensated as a part of compensatory afforestation. However, it is proposed to develop greenbelt around the perimeter of various project appurtenances, selected stretches along reservoir periphery, etc. The main objectives of creating a green belt around a reservoir are to:

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

The general consideration involved while developing the greenbelt are:

- Trees growing up to 10 m or above in height with perennial foliage should be planted around various appurtenances of the proposed project.
- Planting of trees should be undertaken in appropriate encircling rows around the project site.
- Generally fast growing species should be planted.
- Since, the tree trunk is normally devoid of foliage up to a height of 3 m, it may be useful to have shrubbery in front of the trees so as to gives coverage to this portion.

5.2 PLANTATION

The tree plantation will be done at a spacing of 2.5 x 2.5 m. About 1600 trees per ha will be planted. The maintenance of the plantation area will also be done by the project proponent. The treated waste water and the manure generated by composting of solid waste generated for labour camps will be used for the greenbelt development. The species recommended for greenbelt development are given in **Table 5.1**.

Table 5.1: Species recommended for greenbelt development for Turga PSP

Scientific Name	Local Name
Trees	
Aegle marmelos	Bael
Albizia procera	Safed Siris
Albizzia lebbek	Kala siris
Altsonia scholaris	Saptparni
Artocarpus lacucha	Dahua
Cassia fistula	Amaltas
Ficus bengalensis	Bargad
Holoptelea integrifolia	Kanju

Scientific Name	Local Name
Mallotus philippinensis	Kamla
Syzygium cumini	Jamun
Terminalia arjuna	Arjun
Terminalia bellirica	Bahera
Terminalia chebula	Haritaki
Shrubs	
Abutilon indicum	Jhampi
Annona squamosa	Seethaphal
Calotropis gigantean	Akand
Carissa spinarum	Auka Kuli
Zizyphus mauritiana	Ber

5.3 COST ESTIMATE FOR GREEN BELT DEVELOPMENT

The cost of plantation per hectare is estimated at Rs. 84,000 per ha which includes sapling cost, nursery cost, labour cost, cost of manure, weeding etc. It is proposed to afforest about 20 ha of land as a part of Greenbelt development. The total cost works out to be Rs. 16.8 lakh.

CHAPTER -6

CONTROL OF WATER, AIR AND NOISE POLLUTION

6.1 WATER POLLUTION CONTROL

6.1.1 Control of Water Pollution during Construction Phase

During project construction phase, sufficient measures need to be implemented to ameliorate the problem of water pollution from various sources. The sewage generated from various labour camps should be treated in septic tanks and disposed by discharging into nearest water body. However, efforts shall be made to discharge the treated effluent only in these water bodies, which are not used for meeting domestic water requirements.

The construction activities would require a crusher to crush large lumps of rocks to the requisite size for coarse as well as fine aggregates. The effluent generated from these crushers will have high-suspended solids. The effluent needs to be treated before disposal. Settling tanks of appropriate size for treatment of effluent from various crushers should be provided.

During tunneling work ground water flows into the tunnel along with construction water, which is used for various works like drilling, shortcreting, etc. The effluent thus generated in the tunnel contains high suspended solids. Normally, water is collected in the side drains and drained off into the nearest water body without treatment. It is recommended to construct a settling tank of adequate size to settle the suspended impurities. The sludge from the various settling tanks can be collected once in 15 days and disposed at the site designed for disposal of municipal solid wastes from the labour camps. The sludge after drying could also be used as cover material at landfill disposal site. An amount of Rs. 20.0 lakh has been earmarked for construction of various settling tanks.

6.1.2 Control of Water Pollution during Operation Phase

During project operation phase, due to absence of any large-scale construction activity, the cause and source of water pollution will be much different. Since, only a small number of O&M staff will reside in the area in the well-designed colony of existing PPSP Project Colony with all the infrastructural facilities, water pollution due to disposal of sewage is not anticipated.

6.2 AIR POLLUTION CONTROL

6.2.1 Control of Emissions

Minor air quality impacts will be caused by emissions from construction vehicles, equipment and DG sets, and emissions from transportation traffic. Frequent truck trips will be required during the construction period for removal of excavated material and delivery of select

concrete and other equipment and materials. The following measures are recommended to control air pollution:

- The contractor will be responsible for maintaining properly functioning construction equipment to minimize exhaust.
- Construction equipment and vehicles will be turned off when not used for extended periods of time.
- Unnecessary idling of construction vehicles to be prohibited.
- Effective traffic management to be undertaken to avoid significant delays in and around the project area.
- Road damage caused by sub-project activities will be promptly attended to with proper road repair and maintenance work.

6.2.2 Control of Air Pollution due to DG sets

The Central Pollution Control Board (CPCB) has issued emission limits for generators upto 800 KW. The same are outlined in **Table 6.1**, and are recommended to be followed.

Table 6.1: Emission limits for DG sets prescribed by CPCB

Parameter	Emission limits (gm/kwhr)
NO_x	9.2
HC	1.3
CO	2.5
PM	0.3
Smoke limit*	0.7

* Light absorption coefficient at full load (m^{-1})

The above standards need to be followed by the contractor operating the DG sets.

The other measures are recommended as below:

- Location of DG sets and other emission generating equipment should be decided keeping in view the predominant wind direction so that emissions do not effect nearby residential areas.
- Stack height of DG sets to be kept in accordance with CPCB norms, which prescribes the minimum height of stack to be provided with each generator set to be calculated using the following formula:

  $H = h+0.2x \sqrt{KVA}$

  H = Total height of stack in metre

  h = Height of the building in metres where the generator set is installed

  KVA = Total generator capacity of the set in KVA

6.2.3 Dust Control

The project authorities will work closely with representatives from the community living in the vicinity of project area to identify areas of concern and to mitigate dust-related impacts effectively (e.g., through direct meetings, utilization of construction management and inspection program, and/or through the complaint response program). To minimize issues related to the generation of dust during the construction phase of the project, the following measures have been identified:

- Identification of construction limits (minimal area required for construction activities).
- When practical, excavated spoils will be removed as the contractor proceeds along the length of the activity.
- When necessary, stockpiling of excavated material will be covered or staged offsite location with muck being delivered as needed during the course of construction.
- Excessive soil on paved areas will be sprayed (wet) and/or swept and unpaved areas will be sprayed and/or mulched. The use of petroleum products or similar products for such activities will be strictly prohibited.
- Contractors will be required to cover stockpiled soils and trucks hauling soil, sand, and other loose materials (or require trucks to maintain at least two feet of freeboard).
- Contractor shall ensure that there is effective traffic management at site. The number of trucks/vehicles to move at various construction sites to be fixed.
- The construction area and vicinity (access roads, and working areas) shall be swept with water sweepers on a daily basis or as necessary to ensure there is no visible dust.

6.3 NOISE CONTROL MEASURES

6.3.1 Control of noise from construction equipment

The contractors will be required to maintain properly functioning equipment and comply with occupational safety and health standards. The construction equipment will be required to use available noise suppression devices and properly maintained mufflers.

- vehicles to be equipped with mufflers recommended by the vehicle manufacturer.
- staging of construction equipment and unnecessary idling of equipment within noise sensitive areas to be avoided whenever possible.
- notification will be given to residents within 100 m of major noise generating activities. The notification will describe the noise abatement measures that will be implemented.

- monitoring of noise levels will be conducted during the construction phase of the project. In case of exceeding of pre-determined acceptable noise levels by the machinery will require the contractor(s) to stop work and remedy the situation prior to continuing construction.

6.3.2 Control Noise from DG sets

The following Noise Standards for DG sets are recommended for the running of DG sets during the construction:

- The maximum permissible sound pressure level for new diesel generator sets with rated capacity up to 1000 KVA shall be 75 dB(A) at 1 m from the enclosure surface.
- Noise from the DG set should be controlled by providing an acoustic enclosure or by treating the enclosure acoustically.
- The Acoustic Enclosure should be made of CRCA sheets of appropriate thickness and structural/ sheet metal base. The walls of the enclosure should be insulated with fire retardant foam so as to comply with the 75 dBA at 1m sound levels specified by CPCB, Ministry of Environment & Forests.
- The acoustic enclosure/acoustic treatment of the room should be designed for minimum 25 dB (A) Insertion Loss or for meeting the ambient noise standards, whichever is on the higher side.
- The DG set should also be provided with proper exhaust muffler.
- Proper efforts to be made to bring down the noise levels due to the DG set, outside its premises, within the ambient noise requirements by proper siting and control measures.
- A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.

6.3.3 Control Noise from crushers

Based on literature review, noise generated by a crusher is in the range of 79-80 dB(A) at a distance of 250 ft or about 75 m from the crusher. Thus, noise level at a distance of 2 m from the crusher shall be of the order of 110 dB (A). The exposure to labour operating in such high noise areas shall be restricted upto 30 minutes on a daily basis. Alternatively, the workers need to be provided with ear muffs or plugs, so as to attenuate the noise level near the crusher by atleast 15 dB (A). The exposure to noise level in such a scenario is to be limited up to 4 hours per day.

It is known that continuous exposure to noise levels above 90 dB(A) affects the hearing of the workers/operators and hence has to be avoided. Other physiological and psychological effects have also been reported in literature, but the effect on hearing acuity has been specially stressed. To prevent these effects, it has been recommended by international specialist organizations that the exposure period of affected persons be limited as specified in **Table 6.2**.

Table-6.2: Maximum Exposure Periods specified by Occupational Safety and Health Administration (OSHA)

Maximum equivalent continuous noise level dB(A)	Unprotected exposure period per day for 8 hrs/day and 5 days/week
90	8
95	4
100	2
105	1
110	½
115	¼
120	No exposure permitted at or above this level

6.4 IMPLEMENTING AGENCY

Various management measures needs to be implemented for Control of air pollution. Control measures needed to be included in the Tender Document for the Contractor involved in construction activities. The same shall be monitored on a regular basis by the project proponents.

CHAPTER-7

PLAN FOR SOLID WASTE MANAGEMENT PLAN & SANITATION FACILITIES IN LABOUR CAMPS

7.1 INTRODUCTION

The labour camp for and residential complex for technical staff involved in construction phase will be located in the vicinity of construction sites. The total increase in labour population during construction phase shall be about 4,000. In addition to this, during construction stage it is expected that about 100-200 people from nearby villages will visit project site every day for commercial purposes and constitute the regular floating population. This floating population may also generate solid waste.

7.2 SANITATION FACILITIES IN LABOUR CAMPS

7.2.1 Increase in Labour Population

The project construction is likely to last for a period of 63 months. About 200 technical staff and 800 labour population shall be involved in construction phase. The total increase in population shall be about 4,000. The aggregation of large number of workers in the project area during the construction phase is likely to put considerable stress on the prevailing biotic and abiotic environment of the area. The stress could be on account of increased water demand, sewage and solid waste generation, fuel requirements etc. The aim of this EMP is to minimize these stresses.

7.2.2 Facilities in Labour Camps

a) Housing

It shall be made mandatory for the contractor involved in the construction activities to provide adequate facilities for water supply and sanitation. It is recommended that the contractor provides living units to each of the labour family involved in the construction activities. The units should have proper ventilation.

b) Water supply

As mentioned earlier, about 4000 workers and technical staff (including family) are likely to congregate during project construction phase. The domestic water requirement of the labour/employee population is expected to be of the order of 0.28 mld @ 70 lpcd. Appropriate water supply sources need to be identified. Proper infrastructure for storage and if required treatment e.g. disinfection or other units, shall also be provided.

c) Sewage treatment

The domestic water requirement shall be of the order of 0.28 mld. It is assumed that about 80% of the water supplied will be generated as sewage. Thus, the total quantum of sewage generated is expected to be of the order of 0.23 mld. The BOD load contributed by domestic sources will be about 180kg/day. The sewage generated from labour camps shall be treated prior to disposal.

The labour population is proposed to be situated in existing colonies. One community toilet shall be provided for 20 persons. The sewage from the community toilets can be treated in a Sewage Treatment Plant (STP) comprising of aerated lagoon and secondary settling tank. The treated sewage can be used for meeting irrigation requirements of areas being afforested under greenbelt development. The total cost required for implementation of sanitation facilities in labour camps shall be Rs. 90.0 lakh. The details are given in Table 7.1.

Table 7.1: Cost estimate for sanitation facilities in labour camps

Item	Unit	Number	Total cost (Rs. lakh)
Community toilet	Rs. 30,000/community toilet	200	60.0
Aerated lagoon & Secondary settling tank	Lump sum		30.0
Total			**90.0**

The dimensions of the various units of sewage treatment plant are given as below:

Aerated lagoon

- Length : 30 m
- Width : 15 m
- Depth : 3 m

Secondary Settling tank

- Diameter : 3.5 m
- Depth : 2.5 m

7.3 SOLID WASTE MANAGEMENT

7.3.1 Quantity of Solid Waste Generation

The quantity of waste generated in Indian cities reported to be in the range of 0.2-0.6 kg/capita /day as per the "Manual on Solid Waste Management" prepared by Central Public Health & Environment Engineering Organisation (CPHEEO), Ministry of Urban Development, Govt. of India. The Waste Generation pattern is very much dependant on the living style of the population. As the major share of the population is labour force will stay in the project area, the solid waste generation factor of 210 g/capita/day has been taken into consideration.

Solid waste generation will be the leading problem among the negative impacts assuming that huge quantity of municipal waste that would be generated from residential colony, labour camps and office buildings when the project is constructed. Huge amount of sewage will also be generated from the similar sources during the construction and operation phase of the proposed project.

The major generation sources for sewage and municipal wastes would be as follows:

- Municipal waste from residential colony, labour camps, office buildings
- Sewage from residential colony, labour camps, office buildings
- Hazardous wastes (i.e. Bio-Medical wastes) from primary health centre and hospitals

It is also expected that if proper management measures for solid waste are not adopted, it will degrade the nearby environment, create hazards for labour and staff that would be posted in the project area during construction/ operation period of the project. Therefore, all the problems due to origination of solid waste require proper management facilities. The types of wastes, its composition and major generation sources during the construction/ operation of proposed Project are indicated in Table-7.2.

Table-7.2: Expected typical composition of waste in proposed project

Waste Type	Composition of waste	Sources of waste generation
Municipal waste	Food wastes, plastics, paper, sewage, glass, vegetables waste.	From residential and labour camp areas
Construction waste	Empty cement begs, dust, debris, demolition and construction wastes, scrap, dust and ashes etc.	From construction site and crusher etc.
Bio-medical waste	Syringes, cotton, bandages, glass tubes, etc.	From primary health centers

7.3.2 Composition of Municipal Solid Wastes

The composition of garbage in India indicates lower organic matter and high ash or dust contents. It has been estimated that recyclable content in solid waste varies from 13 to 20% and compostable materials is about 80-85%. A typical composition of municipal solid waste is given below in Table-7.3.

Table-7.3: Typical composition of municipal solid wastes expected in the proposed project

Description	Percentage by weight
Vegetable, leaves	40.15
Grass	3.80
Paper	0.81
Plastic	0.62
Glass/ceramics	0.44

Description	Percentage by weight
Metal	0.64
Stones/ashes	41.81
Miscellaneous	11.73

Source: Central Pollution Control Board

Chemical composition of solid waste is another important aspect for evaluating alternative processing and energy recovery point of view. The details of typical chemical composition of municipal wastes in India are given in Table 7.4.

Table 7.4: Chemical components of municipal solid wastes expected in the proposed project

Component	C (%)	H (%)	O (%)	N (%)	S (%)	Ash (%)
Food wastes	48	6.4	37.6	2.6	0.4	5
Paper	43.5	8	44	0.3	0.2	6
Card board	44	5.9	44.6	0.3	0.2	5
Plastic	60	7.2	22.8	-	-	10
Textiles	55	6.6	31.2	4.6	0.15	2.5
Rubber	78	10	-	2	-	10
Leather	60	8.0	11.6	10	0.4	10
Garden trimming	47.8	6	38	3.4	0.3	4.5
Wood	49.5	6	42.7	0.2	0.1	1.5
Dirt, ashes, brick etc	26.3	3	2	0.5	0.2	68

Source: Central Pollution Control Board

7.3.3 Administrative Set Up

Administratively, a Solid Waste Management Committee (SWMC) comprising of the project representatives will look after the management of solid waste. The SWMC may comprise of the following:

- In-charge of civil works, at least of the rank of Divisional Engineer / Assistant Engineer (1 No.)
- Supervisors/SAE (2 Nos.)

The SWMC will be supported by sanitary workers, sweepers etc., the number of which may be decided by the SWMC after assessing the work requirement.

7.3.4 Solid Waste Management Plan

A solid waste management system works on four basic principles viz. segregation & primary storage at the source, collection, transportation, treatment and disposal.

a) Segregation at source

- Segregation of waste is one of the critical activities in the Solid Waste Management as it saves undue efforts on transportation and disposal of recyclable or inert wastes. The

segregation of such wastes, before they are transported to the processing/ disposal site, should be carried out.

- Waste segregation cannot be introduced without public awareness and should be implemented in a phased manner. In order to achieve this, the following strategy may be adopted for promoting public awareness:
  i. The residents shall be educated about appropriate use of biodegradable waste like kitchen & garden wastes.
  ii. Extensive awareness campaigns have to be organized by SWMC for educating the public on the aspects related to impacts of solid waste on environment and health, ill effects of littering and burning of wastes, segregation of municipal solid wastes, proper primary storage within their house premises, etc. The awareness can be spread through posters, distribution of pamphlets etc.
  iii. Residents may be advised to develop the habit of segregating the biodegradable waste material like kitchen and garden waste and store in a separate bag or a bin installed at their respective houses.
  - The SWMC would educate its sanitary workers about the revenue earning potential of recyclable waste and various options to earn revenue. The sanitary workers should be advised to collect such waste separately. To encourage collection of recyclables, SWMC may think of devising a plan which can provide some revenue opportunities for the sanitary workers. Market potential with respect to the forward linkages for effective disposal of recyclable waste is to be identified and exploited by the SWMC for the purpose.
  - Collection and segregation of hazardous wastes from the workshops viz. used batteries, transformer oil, used oil, metal scraps etc. and selling them to CPCB registered vendors having Environmentally Sound Management (ESM) system.
  - The operator of waste processing/disposal facility should be advised to carry out inspection of waste received to further segregate recyclables and sell them to recyclers. If it is not feasible to segregate recyclables on their own, the processing/disposal facility operator may allow registered scavengers to enter the premises of the compost plant and pick recyclable waste. This would ensure reduction in rejects, reducing burden on processing plant as well as landfill.
  - SWMC may register the names of recyclers for the recyclables such as plastics, newspapers, glass, metals etc. from residential and commercial sources and the

names of registered recyclers should be published or made known to the public residing in the project / labour colonies / labour sheds.

- SWMC may associate and involve local residents, in increasing awareness among the people to segregate recyclable material at source and hand it over to a designated waste collector identified by SWMC.

b) Primary Storage of Wastes

It is recommended to segregate waste into two categories & store the segregated wastes in two different containers:

- ❑ One container **(Green Coloured)** for the **"Biodegradable Waste"** or the **"Wet Waste"**
- ❑ Other container **(Blue Coloured)** for the **"Non-biodegradable Wastes"** or the **"Dry Waste".**

Wet waste (Biodegradable) includes the following:

- Kitchen waste including food waste of all kinds, cooked and uncooked, including eggshells and bones
- Flower and fruit waste including juice peels and house-plant waste
- Garden sweeping or yard waste consisting of green/dry leaves
- Sanitary wastes
- Green waste from vegetable & fruit vendors/shops
- Waste from food & tea stalls/shops etc.

Dry waste (Non-biodegradable) includes the following:

- Paper and plastic, all kinds
- Cardboard and cartons
- Containers of all kinds excluding those containing hazardous material
- Packaging of all kinds
- Glass of all kinds
- Metals of all kinds
- Rags, rubber
- House sweeping (dust etc.)
- Ashes
- Foils, wrappings, pouches, sachets and tetra packs (rinsed)
- Discarded electronic items from offices, colonies viz. cassettes, computer diskettes, printer cartridges and electronic parts.

- Discarded clothing, furniture and equipment

➢ The wet and dry wastes are to be stored in two different containers as mentioned above. As the biodegradable waste degrades and generates liquid, it is advisable to use non-corrosive container with lid for the storage of bio-degradable/wet waste.

➢ A **Green** coloured container of 10 liters capacity for a family of about 5-6 members would generally be sufficient for wet waste. However, it is advisable that a household should keep larger container or standby container to store the additional wastes produced in 24 hours. The household may have a spare capacity of 100% to meet unforeseen delay in clearance or unforeseen extra loads.

➢ Dry waste can be stored in another **Blue** coloured container of 10-12 litre capacity or plastic bag/Jute Bag/plastic/polymer containers.

➢ The containers are to be procured by SWMC and provided to individual households in the project colonies & labour colonies/camps. Some containers of bigger capacity (0.5 m^3) will also be kept at public places, as community bins, like offices, workshops, shops, community centre, school, canteens/ mess, guest houses etc. The places where community bins have to be placed away from drinking water sources and preferably on elevated areas where water stagnation is not there during rainy days.

➢ In addition to the above wastes, another type of waste called **"Domestic Hazardous Waste"** may also be generated at household level. These include used aerosol cans, batteries, household kitchen and drain cleaning agents, car batteries and car care products, cosmetic items, chemical-based insecticides/rodenticides, light bulbs, tube-lights and compact fluorescent lamps (CFL), paint, oil, lubricant and their empty containers. These wastes are to be stored separately, whenever generated and sold for recycling or handed over to the sanitary workers who come for house-to-house collection.

➢ To enforce successful implementation, necessary rules/by-laws should be framed by SWMC to make segregation and storage at source compulsory and also to avoid littering and burning of wastes at the project sites.

c) Collection of Solid Wastes

❑ It is recommended to have a mechanism for door to door collection of waste from the staff/ labour colonies and labour sheds. The sanitary workers / sweepers) will have tricycle with containers or containerized handcarts having ringing bell and will go for waste collection from individual house at a fixed time every day. The sanitary workers

would ring the bells at the time of reaching the particular area/locality, giving a signal for waste collection to the residents.

- In labour colonies also, the door-to-door collection of waste would be carried out. The containerized rickshaws or handcarts would be employed for collection of wastes. The labourers should be strictly advised to store the wastes in available plastic containers of suitable size. The waste bins including community bins are to be cleaned daily by the sanitary workers at an informed timing.
- During collection of wastes from the bins, care shall be taken to avoid waste spillage and it shall be the responsibility of the sanitary workers to clean & maintain hygienic conditions at the places where community bins are kept.

d) Waste Handling

- As per Municipal Solid Waste (Solid Waste Management & Handling) Rules, 2000; the manual handling of waste has to be avoided. As per the recommended system, the waste from their source of generation is either collected by sanitary workers during door-to-door collection from the colonies or from community bins.
- The sanitary workers, after primary collection, will transport the waste to the storage depots from where it will be lifted by dumper placers and transported to the processing & disposal sites.
- The community bins of size 0.5 m^3 are to be lifted manually and unloaded into the containers kept in the transportation vehicles.
- The sanitary workers involved in manual lifting are to be provided with gloves and masks and shall be instructed to use them compulsorily while handling waste. It will be the responsibility of the sanitary supervisors to monitor the proper use of personnel protective equipment by the workers.

e) Transportation of Solid Wastes

- It is recommended to use tricycles/push carts/containerized handcarts, for primary collection of waste from the individual households, offices and other public places, as described above, up to the waste storage depots. The sufficient number of tri-cycles / push carts/containerized handcarts shall be arranged for effective door-to-door collection system.
- The wastes collected from the street sweeping and drain cleaning is to be shifted to the waste storage depots using tricycles/handcarts.
- The transportation of waste from the waste storage depots to the processing and disposal sites will be done in the covered trucks/dumpers etc. so that the waste is

not exposed to the human population and there is no spillage of waste on the roads during transportation.

- To take care of certain unavoidable circumstances, if it is required to lift waste from some open place, front-end loaders and tractor trolleys may be used. However, the waste in tractor trolley has to be covered with LDPE sheet during its transport.

7.3.5 Disposal of Solid Waste (Non-degradable Portion)

As per the requirements of the Municipal Solid Waste (Solid Waste Management & Handling) Rules 2000, land filling would be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall be done following proper norms and landfill sites shall meet the specifications as given in these rules. The quantum of solid waste to be disposed for landfill is given in **Table-7.5**.

Table-7.5: Estimation of Quantity of waste to be disposed to landfill

S. No.	Description	Data
1.	Per capita MSW generation at present	0.21 kg per capita per day
2.	Population during construction stage of the project	4000
3.	Total Solid Waste (SW) generation at the rate of 0.21 kg/capita/day	840 kg/day
4.	Considering the fraction of bio-degradable waste as 45 % of total SW generated, total quantity of bio-degradable waste to be generated (for vermi-composting)	378 kg/day
5.	Inorganic waste for disposal (48% of total waste) to landfill (considering that recyclable waste in form of paper, glass, metals, plastic etc. constitute 7 % of total waste)	403.2 kg/day
6.	Quantity of rejects generated from the compost plant to be disposed to landfill, assuming the rejects as 30% of waste going to compost plant	114 kg/day
7.	Hence total waste to be disposed in landfill at present	517.2 kg/day
8.	Waste to be disposed to landfill	16.0 tons/month
9.	Waste to be disposed to landfill in 63 months	1010 tonnes

The details of landfill site are given as below:

- Length 20 m
- Width 16 m
- Depth of fill 5 m

A provision of 15% of the total area, for accommodating infrastructure facilities has also been included while working out requirement of space. The liner system will comprise of the following layers below the waste:

- 0.30 m thick drainage layer comprising of coarse sand or gravel (stone dust with no fines)
- 0.2m thick protective layer of sandy silt
- 1.50mm thick HDPE geo-membrane
- 1.0 m thick clay layer/amended soil layer, amended soil layer comprising of local soil + bentonite is to be provided).

7.3.6 Treatment of Solid Waste (Degradable Portion)

Considering the fraction of bio-degradable waste as 45 % of total SW generated, total quantity of bio-degradable waste to be generated (for vermi-composting), which amounts to about 0.6 m^3/day. The vermi-composting the process takes around 60 days to mature. Thus the total capacity of pits required would be (60 X 0.6) 36 cu m.

A pit of 2 m x 1.5 m x 1.3 m deep (0.3m freeboard) size can take 3.0 cu m of compostable waste. Thus the no. of pits required shall be 12. The total area will be almost three times the pit area as some area in between pits will be required for transportation and stacking of waste. Hence, total area required will be 110 m^2. The pits will be covered with GI sheets. Additional 60 sq m would be kept for storage for compost plus screening and other activities.

The pits to be constructed will have around 25 cm of bottom lining consisting of about 5 cm thick stone grit over which 15 cm thick coarse sand followed by 15 cm thick earth lining will be done. The refuse along with animal dung will have to be laid in layers of 5 to 10 cm thickness. The pit will be then watered on alternate days. Thereafter waste is laid in 5 to 10 cm thick layers twice in a week till the whole pit is filled up. Every week the waste will need to be turned up and water will have to be sprinkled every day to keep adequate moisture. The process will take around 45 to 60 days where after the composted waste from the pit is taken out and after drying it is screened with screens having 2 mm diameter holes. The screened compost would be filled in plastic bags and used as good manure especially for cultivation of vegetables and flowers.

7.4 GENERAL SANITARY MEASURES

Sweeping of Streets, Public Spaces & Drain Cleaning

In the project colonies, office complexes etc. sweeping should be carried out by the sanitary workers daily. Sweeping should be carried out between 6 to 8 am in the morning and between 2 to 4 pm in the afternoon. The Sanitary workers will be allotted some specified area and after sweeping they would collect the waste in the form of heaps on the street side. These

heaps would be loaded into handcarts and these handcarts will be emptied at waste collection points. For proper solid waste Solid Waste Management, suitable tools, equipment & vehicles in sufficient numbers are necessary for handling, lifting and transportation of waste. The equipment required for Solid Waste Management are mentioned under cost estimation table.

The sanitary workers involved in drain cleaning may be given tools like seamless handcarts and shovels. It is also recommended to maintain separate roster for cleaning of drains.

Burning of waste causes hazardous/toxic gaseous pollutants and must be avoided. The SWMC will discourage burning of waste along the roadside and/or on public places.

7.5 COST ESTIMATE FOR SOLID WASTE MANAGEMENT PLAN

The total cost required for solid waste management is Rs. 204.75 lakh. The details are given in Table-7.6.

Table-7.6: Cost Estimate for Solid Waste Management and Sanitation Facilities in Labour Camps

S. No.	Item	Cost (Rs. lakh)
1.	Waste bins & Community Bins	1.5
2.	Waste Storage Depots	2.0
3.	Vehicles	7.0
4.	Cost of land for land filled vermin-composting sites	6.0
5.	Reclamation and stabilization cost of landfill and vermin-composting sites	5.0
6.	One covered truck for conveyance of solid waste to landfill and vermin-composting site	20.0
7.	Manpower cost for 4 persons @ Rs. 10,000/ month for 63 months including 10% escalation/year	31.25
8.	02 tractors with trolleys @ Rs. 500,000/ per tractor with trolley	10.0
9.	Awareness programme	2.0
10.	Water facility & Toilet facilities at landfill and vermin-composting site	23.0
11.	Tools & Implements	3.0
12.	Yard lighting maintenance store room lighting, Monitoring station @5000/ fixture x 40'	1.0
13.	Periodical Training & Medical Checkup	3.0
14.	Sanitation Facilities in Labour Camps	90.0
	Total	**204.75**

CHAPTER-8

PUBLIC HEALTH DELIVERY SYSTEM

8.1 INTRODUCTION

The construction of dam may involve many diversified activities and require a large number of labourers. The change in population density through immigrants/influx may cause new health problems in this region. People may carry different types of contagious diseases if any and spread in locality. Influx of human work force may also bring stress on available drinking water sources and sanitary facilities. The additional sewage generated may contaminate drinking water sources resulting in spread of various communicable diseases, if proper precautionary measures are not taken. As a part of Environmental Management Plan, a detailed plan for development of public health and medical facilities has been prepared.

8.2 PUBLIC HEALTH DELIVERY SYSTEM

8.2.1 Control of malaria

The increase in water fringe area provides suitable habitats for the growth of vectors of various diseases and they are likely to increase the incidence of water-related diseases. Malaria is the water related major vector-borne disease. Thus, malaria control measures which aim at destroying the habitat and interrupting the life cycle by mechanical or biological or chemical means need to be implemented. Various Primary Health Centres in the nearby villages and Hospital at District Head Quarters can coordinate the anti-malarial operations in association with the project authorities.

The suggested measures are given in following paragraphs:

- Site selected for habitation of workers should not be in the path of natural drainage.
- Adequate drainage system to dispose storm water drainage from the labour colonies should be provided.
- Adequate vaccination and immunization facilities should be provided for workers at the construction site.

8.2.2 Development of medical facilities

A population of about 4000 is likely to congregate during the construction phase. The labour population will be concentrated at two or three sites. It is proposed that during construction stage, that existing medical facilities of the block hospital at Bagmundi and existing medical facilities at Purulia Pumped Storage Project (PPSP) will be improved and upgraded to take care of the health care system of Turga Pumped Storage Project workforce. Apart from the above, a dispensary will be developed, during project construction phase, so that it can serve the labour population migrating in the area as well as the local population.

The details of manpower, infrastructure requirement for this dispensary are given as below.

Manpower

Doctor : 1
Qualification : M.D.

1 doctor can be employed in the dispensary and will reside in the PPSP Township. The para-medical staff required for assistance to the doctor is given in Table-8.1.

Table-8.1: Details of Para-medical staff for dispensary

Para medical staff	Number
Auxiliary Nurse	1
Male Multipurpose Health worker	1
Attendants	2
Drivers	2
Total	**6**

Residential accommodation will be provided for the para-medical staff.

Proposed Health Facilities at Construction sites and labour camp

It is possible that during the construction work, the technical staffs operating different equipment are not only exposed to the physical strain of work but also to the physical effects of the environment in which they are working. The workers and other technical staff may come up with common manifestations such as insect bites, fever, diarrhea, work exhaustion and other diseases. In addition they may invariably come up with injuries caused by accidents at work site. Under all circumstances, workers need immediate medical care.

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.

Health Extension Activities

The health extension activities will have to be carried out in the villages situated in the nearby areas. It is important to inculcate hygienic habits of environmental sanitation specially with respect to water pollution by domestic wastes. There would be possibility of the transmission of communicable diseases due to migration of labour population from other areas at the construction site. The doctors from the dispensary shall make regular visits to nearby villages and organize health promotional activities with the active participation of the

local village Panchayat, and available local health functionaries. The health functionaries would undertake the following tasks as a part of health promotional activities:

- Collect water samples to ascertain the portability of water from different sources so as to monitor regular disinfection of drinking water sources.
- Maintain close surveillance on incidence of communicable diseases in these villages.
- Maintain close liaison with the community leaders and health functionaries of different departments, so that they can be mobilized in case of an emergency.

8.3 COST ESTIMATES

The cost required for implementation of various public health measures shall be Rs. 282.23 Lakhs. The details are given in the following paragraphs:

A. Expenditure on salaries

Dispensary

Post	Number	Monthly Emoluments (Rs.)	Annual Expenditure (Rs.)
Doctor	1	100,000	12,00,000
Nurse	1	30,000	360,000
Male Multi-purpose Health Workers	1	30,000	360,000
Attendants	2	15,000	360,000
Drivers	2	10,000	240,000
Total			**25,20,000**
First Aid Posts			
Health Assistants	2	20,000	4,80,000
Total			**4,80,000**

Total Expenditure = Rs. 30.0 lakh per year

B. Expenditure on Material and Supplies

Dispensary

Non-recurring

i)	1 Vehicle	Rs. 10,00,000
ii)	Furniture, etc.	Rs. 4,00,000
iii)	Hospital equipment	Rs. 6,00,000
iv)	Ambulance 1 No.	Rs. 8,00,000
Total		**Rs. 28,00,000**

Recurring

i) Drugs and Medicine,	Rs. 20,000/yr
ii) 2 First-Aid Posts at construction sites	Rs. 1,00,000/yr
iii) R & M of Ambulance -2 No.	Rs. 4,00,000/yr
Total	**Rs. 5,20,000/yr**

Infrastructure

One existing quarter of Purulia Pumped Storage Project (PPSP) township will be restored and converted into dispensary, for which an amount of Rs. 20.0 lakh has been earmarked.

2 First-Aid Posts: These are of temporary nature and will be constructed. The cost for construction of two First Aid Posts shall be of the order of Rs.5.0 lakh @Rs. 2.5 lakh/First-aid post.

The total cost for developing the infrastructure will be Rs.25 lakh.

A. Recurring Expenditure

*	Expenditure on salaries	:	Rs. 30,000,000/yr
*	Expenditure on materials & supplies	:	Rs. 5,20,000/yr
	Sub-Total		**Rs. 35,20,000/yr**
Total expenditure for 63 months (A) : (considering 10% escalation per year period)			**Rs. 229.23 lakh**

B. Non-Recurring Expenditure

*	Infrastructure (Construction of Dispensary & 2 First aid posts)	:	Rs. 25 lakhs
*	Expenditure on materials, supplies and equipment	:	Rs. 28 lakhs
	Total (B)		**Rs.53 lakhs**
Total A + B			**Rs. 282.23 lakh**

8.4 DISPOSAL OF BIO-MEDICAL WASTE

Dispensaries use a variety of drugs including antibiotics, cytotoxics, corrosive chemicals etc. a part of which is generated as a solid waste. With greater emphasis on disposables, the quantum of solid waste generated in a hospital is quite high. As per the Bio-Medical Waste (Management and Handling) Rules 1998, the bio-medical waste has been classified into various categories which are outlined in Table-8.2.

Table-8.2: Categories of bio-medical waste as per the Bio-Medical Waste (Management and Handling) Rules 1998

Waste Category No.	Waste category type
Category No. 1	**Human Anatomical Waste** Human tissues, organs, body parts
Category No. 2	**Animal Waste** Animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals, colleges, discharge from hospitals, animal houses
Category No. 3	**Micro-biology and Biotechnology wastes** Wastes from laboratory cultures, stocks or specimens of micro-organisms, live or attenuated vaccines, human and animal cell culture used in research and infections agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures
Category No. 4	**Waste sharps** Needles syringes, scalpels, blades, glass, etc. that may cause punctures and cuts, including both used and unused drugs
Category No. 5	**Discarded medicines and cytotoxic drugs** Wastes comprising of outdated, contaminated and discarded medicines
Category No. 6	**Soil Waste** Items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts, lines bleedings other material contaminated with blood.
Category No. 7	**Solid Waste** Wastes generated from disposable items other than the waste sharps, such as tubings, catheters, intravenous sets, etc.
Category No. 8	**Liquid waste** Waste generated from laboratory and washing, cleaning, house keeping and disinfecting activities
Category No. 9	**Incineration Ash** Ash from incineration of any bio-medical waste
Category No. 10	**Chemical Waste** Chemicals used in production of biologicals, chemicals used in disinfection, as insecticides, etc.

Out of the categories listed in Table-8.2, the biomedical waste categories to be generated in the dispensary proposed to be developed as a part of the project are given in Table-8.3.

Table-8.3: Categories of bio-medical waste to be generated in the dispensary proposed to be developed as a part of the project

Waste Category No.	Waste category type
Category No. 1	**Human Anatomical Waste** Human tissues, organs, body parts

Waste Category No.	Waste category type
Category No. 4	**Waste sharps** Needles syringes, scalpels, blades, glass, etc. that may cause punctures and cuts, including both used and unused drugs
Category No. 5	**Discarded medicines and cytotoxic drugs** Wastes comprising of outdated, contaminated and discarded medicines
Category No. 6	**Soil Waste** Items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts, lines bleedings other material contaminated with blood.
Category No. 7	**Solid Waste** Wastes generated from disposable items other than the waste sharps, such as tubings, catheters, intravenous sets, etc.
Category No. 8	**Liquid waste** Waste generated from laboratory and washing, cleaning, house keeping and disinfecting activities
Category No. 9	**Incineration Ash** Ash from incineration of any bio-medical waste
Category No. 10	**Chemical Waste** Chemicals used in production of biologicals, chemicals used in disinfection, as insecticides, etc.

The bio-medical waste must be segregated in accordance to the guidelines laid under Schedule-I of Bio-medical Waste (Management and Handling) rules notified by Ministry of Environment and Forests. The proposed colour coding and container for disposal are given in Table-8.4. The treatment measures recommended for various categories of waste is outlined in Table-8.5.

Table-8.4: Colour coding and type of container for disposal of Bio-medical waste

Colour coding	Type of container	Waste category
Yellow	Plastic bag	Category 1and category 6
Red	Disinfected container/ plastic bag	Category 6 and category 7
Blue/white transparent	Plastic bag/ puncture proof container	Category 4 and category 7
Black	Plastic bag	Category 5, category 9 and category 10 (solid)

Table-8.5: Recommended treatment measures of various categories of waste

Waste type	Recommended treatment
Category No. 1 – Human Anatomical wastes	Incineration
Category No. 4 – Waste sharps	Secured landfill

Waste type	Recommended treatment
Category No. 5 – Discarded medicines and cytotoxic drugs	Secured landfill
Category No. 6 – Solid Waste	Incineration
Category No. 7 - Solid Waste	Incineration
Category No. 8 – Liquid waste	Treatment through an Effluent Treatment Plant (ETP)
Category No. 9 – Incineration Ash	Secured landfill
Category No. 10 – Chemical waste	Secured land fill

It is proposed to treat the effluent generated from the dispensary prior to its disposal. An amount of Rs. 26.0 lakh has been earmarked for the above.

8.5 BUDGET FOR PUBLIC HEATH DELIVERY SYSTEM

The total budget earmarked for Public Health delivery system shall be Rs. 308.23 lakh. The details are given in Table-8.6.

Table-8.6: Budget for Public Health Delivery System

S.No.	Item	Cost (Rs. lakh)
1.	Commissioning and operation of public health facilities	282.23
2.	Disposal of bio-medical waste	26.00
	Total	**308.23**

CHAPTER 9
MUCK DISPOSAL PLAN

9.1 GENERAL

The total quantity of muck expected to be generated has been estimated to be of the order of 32 lakh m^3. Considering, 25% swelling factor, the total muck to be handled is 40 lakh m^3. About 5o% material shall be used as construction material Thus, 20 lakh m^3 of muck is planned to be disposed. The component wise detail of muck to be generated and identified zones for accommodating the muck generated is given in Table-9.1.

Table-9.1: Component wise details of muck to be generated

S.No.	Description of Items	Unit	Quantity
A	**DIVERSION CHANNEL(730m long)**		
1	Open Excavation (Soil)	m^3	4200
2	Open Excavation (Rock)	m^3	420
b	**COFFER DAM**		
1	Open Excavation (Soil)	m^3	47530
2	Open Excavation (Rock)	m^3	7130
B-LOWER CONCRETE DAM (872 m long & 64m high)			
1	Open Excavation (Soil)	m^3	309773
2	Open Excavation (Rock)	m^3	132760
C-LOWER SADDLE DAM (595 m long & 50 m high)			
1	Open Excavation (Soil)	m^3	75680
2	Open Excavation (Rock)	m^3	88060
E-UPPER ROCKFILL DAM (732 m long & 63.5 m high)			
1	Open Excavation (Soil)	m^3	93400
2	Open Excavation (Rock)	m^3	304852
F-UPPER DAM SPILLWAY			
1	Open Excavation (Soil)	m^3	1350
2	Open Excavation (Rock)	m^3	5008
G-DIVERSION TUNNEL CUM BOTTOM OUTLET			
1	Open Excavation (Soil)	m^3	500
2	Open Excavation (Rock)	m^3	1000
INTAKE			
Inlet Structure			
1	Open Excavation (Soil)	m^3	365580
2	Open Excavation (Rock)	m^3	243720
head race &Penstock including Intake Gate Shaft			
Head race &Penstock			
1	Inclined Shaft Excavation	m^3	32,560
2	Tunnel Excavation (including Upper Penstock)	m^3	140,320
Intake Gate Shaft			
1	Open Excavation (Soil)	m^3	1070
2	Open Excavation (Rock)	m^3	710

S.No.	Description of Items	Unit	Quantity
INTAKE GATE SHAFT (Underground)			
1	Excavation	m^3	12560
WORK ADIT to HRT			
1	Open Excavation (Soil)	m^3	1150
2	Open Excavation (Rock)	m^3	4590
	Tunnel Excavation	m^3	49070
Work Adit to Lower Penstock			
1	Underground Excavation	m^3	27160
Tail Race			
Tail race Tunnel			
1	Tunnel Excavation	m^3	112870
Tailrace gate shaft (Tunnel)			
1	Gate Shaft Excavation	m^3	9610
Work Adit toTRT			
1	Tunnel Excavation	m^3	28380
TailRace Outlet			
outlet Structure			
1	Open Excavation (Soil)	m^3	408640
2	Open Excavation (Rock)	m^3	272430
POWER HOUSE			
1	Cavern Excavation	m^3	171010
2	Busbar Excavation	m^3	3580
DRAFT TUNNEL			
1	Tunnel Excavation	m^3	3160
Transformer Cavern			
1	Cavern Excavation	m^3	38180
2	Draft Gate shaft Excavation	m^3	3480
MAT			
1	Open Excavation (Soil)	m^3	6410
2	Open Excavation (Rock)	m^3	25640
3	Tunnel Excavation (UG)	m^3	46460
Top Heading Tunnel to Powerhouse			
1	Tunnel Excavation	m^3	2380
Cable Tunnel & Ventilation Tunnel			
1	Inclined Shaft Excavation	m^3	5720
2	Tunnel Excavation	m^3	1770
Switchyard			
1	Common Excavation	m^3	42540
2	Rock Excavation	m^3	63460
3	Excavation for Foundation	m^3	7370
TOTAL MUCK GENERATED			**3203243**
SWELL Factor @ 25%			4004054
Quantity to be used as Construction material @ 50%			2002027
Quantity to be disposed off			**2002027, say 20 lakh cum**

The total volume to be disposed is 20 lakh m^3. The muck will be disposed in 3 muck disposal sites, as outlined in Table-9.2. The area of muck disposal sites is 11.04 ha. The capacity of of muck disposal sites 11.04 lakh m^3. The remaining muck (8.96 lakh m^3) will be disposed in Kudna and Dulgubera Quarry areas, which have a total capacity of 9.7 lakh m^3.

Table-9.2: Muck Disposal Area and Capacities

Zone No.	Area (ha)
USP-1	2.20
USP-2	4.32
LSP-2	4.52
Kudna Quarry Area	9.80
Dulgubera Quarry Area	3.25
Total	**24.09**

9.2 IMPACTS DUE TO MUCK DISPOSAL

Muck, if not securely transported and dumped at pre-designated sites, can have serious environmental impacts, such as:

- Muck, if not disposed properly, can be washed away into the main river which can cause negative impacts on the aquatic ecosystem of the river.
- Muck disposal can lead to impacts on various aspects of environment. Normally, the land is cleared before muck disposal. During clearing operations, trees are cut, and undergrowth perishes as a result of muck disposal.
- In many of the sites, muck is stacked without adequate stabilisation measures. In such a scenario, the muck moves along with runoff and creates landslide like situations. Many a times, boulders/large stone pieces enter the river/water body, affecting the benthic fauna, fisheries and other components of aquatic biota.
- Normally muck disposal is done at low lying areas, which get filled up due to stacking of muck. This can sometimes affect the natural drainage pattern of the area leading to accumulation of water or partial flooding of some area which can provide ideal breeding habitat for mosquitoes.

9.3 RESTORATION OF MUCK DISPOSAL SITES

The unused muck (20 lakh m^3) would be piled at an angle of repose at the proposed dumping sites. For the stabilization of dumped materials various engineering and phyto-remedial measures are being proposed in the management plan.

Phyto-remediation of Muck Disposal Areas

The work plan formulated for re-vegetation of the muck disposal areas through "Integrated Biological and Biotechnological Approach" is based on following parameters:

1. Depending upon the quality of muck material formulation of appropriate blends of organic waste and soil to enhance the nutrient status of rhizosphere.
2. Isolation and screening of specialized strains of rnycorrhizal fungi, rhizobium, azotobacter and phosphate solubilizers (bio-fertilizers inoculum) suitable for the dumped material.
3. Mass culture of plant specific bio fertilizer and mycorrhizal fungi to be procured from different institutions/organizations which are engaged in the phyto-remediation activity of degraded areas.
4. Plantation of dumping sites/areas using identified blend and bio fertilizer inoculum.

The afforestation with suitable plant species of high ecological and economic value, which can adapt to local habitat, will be undertaken.

Proper dumping shall be done over the designated dumping sites. The waste material dumped at spoil tips would comprise mainly of loose rock fragments that would be mechanically compacted and properly levelled with suitable safe slopes and retaining walls/crate walls shall be constructed so that in no case the dumped material is washed away into the river. Construction material like stones, sand, etc. required for the construction of road should be obtained mostly from the excavated material to minimize the environmental damage. The efforts shall be made to utilize maximum dumped material for the project activities and backfilling. In the streams, box culverts will be provided to prevent the erosion of stream bed.

Re-vegetation of Spoil Tips

After proper dumping of the muck all three dumping sites shall be rejuvenated using bio-technological approach. The area shall be restored through plantation and turfing on the slope.

Soil Working and Plantation Techniques

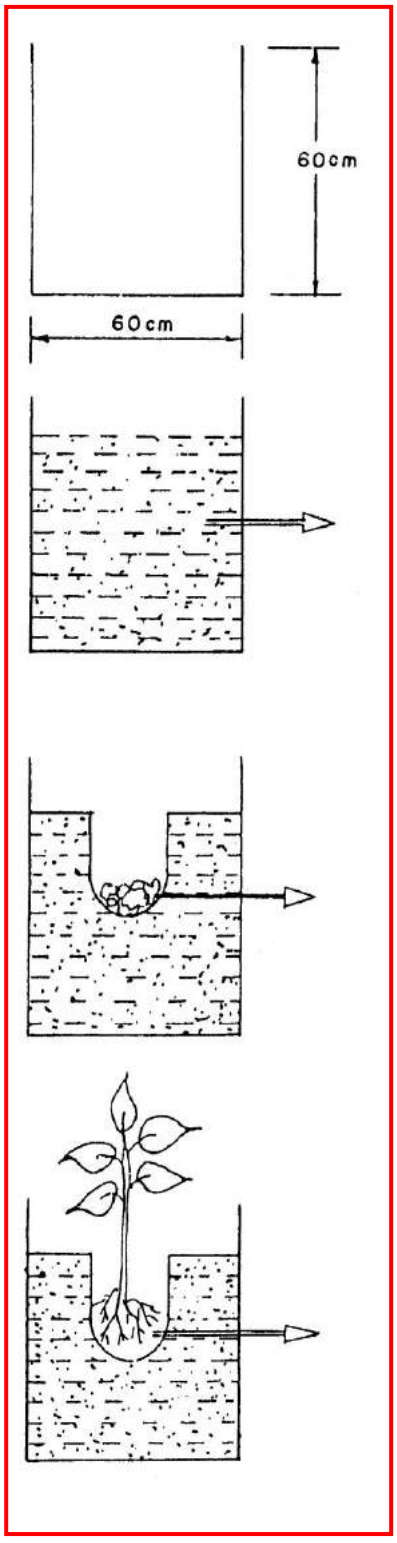
Isolation and screening of specialised strains of mycorrhizal fungi, rhizobia, azotobacters and phosphate solubilizers (biofertilizer inoculum) in accordance with the suitability for the spoil tips will be done at site, based on following:

- Inoculation of plants with specific biofertilizers and mycorrhizal strains.
- Periodical evaluation of rhizosphere development for physical, chemical and microbiological parameters.
- Monitoring of growth response in different plant species periodically and identification of corrective measures, if necessary. Mass culture of plant specific biofertilizers and mycorrhizal fungi.

The pitting details are as follows:

- Total No. of pits : 1800 per hectare
- Size of each pit : 0.6 m x 0.6m
- Spacing between pits : 2.5m x 2.0m

The excavated material from the pits will be mixed with 43.2 litre of external soil, 10 kg of apple peel and 5 kg of farmyard manure, and 2 kg of vermi-compost. The pit will be refilled with the mixture, 10-15 gm of mycorrhizal inoculum near the root system is to be added. After this, plant saplings already inoculated with biofertilizers (Rhizobium and Azotobacter bacteria) would be planted and refilling will be done to cover the entire plant root system. The schematic technique of plantation is shown in Figure-9.1 Turfing (sodding) and suitable shrubs will be grown at slopes. About 5 cm of thick layer external soil will be spread on the slope area. Sod patches (40 cm x 20 cm) will be grown per square meter. Before sowing, the area will be properly amended with the manure @ of 2 kg/m^2.



1. **Excavate in spoil dump pit of size 60 cm x 60 cm x 60 cm**

2. **Mix 43.2 litres of soil, 10 kg of apple peel compost, 5 kg of farm yard manure and 2 kg of vermi-compost with excavated spoil (Soil : Spoil = 1:4)**

3. **Refill the pit with Mixture**
4. **10 -15 g of Mycorrhizae inoculum near the root system**

5. **Plantation of sapling inoculated with biofertilizers (*Rhizobium* + *Azotobactor*) and refilling**

Figure-9.1: Schematic representation of plantation using VAM technique

Irrigation Facility

Generally, afforestation programme in the vicinity is not supplemented with any irrigation modalities and depends on rains. However, in order to ascertain quick greenery and growth in the spoil tip areas, irrigation, especially during the drought period is to be provided. For this, water-harvesting tanks will be constructed to supplement the drip irrigation facility in the downstream for the horticultural crops. Research trenches will also act as water harvesting structures to facilitate irrigation for the cash crops.

Fencing

All the sites will be properly fenced to protect the area from human and animal interference. About 4400 m of fence would be required at all the sites.

9.4 COST ESTIMATE FOR MUCK DISPOSAL PLAN

An amount of Rs. 120.0 lakh has been earmarked for stabilization of muck disposal sites. The details are given in Table-9.3.

Table-9.3: Summary of cost required for muck disposal

S. No.	Cost	Amount (Rs. lakh)
1.	Plantation on spoil tips (plain area) including bio-fertilizer cost	15.0
2.	Turfing on slopes	15.0
3.	Fencing cost	15.0
4.	Retaining Wall	75.0
	Total Cost	**120.0**

CHAPTER-10

RESTORATION, STABILIZATION AND LANDSCAPING OF QUARRY SITES

10.1 INTRODUCTION

The landscape and restoration plan targets towards overall improvement in the condition of the area. The landscape plan provides benefits to improve beautification and its utility. All the activities are aimed at restoring the areas where scars would be formed. The restoration would prevent soil erosion enhance forest cover and stabilize degraded areas.

10.2 QUARRYING OPERATIONS

The estimated requirements of construction material for the project are listed in Table-10.1. The quantum of construction material available in various quarries is given in Table-10.2.

Table-10.1: Quantities of Construction Material Required

S. No.	Structure	Core Material (Lac m^3)	Filter Material (Lac m^3)	Rockfill Material (Lac m^3)	Fine Aggregate (Lac m^3)	Coarse Aggregate (Lac m^3)
1	Upper Dam	5.50	2.23	28.80	0.21	0.42
2	Lower Dam	-	-	-	3.78	7.55
3	Lower Saddle Dam	2.90	1.40	14.97	-	-
4	Power House and T.H.	-	-	-	0.25	0.50
5	Waterway	-	-	-	0.36	0.72
	Total	**8.4**	**3.63**	**43.77**	**4.60**	**9.19**

Table-10.2: Quantities of Construction Material Available

S. No.	Description	Name of Quarry	Quantity (lakh m^3)
1	Clay	• Jilingtadh • Hathinada • Purana tarpania	1.37 5.85 2.27
		• Kudna • Turga Lower Reservoir • Gosaidih • Drift Area and Bagmundi	1.49 0.18 0.73 1.03
2	Rockfill & Filter	• Kudna • Dulgubera	220 10
3	Coarse Aggregate & Fine Aggregate	• Turga • Dulgubera • Malti • Kudna • Hadhadi nala	22 10 50 220 75

The quarrying operations are semi-mechanized in nature. In a hilly terrain, 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.

River Bed Material for Aggregates

The extraction of construction material can affect the water quality of Hadhadi nala due to increase in the turbidity levels. This is mainly because the dredged material gets released during one or all the operations mentioned below:

- Excavation of material from the river bed.
- Loss of material during transport to the surface.
- Overflow from the dredger while loading
- Loss of material from the dredger during transportation.

The cumulative impact of all the above operations will increase in turbidity levels. Good dredging practices can however, minimize turbidity. It has also been observed that slope collapse is the major factor responsible for increase in the turbidity levels. If the depth of cut is too high, there is possibility of slope collapse, which releases a sediment cloud. This will further move outside the suction radius of dredged head. In order to avoid this typical situation, the depth of cut be restricted to:

$$\gamma H/C < 5.5$$

where,

γ	-	unit weight of the soil
H	-	depth of soil
C	-	Cohesive strength of soil

10.3 RESTORATION PLAN FOR QUARRY SITE AND BORROW AREA

The measures adopted for landscaping of these quarry sites have been described below:

i) Measures to be adopted before quarrying

The top soil, wherever, available in the quarry will be removed before starting the quarrying activity or any other surface disturbance. This top soil will be kept separate and stock piled so that it can be reused after quarrying is over for rehabilitation of sites.

ii) Measures to be adopted after quarrying

Diversion of run off

Effective drainage system will be provided to avoid the infiltration of run-off and surface waters into the ground of quarry sites. Garland drains around quarry site shall be constructed to capture the runoff and divert the same to the nearest natural drain.

Filling of depressions

Removal of rocks from quarry sites for different construction works will result in the formation of depression and/or craters. These will be filled by the dumping materials consisting of boulders, rock, gravel and soil from nearby plant/working sites.

Construction of retaining walls

Retaining walls will be constructed at the filled up depressions of quarry sites to provide necessary support particularly where there are moderately steep slopes. In addition concrete guards, shall be constructed to check the soil erosion of the area.

Rocks for landscaping

After the quarrying activities are over, these sites will be splattered with the leftovers of rocks and boulders. These boulders and rocks can support the growth of mosses and lichens, which will act as ecological pioneers and initiate the process of succession and colonization. The boulders of moderate size will be used to line the boundary of a path.

Laying of the top soil

The depressions/craters filled up with rock aggregates will be covered with top soil. Fungal spores naturally present in top soil will aid plant growth and natural plant succession. The 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.

Re-vegetation

The work plan formulated for re-vegetation of the dumping sites through 'Integrated Biological and Bio-technological Approach' would be based upon the following parameters:

i) Evaluation of rock material for their physical and chemical properties to assess the nutrient status to support vegetation.

ii) Formulation of appropriate blends of organic waste and soil to enhance the nutrient status of rhizosphere.

iii) Isolation and screening of specialized strains of mycorrhizal fungi, rhizobium, azotobacter and phosphate solubilizers (bio-fertilizers inoculums) suitable for the mined out sites.

iv) Mass culture of plant specific biofertilizer and mycorrhizal fungi to be procured from different institutions/organisations which are engaged in the phyto-remediation activity of degraded areas.

v) Plantation at quarry sites/areas using identified blend and biofertilizer inoculum.

10.4 BUDGET

A provision of Rs. 60.0 lakh has been earmarked for quarry slope stabilization. The details are given in **Table-10.1.**

Table-10.1: Cost estimate for restoration of quarry site and borrow area

S. No.	Activities/purpose	Cost (Rs. lakh)
1.	Filling up the land with soil	5.0
2.	Cost of green manure	5.0
3.	Cost of saplings	7.0
4.	Cost of fertilizers and pesticides	5.0
5.	Fencing with RCC pillars and barbed wire	20.0
6.	Maintenance activities including cleaning of weeds @ Rs.1.2 lakh for 5 years	6.0
7.	Digging of pits	2.0
8.	Construction of garland drains	10.0
	Total	**60.0**

CHAPTER-11

LANDSCAPING AND RESTORATION OF CONSTRUCTION AREAS

11.1 RESTORATION OF CONSTRUCTION SITES

Due to various construction activities, natural environment of the project area will be affected. Engineering and biological measures are suggested for the stabilization and beautification of the disturbed area. Following measures should be adopted for the restoration and landscaping of the construction sites.

- During the construction phase, proper roads and lanes would be provided in the working area. Open area in working area would be planted with various plant species. Ornamental plants and avenue plantation should be done along the roads and lanes and in open places in the dam area.
- Patch plantation may be done at all vacant sites in and around, adits, working areas etc. with plantation in 2-3 or even more rows wherever possible.
- Parks and play grounds with all play implements will be developed in the colony areas during the construction phase and at vacant spaces after completion of the work.
- Green areas would be developed in front of offices, hospital, officers club, field hostels, guest houses etc. during the construction phase.

11.2 POST PROJECT CONSTRUCTION LANDSCAPING

After the completion of all the construction activity, the construction sites and other temporary settlements would be removed and area would be covered with the top soil to support the growth of plant species. These plant species which grow first are considered ecological pioneers and would initiate the process of succession and colonization. Areas close to colony and suitable areas will be landscaped to develop children parks, gardens, etc. The maintenance of the area will be done by the project in O&M stage for the life of the project. Rest of the area will be vegetated and restored.

11.3 COST ESTIMATE FOR RESTORATION OF COSNTRUCTION AREAS

An amount of Rs. 20.0 lakh has been earmarked for landscaping and restoration of construction sites. The details are given in **Table-11.1**.

Table-11.1: Cost Estimate for Restoration of Construction Areas and Landscaping

S. No.	Item of Work	Amount (Rs. lakh)
1	Planting of trees and shrubs	10.0
2	Planting of flowering plants and other herbs	5.00
3	Development of parks	5.00
	Total	**20.0**

CHAPTER-12

ENVIRONMENTAL MANAGEMENT IN ROAD COSNTRUCTION

12.1 INTRODUCTION

The approach roads will have to be constructed as a part of the access to the construction site. The construction of roads disturbs the scenic beauty of the area. In addition, hilly terrain, landslides are often triggered due to road construction because of the loosening of rocks by water trickling from various streams.

12.2 ENVIRONMENTAL MANAGEMENT IN ROAD COSNTRUCTION

The various aspects to be considered while making the project road are briefly described in the following paragraphs:

12.2.1 Design

- Where the road is in cutting, half cut and half fill type selection which involves least disturbance to the natural ground should be adopted subject to considerations of economy and road stability being satisfied.
- The cut slopes should be made stable for the type of strata in the initial construction stage itself by adoption of appropriate slopes with benches, etc. including the use of stabilizing structures like breast walls, pitching, etc.

12.2.2 Construction

- Area for clearing and grubbing should be kept to the minimum subject to the technical requirements of the road. The clearing area should be properly demarcated to save trees and shrubs and to keep tree cutting to the minimum.
- Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control of features can follow immediately thereafter, if the project conditions permit; otherwise temporary erosion control measures shall be provided between successive construction stages. Under no circumstances, however, should very large surface area of erodible earth material be exposed at any one time by clearing and grubbing.
- The method of balanced cut and fill formation should be adopted to avoid large difference in cut and fill quantities.
- The cut slopes should be suitably protected by breast walls, provision of flat stable slopes, construction of catch water and intercepting drains, treatment of slopes and unstable areas above and underneath the road, etc.

- Where rock blasting is involved, controlled blasting techniques should be adopted to avoid over-shattering of hill faces.
- Excavated material should not be thrown haphazardly but dumped duly dressed up in a suitable form at appropriate places where it cannot get easily washed away by rain, and such spoil deposits may be duly turfed or provided with some vegetative cover.

12.2.3 Drainage

- Drainage of the water from hill slopes and road surface is very important. All artificial drain must be linked with the existing natural drainage system for which separate detailed engineering survey may be carried out and planning done.
- The surface drains should have gentle slopes. Where falls in levels are to be negotiated, check dams with silting basins should be constructed and that soil is not eroded and carried away by high velocity flows.
- Location and alignment of culverts should also be so chosen as to avoid severe erosion at outlets and siltation at inlets

12.2.4 Grassing and Planting

- Deforestation and road construction should be bare minimum and strict control must be exercised in consultation with the forest department. Equivalent amount of new trees must be planted as integral part of the project within the available land and if necessary, separate additional land may be acquired for this purpose.
- Depending on the availability of land and other resources, afforestation of roadside land should be carried out to a sufficient distance on either side of the road.

12.2.5 Control of Landslides along the Roads

Steeply sloping banks are liable to landslides, which can be controlled by drainage. The basic principle is to intercept and divert as much water as possible, before it arrives at a point, where it becomes a nuisance. The erosion hazard that of surface erosion of the bank is best controlled by vegetation, but the difficulty lies in growing vegetation on steeply sloping banks. Engineering solutions such as surface drainage, sub-surface drainage, toe protection and rock bolting can be used. Landslides can be stabilized by several methods – engineering or bio-technical measures alone or a combination of these.

12.3 COST ESTIMATES

An amount of Rs. 40.0 lakh has been earmarked for implementation of measures to mitigate adverse impacts due to construction of roads. The details are given in **Table- 12.1.**

Table-12.1: Details of expenditure for implementation of measures for management of Impacts due to construction of roads

S. No.	Item	Cost (Rs. lakh)
1.	Construction of retaining walls	10.0
2.	Stream bank stabilization	10.0
3.	Provision of drainage system along roads	5.0
4	Carpeting the slopes with coir, jute or local fibres	5.0
5	Mulching	5.0
6.	Roadside plantation, Jute matting etc.	5.0
	Total	**40.0**

CHAPTER13

ENERGY CONSERVATION MEASURES

13.1 INTRODUCTION

It is estimated that during the construction of the project, which would last for about 63 months, around 4000 labourers (including their family members) will be working. Majority of the labour force will be outsiders and it will be very important to meet their energy requirement in an ecologically sustainable manner.

For meeting the energy requirement of the workers, contractor/s will be made responsible to provide subsidized kerosene/LPG to their workers which will in turn discourage them from illegal tree felling and removal of fuel wood and timber from the adjoining forests. Further, community kitchen facilities would also be provided to the labourers by the contractors. In addition to above, efforts would be made towards energy conservation by installing non-conventional energy sources as discussed in the subsequent paragraphs.

13.2 ENERGY CONSERVATION DURING CONSTRUCTION PHASE

13.2.1Provision of Free Fuel

As a part of EMP, following measures are proposed:

- Make a clause mandatory in the contract of every contractor involved in project construction to provide supply of fuel to their labourers, so that trees are not cut for meeting their fuel demands.
- Establish LPG godown within the project area for providing LPG cylinder to run community kitchens.
- Establish kerosene oil depot near project area with the help of state government to ensure proper supply of kerosene oil.

The project proponents in association with the state government should make necessary arrangements for distribution of kerosene oil and LPG.

The total cost required for provisions of fuel has been estimated as Rs. 312.37 lakh. The details are given in Tables 13.1.

Table-13.1: Cost estimate for LPG distribution

Year	No. of Employees	Annual requirement @1cylinder per 10 persons/ per month (No. of cylinders)	Total Cost @Rs. 1,000/cylinder (Rs. lakh) including 10% escalation every year
I	1000	4800	48.0
II	1000	4800	52.8
III	1000	4800	58.08
IV	1000	4800	63.89

Year	No. of Employees	Annual requirement @1cylinder per 10 persons/ per month (No. of cylinders)	Total Cost @Rs. 1,000/cylinder (Rs. lakh) including 10% escalation every year
V	1000	4800	70.28
VI 3 months	1000	1200	19.32
	Total		**312.37**

13.2.2 Other Energy Conservation measures during construction phase

The following energy conservation measures would be undertaken during construction works:

- Efficient work scheduling and methods that minimize equipment idle time and double handling of material
- Throttling down and switching off construction equipment when not in use
- Switching off truck engines while they are waiting to access the site and while they are waiting to be loaded and unloaded
- Switching off site office equipment and lights and using optimum lighting intensity for security and safety purposes
- Careful design of temporary roads to reduce transportation distance
- Designing roads on site to reduce transportation distances.
- Regular maintenance of equipment to ensure optimum operations and fuel efficiency
- The specification of energy efficient construction equipment.

13.3 ENERGY CONSERVATION DURING OPERATION PHASE

The following energy conservation measures would be implemented during operation phase:

- Use of CFL lights up to maximum possible extent.
- Awareness about the use of CFL lights by locals.
- Employing renewable energy sources such as day lighting and passive solar heating.

CHAPTER –14

FIRE PROTECTION IN LABOUR CAMP AND STAFF COLONIES

14.1 INTRODUCTION

It has been envisaged that the fire protection planning in labour camps and staff colonies shall be taken up. The details are given in following sections of this chapter.

14.2 CONSTRUCTION OF CAMPS ETC. AND PLACEMENT OF FIRE PROTECTION EQUIPMENT

It has been planned that all facilities to be constructed shall be fully equipped with the fire protection equipments as per IS standards. The analysis of fire hazard in the construction of these camps, colonies and other facilities is given in Table-14.1.

Table-14.1: Analysis of fire hazard in the construction of camps, colonies and other facilities

S. No	Stage	Potential hazard	Remedial Measures
1.	Construction of labourcamps and staff colonies	• Fire prevention and firefighting not considered in design • Inadequate fire protection measures during construction phase	**BY PROJECT PROPONENT** • While construction of Field hostels, Guest House/office and other facilities owned by project proponent shall provide the fire protection system as per IS Standards for Fire code. • Proper housekeeping will also be ensured and maintained during these facilities to protect them from any fire related incidents. • It will be ensured that the fire fightingequipments are placed at common place also including work place preferably within 15 meters of work place. **BY CONTRACTORS** • Clear term of reference will be given to contractor at tendering stage for incorporating fire code as per IS Standard. • Fire fightingequipments will be placed at all common places (within 15 meters of work place)

14.3 IMPLEMENTATION OF FIRE PROTECTION SYSTEM

During construction, it has been envisaged to set up full fledged Environment Health & Safety (EHS) department reporting directly to Head of Project. This department shall also take care of the adequacy of Fire Safety measures set up in all facilities created either owned byproject

proponent or any of its Contractors. The analysis of responsibility for this EHS team in respect of Fire protection system is given in Table-14.2

Table-14.2: Responsibility for this EHS team in respect of Fire protection system

S.No.	Stage	Potential hazard	Remedial Measures
1.	During Occupation	• Fire incident due to electrical short circuit/LPG Leakage/ Improper handling of flammable liquids/lack of precaution • Improper access to and from the location • In adequate fire fighting arrangements • Lack of knowledge • Lack communication • Lack of Knowledge on fighting fire and handling fire equipment • Inadequate emergency response	• Residential complex will be constructed as per the approved design and will be checked for completeness on fire aspect before allotment to residents • Each Block Colony/ camp will be provided with rated estimated trip off circuit breaker will be installed on each block. • All residents are made aware of fire hazard by training, regular campaigns and by placing posters and signs • LPG Cylinders/Flammable liquids will stored at designated storage area. The storage will be well protected, ventilated with adequate provision of fire equipment. • Each block of the colony will be provided with 10 kg DCP fire extinguishers. • Additionally fire point containing fire buckets, CO_2 extinguishers, DCP Extinguisher will be provided at the common place covering four residential blocks in labourcamp. • Placement of written posters of preventive measures in each accommodation block • Regular EHS inspection of the camp site • Placement of placard of emergency numbers to be contacted in case of Emergency • Dedicated phone line will be provided in labour camps for effective communication. • Ensure proper access is

S.No.	Stage	Potential hazard	Remedial Measures
			maintained around and to the residential blocks • Identification of emergency Muster points at safe distance

14.4 RESPONSIBILITY

Project In charge is responsible for implementation of plan through his authorized representative on site. Site EHS Team shall monitor the implementation of plan and report non compliance to site management.

14.5 TRAINING AND AWARENESS

Training of employees on fire prevention and fire fighting is important to prevent occurrence of fire incident in project area. All employees will be given brief overview of fire prevention, fire fighting procedure and response process at the time EHS Induction training. Project proponent will also carry out regular campaigns on fire prevention around the site.EHS Department is responsible for providing required training.

14.6 BUDGET

Implementation of this plan will be mandatory for all contractors. Requirements of this plan will be part of contract agreement. The tentative cost of the fire protection in labour camps and staff colonies is estimated about Rs. 40.0lakh. The details are given in Table-14.3.

Table-14.3: Details of cost for fire protection in labour camps and staff colonies

S. No.	Provision	Estimated cost (Rs. lakhs)
1	Provision of fire extinguishers in labour camps and staff colony	
a)	Fire extinguisher DCP 5 kg/ 10 kg/ 30 kg	10.0
b)	Fire Extinguisher CO_2 10 kg	5.0
c)	Fire extinguisher Foam Type 30 kg	5.0
2	Refilling and maintenance	10.0
3	Inspection Charges	5.0
4	Training, Campaign and poster installation	5.0
	Total	**40.0**

The firefighting system in the project area will be suitably built in the contract document which would be executed by specialized vendors. Hence, the same has not been included in the project cost.

CHAPTER-15

DISASTER MANAGEMENT PLAN

15.1 INTRODUCTION

Any Dam project if not designed on the sound principles of design after detail investigations in respect of hydrology, geology, seismicity etc., could spell a large scale calamity. Thus these are inherent risk to the project like improper investigation, planning, designing and construction which ultimately lead to human catastrophy. Though through detailed field investigations it has been ensured that the dam is founded on firm foundation, designed for suitable seismic design parameters, yet in view of that uncertain element of "Force Mejure" the eventuality of a disaster cannot be ignored but a rescue plan has to be devised for confronting such an exigency without being caught in the vast realm of unpreparedness.

A disaster is an unwarranted, untoward and emergent situation that culminates into heavy toll of life and property and is a calamity sometimes caused by "force mejure" and also by human error. The identification of all types of disaster in any proposed project scenario involves the critical review of the project vis-à-vis the study of historical past incidents/disasters in the similar situations. The evolution of disaster management plan dwells on various aspects such as provision of evacuation paths, setting up of alarms and warning systems, establishing communicating system besides delineating an Emergency Response Organization with an Effective Response System. Keeping in view the grievous affects a disaster can cause on human or animal population, loss of property and environment in and around the areas of impact. Therefore it is essential to assess the possibility of such failures in context to the present project and formulate a contingent plan.

15.2 DAM BREAK INUNDATION ANALYSIS

The outflow flood hydrograph from a dam failure is dependent upon many factors such as physical characteristics of the dam, volume of reservoir and the mode of failure. The parameters which control the magnitude of the peak discharge and the shape of outflow hydrograph include: the breach dimensions, the manner and length of time for the breach to develop, the depth and volume of water stored in the reservoir, and the inflow to the reservoir at the time of failure. The shape and size of the breach and the elapsed time of development of the breach are in turn dependent upon the geometry of the dam, construction materials and the casual agent for failure.

For reasons of simplicity, generally, wide applicability and the uncertainty in the actual mechanism, the **BOSSDAMBRK** model has been used. The model uses failure time interval,

terminal size and shape of the breach as the inputs. The possible shapes of the breach that can be accomplished by the model are rectangular, triangular and trapezoidal. The model is capable of adopting either storage routing or dynamic routing methods for routing floods through reservoirs depending on the nature of flood wave movement in reservoirs at the time failure.

The dynamic routing method based on the complete equations of unsteady flow is the appropriate technique to route the flood hydrograph through the downstream valley. The method is derived from the original equations developed by St. Venant. The model uses St. Venant's equations for routing dam break floods in channels.

15.3 METHODOLOGY

The National Weather Service's DAMBRK model developed by Dr. L. Fread has been used in the study. This model simulates the failure of dam, computes the resultant outflow hydrograph and also simulates movement of the dam break flood wave through the downstream river valley. The model is built around three major capabilities, which are reservoir routing, breach simulation and river routing. However, it does no rainfall-runoff analysis and storm inflow hydrographs to the upstream of reservoir must be developed external to the model. A brief description of the capabilities of the model is described in the following paragraphs

15.3.1 Reservoir Routing

The storage routing is based on the law of conservation given as:

$$I - Q = dS/dt \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

In which, I is reservoir inflow. Q is the total reservoir outflow which includes the flow spillway, breach, overtopping flow and head independent discharge, and rate of change of reservoir storage volume. Equation (1) can be expressed in finite difference form as :

$$(1 + I') 2 - (Q + Q') /2 = \Delta S/\Delta t \text{ -.-----(2)}$$

In which the prime (') superscript denotes the values at the time t - Δt and the notation approximates the differential. The term ΔS may be expressed as:

$$\Delta S = (As + A's) (h-h')/2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

In which, As is the reservoir surface area coincidental with the elevation (h) and is a function of h. The discharge Q which is to be evaluated from equation (2) is a function of h and this

known h is evaluated using Newton–Raphson iteration technique and thus the estimation of discharge corresponding to h.

15.3.2 Dynamic Routing

The hydrologic storage routing technique, expressed by equation (2) implies that the water surface elevation within the reservoir is horizontal. This assumption is quite adequate for gradually occurring breaches with no substantial reservoir inflow hydrographs. However, when the breach is specified to form almost instantaneously so as to produce a negative wave within the reservoir, and/or the reservoir inflow hydrograph is significant enough to produce a positive wave progressing through the reservoir, a routing option which simulates the negative and /or positive wave occurring within the reservoir may be used in DAMBRK model. Such a technique is referred to as dynamic routing. The routing principle is same as dynamic routing in river reaches and it is performed using St. Venant's equation. The movement of the dam break flood wave through the downstream river channel is simulated using the complete unsteady flow equations for one dimensional open channel flow, alternatively known as St. Venant's equations. These equations consist of the continuity equation

$$\frac{\partial Q}{\partial t} + \frac{\partial (A + A0)}{\partial t} = q \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

and the conservation of momentum equation :

$$\frac{\partial Q}{\partial t} + \frac{\partial (A2/ + A)}{\partial t} + g\,A\left(\frac{\partial h}{\partial t} + Sf + S\,e\right) + Lc = 0 \quad \ldots\ldots (5)$$

where,

A = active cross – sectional flow area

A0 = inactive (off-channel storage) cross – sectional area

X = distance the channel

q = lateral inflow or outflow per unit distance along the channel

g = acceleration due to gravity

Q = discharge

H = water surface elevation

Ss = friction slope

Se = expansion – contraction loss slope

Lc = lateral inflow/outflow momentum effect due to assumed flow path of inflow being perpendicular to the main flow.

The friction slope and expansion – contraction loss slope are evaluated by the following equation

$$Sf = \frac{n^3 Q^2}{2.21 A^2 R^{¾}} \quad \text{.....(6)}$$

and,

$$Se = \frac{K\Delta(Q/A)^2}{2g \Delta X} \quad \text{.....(7)}$$

where,

n = Manning's roughness coefficient

R = A/B where B is the top width of the active portion of the channel

K = Expansion – contraction coefficient varying from 0.1 to 0.3 for contraction and 0.5 to – 1.0 expansion

$\Delta(Q/A)^2$ = Difference in $(Q/A)^2$ for cross sections at their end of a reach

The non-linear partial differential equations (4) and (5) are represented by a corresponding set of non-linear finite difference algebraic equations and they are solved by the Newton-Raphson method using weighted four point implicit scheme to evaluate Q and h. The initial conditions are given by known steady discharge at the dam, for which steady state non-uniform boundary flow equation are used. The outflow hydrograph from the reservoir is the upstream boundary condition for the channel routing and the model is capable of dealing with fully supercritical flow or fully supercritical flow in the reach or the upstream reach having supercritical flow and downstream reach having subs critical flow. There is a choice of downstream boundary conditions such as internally calculated loop rating curve, user provided single valued rating curve, user provided time dependent water surface elevation, critical depth and dam which ma pass flow via spillways, overtopping and/or breaching.

15.3.3 Statement of the problem

The computation of flood wave resulting from a dam breach basically involves two scenarios which can be considered jointly or separately: (1) the outflow hydrograph from the pond (2) the routing of the flood wave downstream from the breached dam along the river valley and the flood plain. If breach outflow is independent of downstream conditions, or if their effect can be neglected, the reservoir outflow hydrograph is referred to as the free outflow hydrograph. In this case, the computation of the flood characteristics is divided into two distinct phases: (a) the determination of outflow hydrograph with or without the routing of the negative wave the reservoir, and (b) the routing of flood wave downstream from the

breached dam. In this study the problem of simulating the failure of "Dam" and computing the free outflow hydrograph from the breached section using storage routing technique' with the aim of reproducing the maximum water level marks reached during the passage of flood wave is considered. The information regarding inflow hydrograph into the pond due to the storm at the time of failure, the structural and the hydraulic characteristics details of the dam, the time of failure, the channel cross sections details, the maximum water level marks reached in the reservoir at the time of failure and those observed in the downstream reach of the dam to the passage of flood wave etc. are available for the study.

15.3.4 Availability of Data

The input data required for the National Weather Service's BOSS DAMBRK model can be categorized into two groups. The first data group pertains to the dam and inflow hydrograph into the reservoir and the second group pertains to the routing of the outflow hydrograph through the downstream valley. These are described in the following paragraphs.

- **First Data Group**

  With reference to the data group pertaining to the dam, the information on reservoir elevation-volume relationship, spillway details, elevation of bottom and top of dam, elevation of water surface in the pond at the beginning of analysis and at the time of failure, breach description data are required and available for the study.

- **Second Data Group**

  The second group of data pertaining to the routing of the outflow hydrograph through the downstream valley consists of a description of cross-sections, hydraulic resistance coefficients of the reach, steady state flow in the river at the beginning of the simulation and downstream boundary condition. The cross section is specified by location mileage, and tables of top width and corresponding elevation. In this study, four cross sections details, at km. 0.0, 2.0, 3.5 and 4.2 km downstream of dam, have been used.

15.4 RESULT AND CONCLUSIONS

A rectangular breach at an El 495 masl with side slope 1:0 and breach formation time as 0.5 hr. have been considered in the study for dam break analysis of rock fill Turga upper dam and flow from upper dam will further break lower dam. After the breach, immediately below the dam, the maximum flow will occur immediately after the start of breach. The magnitude of the simulated outflow hydrograph will be 9368 cumec corresponding to maximum stage elevation 491.20 masl at Km. 0.00 is attenuated to 9314 cumecs corresponding to maximum stage elevation of 424.10 masl at km. 2.00. The further break of lower dam will increase the

flow to 18642 at a distance of 3.5Km. The maximum flow and time at various distances d/s of the dam is shown in following **Table-15.1**.

Table-15.1: Summary of wave profile in the event of Dam Break

Distance from Dam (km)	Max Elevation, (masl)	Maximum Flow (cumec)	Time to Maximum Stage, hr.
0.000	491.20	9368	0.000
2.000	424.10	9314	0.540
3.500	398.1	18642	0.600
4.200	288.10	18523	0.680

- Failure of rock fill dam like the proposed Turga Pumped Storage Project, which is designed to the present technical standards and built with adequate quality control, is a very remote possibility.
- The monoliths having the least resistance to withstand the unforeseen loading combinations may give way, which in turn provides a relief and prevents failure of other monoliths. Under such as situation, the discharge and the water depth will be much lesser than those determined from the study.

15.5 DISASTER MANAGEMENT PLAN

The emergency planning for dam break scenario is devised on the basis of results of dam break analysis mainly the travel time of flood wave to various locations in the downstream stretch of the river. It is inferred from the analysis that in case of main dam failure the flood peak discharge as it prorogates through valley shall inundate downstream stretch of 2.0 km within 0.54 Hrs and the flood wave peak will reach 4.2 km in 0.68 Hrs, implying that a little reaction time for executing any rescue plan. The plan is, therefore, based on such measures, which are purely preventive in nature.

15.5.1 Dam Safety and Maintenance Manual

Based on standard recommended guidelines for the safety inspection of dams a manual should be prepared by the project proponents in respect of dam safety surveillance and monitoring aspects. This should be updated with the availability of instrumentation data and observation data with periodical review. The need for greater vigil has to be emphasized during first reservoir impoundment and first few years of operation. The manual should also cover on the routine maintenance schedule of all hydro-mechanical and electrical instruments. It should be cover quantum of specific construction material needed for emergency repair along with

delineation of the suitable locations for its stocking and also identify the much needed machinery and equipment for executing emergency repair work and for accomplishing the evacuation plan.

15.5.2 Emergency Action Plan (EAP)

Dam safety programme as indicated above includes the formation of an Emergency Action Plan for the dam. An emergency is defined as a condition of serious nature which develops unexpectedly and endangers downstream property and human life and required immediate attention. Emergency Action Plan shall include all potential indicators of likely failure of the dam, since the primary concern is for timely and reliable identification and evaluation of the emergency situation, which may lead to dam failure.

This EAP shall cover presents warning and notification procedures to follow during the monsoon season in case of failure or potential failure of the dam. The objective is to provide timely warning to nearby residents and alert key personnel responsible for taking action in case of emergency.

15.5.3Administration and Procedural Aspects

The administrative and procedural aspects of the Emergency Action Plan consist of flow chart depicting the names and addresses of the responsible personnel of project proponent and the Dist. Administration. In order of hierarchy, the following system will usually be appropriate. In the event that the failure is imminent or the failure has occurred or a potential emergency conditions is developing, the observer at the site is required to report itto the Junior Engineer who will report to the Superintending Engineer/ DivisionalEngineer for their reporting to the Chief Engineer through fastest available fastest communication system. The Engineer-in-Charge will keep the district administration informed regarding the developing situation. Each personnel are to acknowledge his/her responsibilities under the EAP in an appropriate format at a priority.

The technical aspects of the EAP consist of preventive action to be taken with regards to the structural safety of the dam. The EAP is drawn at a priority for the regular inspection of the dam. For this purpose, providing an adequate and easy access to the dam site is a necessity. The dam, its sluices, overflows and non-overflow sections should be properly illuminated for effective operations during night time. Whenever sinkholes, boils, increased leakages, movement of masonry rock, gate failure, rapid rise or fall of the level in the reservoir, rise in the level of reservoir beyond the maximum working level, or wave overrun of the dam crest are observed, the personnel on patrol is required to inform immediately to the Assistant

Engineer (AE)/Sub-Assistant Engineer (SAE)for initiation of the execution of EAP. They are required to inform the Engineer-in-Charge and the local administrative authorities. It is desirable that the downstream inhabitants are warned using siren, if available, so as to make them aware the likely imminent danger.

The other preventive measures may include availability of sufficient number of sandbags at several selected downstream locations and logs (for holding sandbags) and at the dam site, one tractor, two motor boats, gas lanterns, Manila ropes and life jackets. Areas from where the labour can be mobilized should be chalked out at a priority. In addition to these, public participation in the process of execution of the EAP may further help in amelioration of the adverse impacts of the likely disaster. For this, it is necessary that the public should be made aware of its responsibilities.

15.5.4 Preventive Action

Once the likelihood of an emergency situation is suspected, action has to be initiated to prevent a failure. The point at which each situation reaches an emergency status shall be specified and at that stage the vigilance and surveillance shall be upgraded both in respect of time and level. At this stage a thorough inspection of the dam should be carried out to locate any visible sign(s) of distress.

Engineers responsible for preventive action should identify sources of equipment needed for repair, materials, labour and expertise for use during an emergency. The amount and type of material required for emergency repairs should be determined for dam, depending upon its characteristics, design, construction history and past behavior. It is desirable to stockpile suitable construction materials at appropriate sites. The anticipated need of equipment should be evaluated and if these are not available at the dam site, the exact location and availability of these equipments should be determined and specified. The sources/agencies must have necessary instructions for assistance during emergency. Due to the inherent uncertainties about their effectiveness, preventive actions should usually be carried out simultaneously with the appropriate notification on alert situation or a warning situation.

15.5.5 Communication System

An effective communication system and a downstream warning system are absolutely essential for the success of an emergency preparedness plan. The difference between a high flood and dam-break situation must be made clear to the downstream population.

15.5.6 Evacuations Plans

Emergency Action Plan includes evacuation plans and procedures for implementation based on local needs. These could be:

- Demarcation / prioritization of areas to be evacuated.
- Notification procedures and evacuation instructions.
- Safe routes, transport and traffic control.
- Safe areas/shelters.
- Functions and responsibilities of members of evacuation team.

Any precarious situation during floods will be communicated either by an alert situation or by an alert situation followed by a warning situation. An alert situation would indicate that although failure of flooding is not imminent, a more serious situation could occur unless conditions improve. A warning situation would indicate that flooding is imminent as a result of an impending failure of the dam. It would normally include an order for evacuation of delineated inundation areas.

15.5.7 Evacuation Team

It will comprise of following official / Representative:

- District Magistrate (D. M.)/ His Nominated officer (To peacefully relocate the people to places at higher elevation with state administration).
- Engineer in charge of the project (Team Leader)
- Superintendent of Police (S. P.) / Nominated Police Officer (To maintain law and order)
- Chief Medical Officer (C. M. O.), (To tackle morbidity of affected people)
- Head of affected village to execute the resettlement operation with the aid of state machinery and project proponents.
- Sub committees at village level

The Engineer-in-Charge will be responsible for the entire operation including prompt determination of the flood situation time to time. Once the red alert is declared the whole state machinery will come into swing and will start evacuating people in the inundation areas delineated in the inundation maps. For successful execution, annually demo exercise will be done. The D.M. is to monitor the entire operation.

15.5.8 Public Awareness for Disaster Mitigation

In addition, guidelines that have to be followed by the inhabitants of flood prone areas, in the event of flood resulting from dam failure, which form part of public awareness for disaster mitigation may also include following:

- Listen to the radio and cable network for advance information and advice.
- Disconnect all electrical appliances and move all valuable personal and household goods beyond the reach of floodwater, if one is warned or if one suspects that flood waters may enter the house.
- Move vehicles, farm animals and movables goods to the higher place nearby.
- Keep sources of water pollution i.e. insecticides out of the reach of water.
- Turn off electricity and LPG gas before one has to leave the house.
- Lock all outside doors and windows if one has to leave the house.
- Never wander around a flood area.

15.5.9 Notifications

Notification procedures are an integral part of any emergency action plan. Separate procedures should be established for slowly and rapidly developing situations and failure. Notifications would include communication of either an alert situation or an alert situation followed by a warning situation. An alert situation would indicate that although failure or flooding is not imminent, a more serious situation could occur unless conditions improve. A warning situation would indicate that flooding is imminent as a result of an impending failure of the dam. It would normally include an order for evacuation of delineated inundation areas.

15.5.10 Notification Procedures

Copies of the EAP that also include the above described inundation map are displayed at prominent locations, in the rooms and locations of the personnel named in the notification chart. For a regular watch on the flood level situation, it is necessary that the flood cells be manned by two or more people so that an alternative person is always available for notification round the clock. For speedy and unhindered communication, a wireless system is a preferable mode of communication. Telephones/cell phones may be kept for back up, wherever available. It is also preferred that the entire flood cells, if more than one, are tuned in the same wireless channel. It will ensure communication from the dam site to the control rooms. The communication can be established by messenger service in the absence of such modes of communication.

15.5.11 Management after receding of Flood Water

It is to be accepted that in the event of dam break, even with maximum efforts, the loss of human lives, livestock and property would be inevitable. Under such a scenario, a massive effort would be used by various government agencies to provide various relief measures to the evacuees. Formulation of a plan delineating such measures is beyond the scope of work of

this document. However, some of the measures which need to be implemented are listed as below:

- Provision of various food items and shelter to the evacuees.
- Provision of fuel for various evacuees.
- Provision of adequate fodder supply.
- Arrangements for potable water supply.
- Commissioning of low cost sewage treatment and sanitation facilities, and disposal of treatment sewage.
- Expeditious disposal of dead bodies human and livestock.
- Immunization programmes for prevention of outbreak of epidemics of various water related diseases.
- Adequate stocks of medicines of various diseases, especially water-related diseases.

15.6 COST ESTIMATE

The budget for different activities required to be carried out for mitigation and prevention of dam break hazard exclusively from the upper and lower dam is Rs40.0 lakh as per details given in **Table-15.2**.

Table-15.2: Budget earmarked for implementation of Disaster Management Plan

S. No.	Particular	Cost (Rs. lakh)
1.	Installation of alert system and communication between Upper and Lower Dams	20.0
2.	Setting up of communication system between dam and d/s settlements	10.0
3.	Public information system	10.0
	Total	**40.0**

CHAPTER-16
ENVIRONMENTAL MONITORING PROGRAMME

16.1 THE NEED

Monitoring is an essential component for sustainability of any water resources project. Monitoring of environmental indicators signal potential problems and facilitate timely prompt implementation of effective remedial measures. It is an integral part of any environmental assessment process. Monitoring becomes essential to ensure that the mitigation measures planned for environmental protection function effectively during the entire period of project operation. It will also allow for validation of the assumption and assessments made in the present study. Any water resources development project introduces complex inter-relationships in the project area between people, various natural resources, biota and the many developing forces. Thus, a new environment is created. It is very difficult to predict with complete certainty the exact post-project environmental scenario. Hence, monitoring of critical parameters is essential in the post-project phase. The data so generated can serve as a data bank for prediction of post project scenarios in similar projects.

16.2 AREAS OF CONCERN

Based on the findings of the Environmental Impact Assessment study in various Environmental Management Plan the important parameter viz. Catchments Area Treatment, Biodiversity Conservation & Management, Public Health Delivery System, Fish Management, Restoration of Dumping Sites, Quarry areas, Landscaping and Restoration of Construction Area, Green Belt Development etc. have been proposed.

16.3 WATER QUALITY

Construction Phase

It is proposed to monitor the effluent before and after treatment from oxidation ditch. The frequency of monitoring could be once per month. It is assumed that 2STPs shall be constructed to treat the sewage generated from five labour camps. A total of (2STPs X 12 months X 2 samples, i.e. before and after treatment) 48 samples/year need to be analysed. The parameters to be monitored include pH, Bio-chemical Oxygen Demand, Total Suspended Solids and Total Dissolved Solids. The cost of analysis of one sample is expected to be Rs. 2,000. Thus, total cost for analysis of 48 samples is expected to be Rs. 0.96lakh/year. The analysis work can be done by a laboratory recognized by the State Pollution Control Board.

Operation phase

The surface water quality of river Turga and proposed reservoirs needs to be monitored thrice a year. The proposed parameters to be monitored are as follows:

pH, temperature, electrical conductivity, total suspended solids, turbidity, total dissolved solids, calcium, magnesium, total hardness, chlorides, sulphates, nitrates, DO, COD, BOD, Iron, Zinc and Manganese. The sampling sites shall be:

- 1 km upstream of UpperReservoir site.
- Upper Reservoir.
- 1km downstream of the proposed Upper Dam site
- Lower Reservoir
- 1, 3 and 5 km downstream of theproposedLower Dam site

The total cost of analysis will be Rs. 1.26 lakh per year. This analysis shall be done throughout the entire life of the project. The analysis work can be conducted by a reputed external agency recognized by State Pollution Control Board.

16.4 AIR QUALITY AND METEOROLOGY

Project Construction Phase

The ambient air quality monitoring during construction phase can be carried out by an external agency, approved by State Pollution Control Board at four stations close to construction sites. Every year monitoring is to be done for the following three seasons:

- Winter
- Summer
- Post-monsoon

The frequency of monitoring could be twice a week for four consecutive weeks at each station for each season. The parameters to be monitored are Particulate Matter less than 2.5 microns ($PM_{2.5}$), Particulate Matter less than 10 microns (PM_{10}), Sulphur dioxide (SO_2) and Nitrogen dioxide (NO_2).

Every year, ambient air quality is to be monitored for (4 stations x 2 days/week x 4 weeks x 3 seasons) = 96 days. A total cost of Rs. 4.8 lakh/year @ Rs.5,000/day can be earmarked for this purpose.

In addition, an amount of Rs. 4.5 lakh has been earmarked for purchase of meteorological instruments.

16.5 NOISE

Project Construction Phase

Noise emissions from vehicular movement, operation of various construction equipment may be monitored during construction phase at major construction sites. The frequency of

monitoring could be once every three months. For monitoring of noise generators an Integrating Sound Level Meter will be required. An amount of Rs. 1.0 lakh has been earmarked for the purpose.

Project Operation Phase

No major impact due to noise is observed in operation phase.

16.6 ECOLOGY

Project Construction Phase

A detailed ecological survey covering forestry, fisheries, wildlife is recommended during entire construction phase. The survey can be conducted once in each season for three seasons every year for the entire construction period. The various aspects to be covered include:

- Qualitative and Quantitative assessment of flora and fauna.
- Monitoring of restoration of muck disposal area.

Monitoring of aquatic ecology will be essential to achieve sustainable yield of fish. Some of the parameters to be monitored are phytoplanktons, zooplanktons, benthic life and fish composition, etc. The monitoring shall be conducted by a reputed external agency, for which an amount of Rs.18.00 lakh/year can be earmarked.

Project Operation Phase

Status of afforestation programmes, changes in migration patterns of the aquatic and terrestrial fauna species shall be studied. The study could be undertaken with a frequency of once in each season for three seasons per year till the entire design life of the project. A provision of Rs.18.00 lakh/year can be kept for this purpose. The monitoring can be conducted by a reputed external agency.

16.7 INCIDENCE OF WATER-RELATED DISEASES

Project Construction Phase

Identification of water-related diseases, adequacy of local vector control and curative measures, status of public health are some of the parameters which should be closely monitored three times a year with the help of data maintained in the government dispensaries/hospitals.

Implementation	:	Public Health Department, and Dispensary constructedfor labour camps
Cost per annum	:	Rs.5.00 lakh

Project Operation Phase

Increased prevalence of various vector borne diseases and adequacy of local vector control and curative measures need to be monitored. The monitoring can be done three times in a

year.

Implementation : Nearby Dispensary/PHCs
Cost per annum : Rs.5.00 lakh

16.8 LANDUSE PATTERN

Project Operation Phase

During project operation phase, it is proposed to monitor land use pattern once every year. An amount of Rs. 5.00 lakh can be earmarked for this purpose.

16.9 SUMMARY OF ENVIRONMENTAL MONITORING PROGRAMME

The details of environmental monitoring programme are given in Tables 16.1 and 16.2 respectively.

Table 16.1: Summary of Environmental Monitoring Programme during Project Construction Phase

S. No.	Item	Parameters	Frequency	Location
1.	Effluent from STPs	pH, BOD, COD, TSS, TDS	Once every month	Before and after treatment from each STP
2.	Water-related diseases	Identification of water related diseases, adequacy of local vector control and curative measure, etc.	Three times a year	Labour camps and colonies
3.	Noise level	Equivalent noise level (L_{eq})	Once in three months	At major construction sites.
4.	Ambient Air quality	$PM_{2.5}$, $PM_{10,}$ SO_2 and NO_2	Once every season	At major construction sites
5.	Meteorological aspects	Wind direction & velocity temperature humidity, rain	Once every season	At one of the ambient air quality sampling sites
6.	Ecology	Status of afforestation programmess of green belt development, Terrestrial Flora and fauna and aquatic ecology	Once every season	
7.	Aquatic ecology	Phytoplanktons, zooplanktons, benthic life, fish composition	Once every season	

Table 16.2:Summary of Environmental Monitoring Programme during Project Operation Phase

S. No.	Items	Parameters	Frequency	Location
1.	Water	pH, Temperature, EC, TSS,Turbidity, Total Dissolved Solids, Calcium,	Once every season	• 1 km upstream of submergence site.

S. No.	Items	Parameters	Frequency	Location
		Magnesium, Total Hardness, Chlorides, Sulphates, Nitrates, DO. COD, BOD, Iron, Zinc, Manganese		• Proposed Upper dam Reservoir. • 1km downstream of the ProposedUpper dam site • ProposedLower dam Reservoir • 1, 3 and 5 km downstream of the ProposedLower dam reservoir
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.	Ecology	Status of afforestation programmess of green belt development, Terrestrial Flora and fauna and aquatic ecology	Once every season	-
4.	Water-related diseases	Identification of water-related diseases, sites, adequacy of local vector control measures, etc.	Once every season	• Villages adjacent to project sites
5.	Aquatic ecology	Phytoplanktons, zooplanktons, benthic life, fish composition	Once every season	• 1 km upstream of submergence site. • Proposed Upper dam Reservoir. • 1km downstream of the ProposedUpper dam site • Proposed Lower dam Reservoir • 1, 3 and 5 km downstream of the ProposedLower dam reservoir
6.	Landuse	Landuse pattern using satellite data	Once in a year	Catchment area

16.10 COST ESTIMATE FOR ENVIRONMENTAL MONITORING PROGRAMME

The cost required for implementation of the Environmental Monitoring Programme is of the order of Rs. 187.23lakh. A 10% annual price increase may be considered for every year. The construction period for estimation of cost for implementation of Environmental Monitoring programme during construction phase has been taken as 63 months.The details are given in **Table 16.3**.

Table 16.3: Cost for Implementing Environmental Monitoring Programme during construction phase

S. No	Item	Cost (Rs. lakh/year)	Total cost for construction period of 63 months with 10% escalation per year (Rs.in lakh)
1	Water quality	0.96	6.25
2	Ambient Air quality	4.80	31.25
3.	Ecology	18.00	117.18
4.	Incidence of water related diseases	5.00	32.55
	Total	**28.76**	**187.23**

The cost required for implementation of the Environmental Monitoring Programme in operation phase is of the order of Rs. 29.26 lakh/year. The details are given in **Table 16.4**.

Table 16.4: Cost for Implementing Environmental Monitoring Programme duringoperation phase

S. No.	Item	Cost (Rs.in Lakh/year)
1.	Water quality	1.26
2.	Ecology	18.00
3.	Incidence of water related diseases	5.00
4.	Landuse pattern	5.00
	Total	**29.26**

CHAPTER-17

COST ESTIMATES

17.1 COST FOR IMPLEMENTING ENVIRONMENTAL MANAGEMENT PLAN

The total amount to be spent for implementation of Environmental Management Plan (EMP) is Rs.4618.85 lakh or Rs. 46.19 crore. The details are given in Table-17.1.

Table-17.1: Cost for Implementing Environmental Management Plan

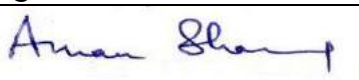
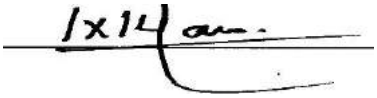
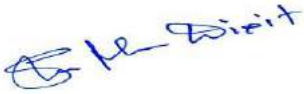
S.No.	Item	Cost (Rs. Lakh)
1.	Catchment Area Treatment	409.65
2.	Compensatory Afforestation, & Bio-diversity Conservation	483.50
3.	Fisheries Management	88.70
4.	Greenbelt development	16.80
5.	Water, Air & Noise pollution control	20.00
6.	Environmental Management in labour camps	204.75
7.	Public health delivery system	308.23
8.	Muck management	120.00
9.	Restoration, Stabilization and Landscaping of Quarry sites	60.00
10.	Restoration and Landscaping of construction sites	20.00
11.	Environmental management in roadconstruction	40.00
12.	Energy Conservation measures	312.37
13.	Disaster Management Plan	40.00
14.	Local Area Development Plan(Refer Table-4.6, Volume-II)	2204.00
15.	Plan to preserve cultural identity of the locals (Refer Section 5.7, Volume-II)	98.12
16.	Environmental Monitoring during construction phase (Refer Table-16.3, Volume-I)	187.23
17.	Purchase of meteorological instruments(Refer Section 16.4, Volume-III)	4.50
18.	Purchase of noise meter(Refer Section 16.5, Volume-III)	1.00
	Total	**4618.85**

CHAPTER-18

DISCLOSURE OF CONSULTANTS INVOLVED IN THE CEIA STUDY

The CEIA study has been conducted by WAPCOS Ltd., a government of India Undertaking under Ministry of Water Resources. The company has a full-fledged Centre for Environment who has conducted the above referred study. The list of the Experts involved in the CEIA study is given in Table-18.1.

Table-18.1: List of Experts involved in the CIEA study

S. No.	Name	Expertise	Signature
1.	Dr. Aman Sharma	EIA Coordinator	
2.	Mr. Shambhu Azad	Hydrologist & Ground Water Expert	
3.	Dr. A. K. Sharma	Ecology and Bio-diversity Expert	
4.	Mr. R.V. Ramana	Noise Expert	
5.	Dr. K.K. Gaur	Social Expert	
6.	Mr. S.M. Dixit	Air Quality Expert	
7.	Mrs. Moumita Mondal Ghosh	Landuse Expert	

वाप्कोस लिमिटेड
WAPCOS LIMITED
(भारत सरकार का उपक्रम)
जल संसाधन, नदी विकास व गंगा संरक्षण मंत्रालय
(A Government of India Undertaking)
Ministry of Water Resources, River Development & Ganga Rejuvenation

Date: 27.11.2015

UNDERTAKING

As per MoEF Office Memorandum no. J-11013/41/2006/-IA-III, dated 5th October, 2011, M/s. WAPCOS Limited, Gurgaon, Haryana herewith declares ownership of the contents (information and data) of the EIA Study for Turga Pumped Storage Project, West Bengal.

27/11/15

(Authorised Signatory)

डॉ. अमन शर्मा/ Dr. Aman Sharma
वरि. महा प्रबंधक (गंगा संरक्षण एवं पर्यावरण)
Sr. General Manager (Ganga Rejuvenation & Envt.)
वाप्कोस लिमिटेड / WAPCOS LIMITED
(भारत सरकार का उपक्रम/A Govt. of India Undertaking)
76-सी, सैक्टर -18, गुड़गाँव -122015 (हरि०)
76 - C, Sector - 18, Gurgaon -122015 (Hr.)

76-C, Institutional Area, Sector - 18, Gurgaon - 122 015 (Haryana), INDIA
Tel. : +91-124-2399421 (16 Lines) Fax : +91-124-2397392
E-mail : ho@wapcos.gov.in ; mail@wapcos.gov.in Website : http://www.wapcos.gov.in
CIN NO. U74899DL1969G01005070

Accrediation Certificate of the EIA consultant as per the office memorandum issues by MOEF, GOI

National Accreditation Board
for Education and Training

NABET

NABET/EIA/RA068/085 **Oct 09, 2015**

Chairman cum Managing Director
WAPCOS Limited (A Government of India Undertaking)
Plot-76-C, Sector-18, Gurgaon – 122015, Haryana
(Kind Attention: **Mr. R.K. Gupta**)

Dear Sir,

Sub: Re-Accreditation

This has reference to your application to QCI-NABET for re-accreditation (RA) as EIA Consultant Organization and the assessment carried for same in your organization from Apr. 07-09, 2015.

We are pleased to inform you that based on the document and office assessments during RA, the Accreditation Committee has approved renewal of accreditation given to your organization for a period of three years from **Apr. 09, 2015 to Apr. 08, 2018** subject to coverage of balance Functional areas and specific response to NCs/Obs./Alerts issued, if applicable (Refer Annexure III) with the following details:

1. Annexure I - Scope of accreditation
2. Annexure II - List of experts with approved sectors/ functional areas
3. Annexure III - Non-Conformances/ Observations/ Alerts (NCs/ Obs./ Alerts)
4. Annexure IV - Observations on Quality Management System (QMS)
5. Annexure V - Terms and conditions of accreditation
6. Annexure VI - Result of assessment
7. Annexure VII - Guidelines for addressing Major Non-Conformances/ Observations/ Alerts
8. Annexure VIII - Format to be followed for mentioning the names of the experts involved in EIA reports prepared by **WAPCOS Limited.**

Result of RA including Non-Conformances/ Observations/ Alerts (NCs/ Obs./ Alerts) applicable to your organization as per RA are also posted on QCI website vide minutes of the Accreditation Committee meetings dated June 10, 2015. You are requested to take necessary actions to close the NCs/ Obs. as per guidelines and timeframe mentioned in Annexure VII of this letter. You are also advised to review eligibility of organization as per Version 3 of the Scheme (posted on NABET website) which has become effective from Sep 1, 2015 and meet its requirements by Dec. 31, 2015 positively.

You are required to make all payments to NABET as applicable, within one month from the date of invoice sent to you. Continuation of this accreditation of your organization is subject to the clearance of all dues by your organization, satisfactory compliance to Annexure III and V.

With best regards,

Yours sincerely,

(Abhay Sharma)
Assistant Director

Scope of Accreditation **Annexure I**

NAME OF THE CONSULTANT ORGANIZATION: WAPCOS Limited (A Government of India Undertaking)
Plot-76-C, Sector-18, Gurgaon – 122015, Haryana

Sl. No.	Sector number		Name of Sector	Category A/B
	As per MoEF Notification	As per NABET Scheme		
1.	1 (a) (i)	1	Mining of Minerals- Open cast only	A
2.	1 (c)	3	River Valley, Hydel, Drainage and Irrigation projects	A
3.	1 (d)	4	Thermal Power Plants	A
4.	7 (e)	33	Ports, harbours, jetties, marine terminals, break waters and dredging	A
5.	8 (a)	38	Building and large construction projects including shopping malls, multiplexes, commercial complexes, housing estates, hospitals, institutions	B
Total = 05 Sectors				
Individual EIA Coordinators approved for different sectors are mentioned in Annexure II				

The ACO has overall obtained more than 60 % marks and therefore qualifies for Cat. A.

(Abhay Sharma)
Assistant Director

Accreditation Certificate of the laboratory

NABL

National Accreditation Board for Testing and Calibration Laboratories

(An Autonomous Body under Department of Science & Technology, Govt. of India)

CERTIFICATE OF ACCREDITATION

SPECTRO ANALYTICAL LABS LTD.

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2005

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

E-41, Okhla Industrial Area, Phase-II, New Delhi

in the discipline of

CHEMICAL TESTING

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Certificate Number T-0249

Issue Date 03/02/2015

Valid Until 02/02/2017

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the additional requirements of NABL.

Signed for and on behalf of NABL

N. Venkateswaran
Program Manager

Anil Relia
Director

Prof. Ashutosh Sharma
Chairman

Accreditation Certificate of the laboratory

NABL

National Accreditation Board for Testing and Calibration Laboratories

Department of Science & Technology, India

CERTIFICATE OF ACCREDITATION

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E-41, Okhla Industrial Area, Phase-II, New Delhi

in the discipline of

BIOLOGICAL TESTING

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Certificate Number T-1073

Issue Date 02/03/2014

Valid Until 01/03/2016

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the additional requirements of NABL.

Signed for and on behalf of NABL

Prachi Kukreti
Convenor

Anil Relia
Director

Dr T. Ramasami
Chairman

West Bengal State Electricity Distribution Company limited
(A West Bengal Government Enterprise)
Vidyut Bhavan (5th Floor), Block-DJ , Sector-II, Salt Lake ,Kolkata
West Bengal – 700091 (India)
Tel: 033-23345821/23197628
Fax.: 033-23345855
(April-2016)