

PRE-FEASIBILITY REPORT

FOR

**DAGMARA MULTIPURPOSE HYDROPOWER PROJECT
ON KOSI RIVER, DISTRICT SUPAUL, BIHAR**

PROJECT PROPONENT



BIHAR STATE HYDROELECTRIC POWER CORPORATION, BIHAR



Prepared By



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**(QCI Accredited consultant at S. No. 102 as per List of Accredited
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EXECUTIVE SUMMARY

1. Introduction

Bihar State Hydroelectric Power Corporation Limited (BHPC) is endeavoring to associate with public and private sector companies for accelerated development of hydro power potential in the State.

A proposal for construction of second barrage at Dagmara about 22.5 km/ds of existing Bhimanagar barrage on Kosi River has been conceived since long to arrest lateral shifting tendency of Kosi River as well as power generation. Detailed studies were carried out at RD 22.5 Km but the site was rejected due to submergence area extending in to Nepal Territory. The present location at RD 31 Km was selected in such a way that the afflux caused by NH-57 bridge does neither affect the TWL of powerhouse nor the submergence area extends into Nepal.

2. Project Location

The proposed project is located near village old Bhaptiahi on left bank, about 31 km downstream of Bhimnagar barrage on Kosi River in district Supaul of Bihar. The proposed barrage site is located at Latitude: 26°18'50.4" N, Longitude: 86° 45'32.4" E on Eastern Embankment (Left Side) and Latitude: 26°21'25.2"N, Longitude: 86°42'3.6" E on Western Embankment (Right Side).

The proposed project site is about 250 km away from Patna and well connected by road. National highway NH-57, which connects Purnea to Muzaffarpur via Forbesganj and Darbhanga is crossing the Kosi River approx 10 km downstream of proposed Dagmara barrage and is approachable from both ends of the proposed barrage via embankment roads.

3. Project Background

Bihar State Hydroelectric Power Corporation (BHPC) got prepared a Pre-Feasibility Report in respect of Proposed Dagmara H.E. Project and further signed an agreement with WAPCOS Limited in September 2007 to prepare a Detailed Project Report at a location about 22.5 km downstream of Bhimnagar barrage on Kosi River.

However, since the submergence area of project at that location was extending in to Nepal territory, the location was shifted further downstream by about 8.5 km (RD 31 km from Bhimnagar Barrage) to restrict the submergence area in Indian Territory only and a PFR for 130 MW HEP was prepared by BHPC Ltd and DPR has been prepared by WAPCOS Ltd. In 2011 due to very high per unit cost of power the project became unviable and could not get TEC from CEA. Bihar State Hydroelectric Power Corporation has taken up to update and optimize the design to reduce the per unit cost and make the project viable. BHPC has awarded task to make the project techno-economically viable to a reputed Delhi based Engineering Consultancy firm Rodic Consultants Pvt Ltd. Rodic would work on every aspect of the project to arrive at the final cost as per current SOR.

Proposed Dagmara Multipurpose Hydropower Project is a multipurpose Run-of-River scheme with a gross head of about 5.87 meter for power generation. The project envisages construction of a concrete barrage of 945.5 meter length and earthen dam of about 5750 m length across Kosi River. Surface powerhouse of length 381.50 meter having 17 units of installed capacity of 7.65 MW each (total installed capacity 130 MW) is proposed on the left side of barrage. The FRL of barrage is EL 65.50 meter. The gross storage is about 255.83 MCM and submergence area is 7790 ha. Based on the power generation design it falls under category "A" as per EIA Notification 2006 & its subsequent amendments.

4. Connectivity

Both the flood embankments of Kosi have motorable roads and connect to important places like Bhimnagar barrage, Nirmali, Birpur, Raghapur etc via link roads.

National Highway NH-57, which connects Purnea to Muzaffarpur via Forbesganj and Darbhanga is crossing the Kosi river just 10 km downstream of proposed Dagmara barrage, and is approachable from both ends of the proposed barrage via embankment roads. The project site is about 250 km away from Patna and well connected by road.

The site is also well connected by rail. Nearest rail head (Meter Gauge) on left bank is Raghapur (about 3 Km) and on right bank is Nirmali (about 25 km).

5. Land Requirement

About 7860.35 ha of land proposed to be acquired for the proposed Dagmara Hydro Electric project. The details of land acquisition, project appurtenances wise in Bihar are summarized in table below.

S. No.	Project Appurtenance	Area (ha)
1	Submergence	7790
2	Barrage	27.20
3	Dam	39.00
4	Powerhouse	2.15
5	Switchyard	2.00
	Total	7860.35

The water is impounded in Dagmara barrage reservoir by constructing a barrage of 945.5 m length and an earthen dam of 5750 m length. The pondage level is optimized at elevation of 65.50 m at which the submergence area is of about 7790 ha retaining about 255.83 MCM of water.

6. Importance and benefit of the Proposed Project

Proposed Multipurpose project envisages strengthen existing embankments and arrest the Kosi flood events, create scope for several development and recreational activities. The project will be a boost to power generation status of the Bihar. This will create opportunities of employment and will encourage eco-tourism in the area. The dam will act as alternate bridge over Kosi, ground water recharge, floating solar power potential, carbon credit, fisheries cultivation, irrigation potential, possibility of use of silt deposited in existing east Kosi canal are some of the other benefits of the project.

The CSR associated activities will add several kinds of facilities in the area that will improve the quality of life by providing, primary education, primary health care, woman and child welfare practices, medical camp etc.

Therefore, the implementation of the proposed project is highly recommended in the favour of society and in the state as well as national.

Chapter 1 INTRODUCTION

1.1 Identification of the Project Proponent

Bihar State Hydroelectric Power Corporation Limited (BHPC) is a company of government of Bihar registered under Companies Act 1956. The Company is responsible for exploring all possibilities of hydroelectric potential and its development in the State. The BHPC endeavors to associate with public and private sector companies for accelerated development of hydro power potential in the State.

1.2 Brief Information about the Project

The State of Bihar has proposed to construct a Hydro Power Station with a low level dam on River Kosi. The purpose of this dam/reservoir is to create head for generating power in addition to acting as a reservoir to arrest the potential of damages during floods and indirect benefit to stabilize/augment the existing irrigation potential on its downstream side to stabilize and extend irrigation facilities to new areas under its Command.

Reconnaissance survey was carried out in the entire reach from Bhimnagar barrage to NH-57. Earlier, it was proposed approximately RD 22.5 km in the downstream of the existing Bhimnagar Barrage on Kosi River near Indo-Nepal Border. After, detailed studies the site was rejected as submergence area was extending upto Nepal Territory. On advice of Ministry of Water Resources, Govt, of India, shifted the barrage site further downstream so that the submergence area does not extend into Nepal Territory. The proposed location at RD 31 Km was selected in such a way that the afflux caused by NH-57 bridge does not affect the TWL of power house nor the submergence area extends beyond the border.

The proposed components of HEP project are as follows:

Principal components of the project are:

1. R.C.C. raft type Barrage having length 945.5 m.
2. Divide wall between barrage and power house
3. Earthen dam of 5750 m length (2220 m on the left and 3530 m on right side of barrage)
4. Raising the existing earthen embankments up to EL 67.50 m (9 km length on left and 8.5 km on right bank).
5. Switch Yard of Size 40 m x 70 m on the left side of Power House.
6. Surface power house of length 381.5 m housing 17 Pit Type Bulb turbines each coupled to generator of 7.65 MW capacity through Speed Increasing gear Box housed inside the bulb.

Other features of Power house area are:

- Intake pool of 89.5 m in length & 381.5 m in width.
- Tail pool of size 48.7 m in length & 381.5 m in width.

In addition to the above, the diversion arrangement comprising of diversion channel along with Coffer dam etc. is also envisaged in different phases of construction.

Since there are large discharge variations in the Kosi River, it is proposed to install 17 units of 7.65 MW each to capture maximum water utilization and cost economics, compared to conventional lesser number of large size units.

1.3 Need for the Project and Its Importance to the country or Region

The need of the project is to achieve minimal levels of self-sufficiency in generation capacity which is necessary in the context of this significant growth requirement. Hydro power generation as a clean, renewable and long-term source of energy with peaking capability has a valuable role in this generation addition strategy for Bihar and can significantly supplement the large coal-based capacity addition targets for the state.

Dagmara Hydro Electric Project is envisaged as run-of-the-river project on Kosi River and will feed power to the Eastern Region Grid which comprises the states of Bihar, Jharkhand, Orissa Sikkim West Bengal and DVC. Thus, based on the capacity addition programmed and anticipated power requirement of Bihar, the need for 130 MW Dagmara HE scheme has been proposed.

1.4 Demand-supply Gap.

In view of the future scenario, with shortages projected in both energy and peak power generation at the end of 11th Plan for Bihar State and overall peak power deficit at country level even at the end of 12th Plan, development of Dagmara Hydro Electric Project during the 12th Plan is therefore fully consistent with CEA forecasts of demand and supply situation and is considered essential, apart from achieving ideal thermal-hydro mix ratio and socio-economic development of the state.

1.5 Imports V/s Indigenous production

The proposed project will lead to achieve the power generation demand and substantial enhancement of indigenous food grain production in Kharif and Rabi crops to increased irrigation intensities.

1.6 Export Possibility

The proposed Dagmara hydroelectric project in Bihar will not only benefit the state but will go a long way to meet the overall power and mix requirements at the country level, especially the Eastern Region of the country.

1.7 Domestic/Export Markets

By increasing hydropower generation and improving efficiencies in distribution of electricity, Bihar hopes to offer energy at stable and suitable prices for eco-friendly industrial development.

1.8 Employment Generation (Direct And Indirect) Due To The Project

The peak labour strength likely to be employed during project construction phase is about 600 workers and 200 technical staff. During project construction phase, worker will be hired from the nearby villages.

Chapter 2 PROJECT DESCRIPTION

2.1 Type of Project (Including Interlinked and Interdependent Projects, If Any)

Proposed Dagmara Multipurpose Hydropower Project is an interdependent project and it is a Run-of-River scheme with a gross head of about 5.87 meter for power generation. The project envisages construction of a concrete barrage of 945.5 meter length and earthen dam of about 5750 m length across Kosi River. Surface power house of length 381.50 meter having 17 units of installed capacity of 7.65 MW each (total installed capacity 130 MW) is proposed on the left side of barrage. The FRL of barrage is EL 65.50 meter. The gross storage is about 255.83 MCM and submergence area is 7790 ha. On the basis of the power generation design it falls under category "A" as per MoEF&CC, EIA Notification 2006 & its subsequent amendments.

2.2 Location with Coordinates

The project is located near village Old-Bhaptiahi on left bank, about 31 km downstream of Bhimnagar barrage on Kosi River in district Supaul of Bihar. The co-ordinates of the proposed barrage site is as under:

	Eastern Embankment (Left Side)	Western Embankment (Right Side)
Latitude	26°18'50.4" N	26°21'25.2" N
Longitude	86°45'32.4" E	86°42'3.6" E

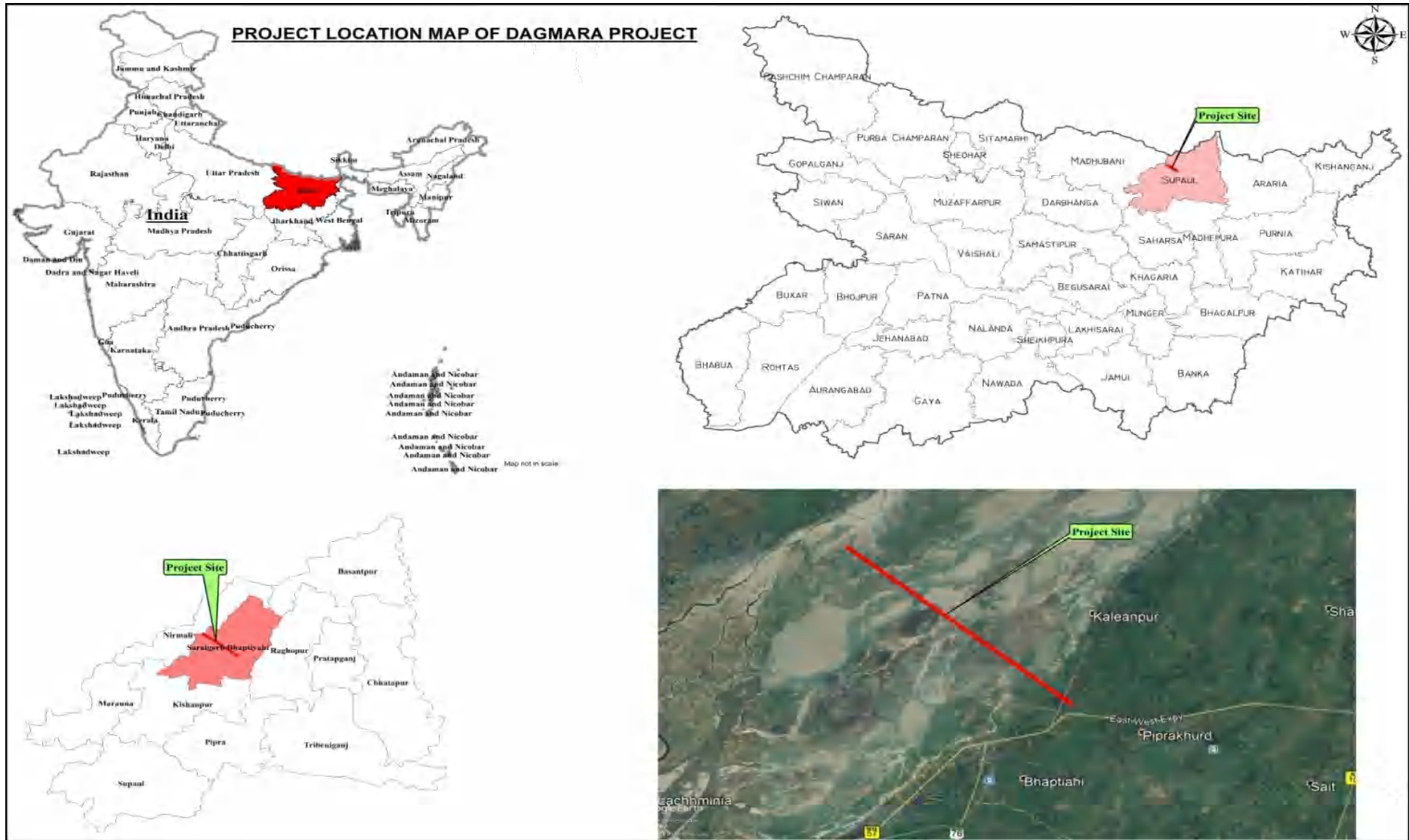


Figure 2-1: Location Map

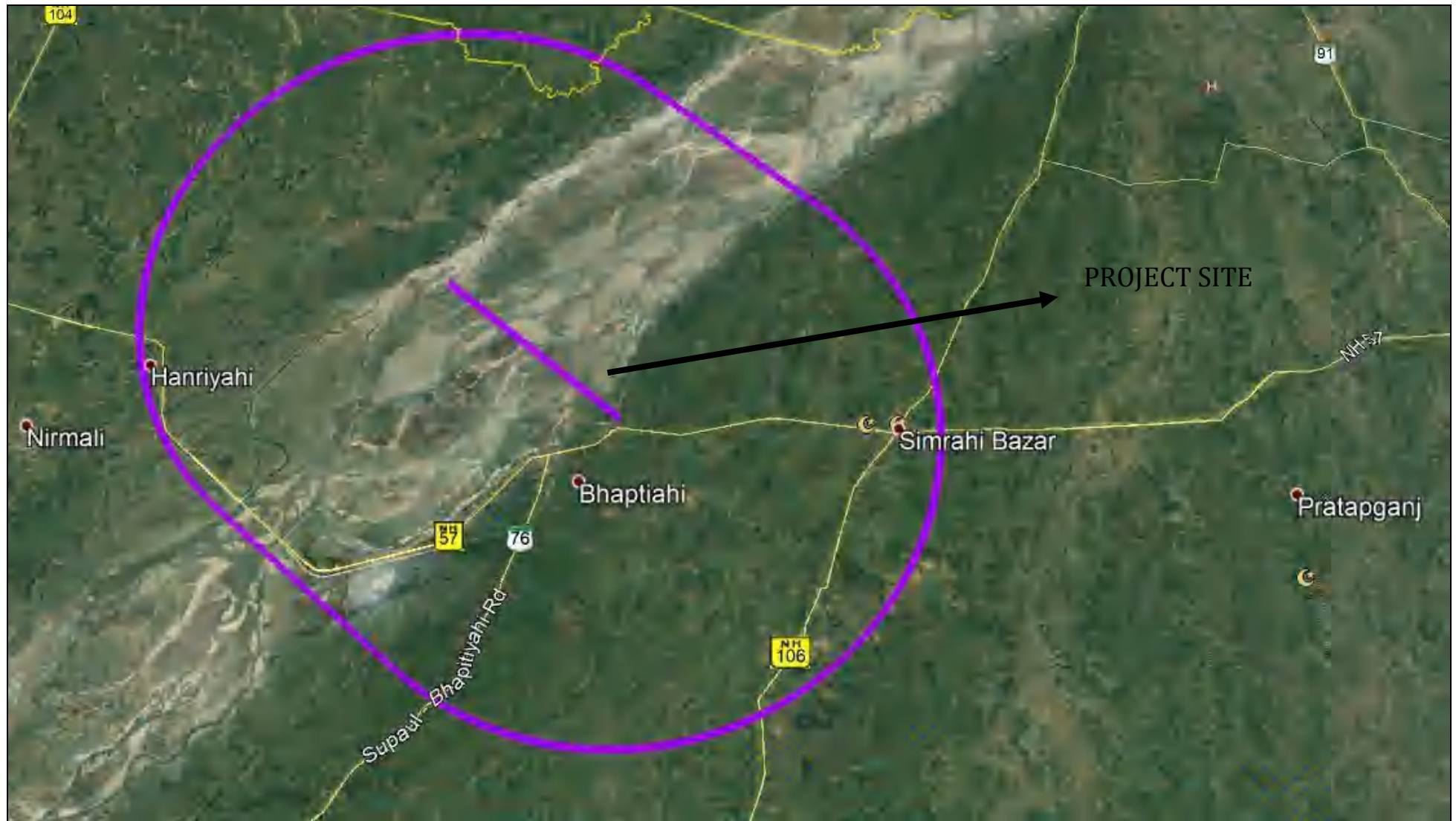


Figure 2-2 Google Earth map of 10 Km study area

2.3 Details of Alternate Sites

Reconnaissance survey was carried out in the entire reach from Bhimnagar barrage to NH-57 Bridge. Detailed studies were carried out at RD 22.5 km, however, the site was rejected due to its submergence area extending in to Nepal Territory. The present location at RD 31 km was selected in such a way that neither the afflux caused by NH-57 Bridge affects the TWL of neither power house nor the submergence-area extends beyond international border.

Now the proposed Dagmara HEP detailed project study is being done by Rodic Consultants Pvt. Ltd and they are in the process of preparing DPR and the alternative site consideration will be provided in EIA/EMP report.

2.4 Size or magnitude of operation

The total length of barrage including under sluices, bypass bays and fish ladder is worked out as 945.5 m. 40 nos. of barrage bays of 18.0 m span and 2.5 m thick piers in-between have been considered. 5 nos. of contraction joints are proposed for the barrage resulting in the provision of 5 nos. of double piers, considering one at each contraction joint.

The powerhouse is to be equipped with 17 numbers of bulb turbines, each having a capacity of 7.65 MW.

The spillway has 40 No. of bays with openings of 18 m wide x 8 m high to pass 27000 cumecs flood. The spillway bays are separated by 2.5 m thick piers and 5 no of 5 m thick double piers with expansion cum contraction joint. A conventional stilling basin type energy dissipation arrangement of 39 m length has been provided with its floor at EL 51.00 m.

A divide wall separates the barrage from the Powerhouse complex. A contraction joint has been provided between the power house, end wall and divide wall for separation of the wall from the barrage. The top level of the divide wall varies from EL 67.50 to EL 62.75 m. A fish ladder 5 m wide has been provided in the under sluice portion to allow the fish migration.

2.5 Project description with process details (a schematic diagram/flow chart showing the project layout, components of the project etc. should be given)

The principal components of the project are:

1. R.C.C. raft type Barrage having length 945.5 m.
2. Divide wall between barrage and power house
3. Earthen dam of 5750 m length (2220 m on the left and 3530 m on right side of barrage)
4. Raising the existing earthen embankments up to EL 67.50 m (9 km length on left and 8.5 km on right bank).
5. Switch Yard of Size 40 mx 70 m on the left side of Power House
6. Surface power house of length 381.5 m housing 17 Pit Type Bulb turbines each coupled to generator of 7.65 MW capacity through Speed Increasing gear Box housed inside the bulb.

Other features of Power house area are:

- ✓ Increasing gear Box housed inside the bulb.
- ✓ Intake pool of 89.5 m in length & 381.5 m in width.
- ✓ Tail pool of size 48.7 m in length & 38 1.5 m in width.

It is proposed to install 17 units of 7.65 MW each to capture maximum water utilization and cost economics, compared to conventional lesser number of large size units.

In order to minimize the hazards by silt to the Generating Plant, it is proposed to have 17 intake gates and 17 Draft tube stop log gates, shifted upstream and downstream respectively compared to conventional locations at Inlet and exit of Turbine water ways, thus minimizing the silt deposits at inlet and exit of water ways of the turbines.

For maintenance of one unit one common set of stop log maintenance gate each is considered at intake and exit of water ways of each unit.

The main components of the barrage are as below.

- i) Barrage spillway portion and under sluice portion
- ii) One Fish ladder of 5.0 m span
- iii) Two nos. of By-Pass bays of 10.5 m span each

Table 2-1: Salient Features of Dagmara Multipurpose Hydro power Project

S. No	Description	
1.0	Location	
	Country	India
	State	Bihar
	District	Supaul
	Sub Division	Supaul
	Block	Bhaptiahi
	River	Kosi
	Project Area	submergence area-7790 ha Other area for Barrage, Dam, Powerhouse, Switchyard :-70.35. Additional land -12 ha for facilities.
	Eastern Embankment	Latitude: 26018'50.4" N Longitude: 86045' 32.4" E
	Western Embankment	Latitude: 26021'25.2" N Longitude: 86042'3.6" E
	Access to the Project	Supaul Bhaptiahi Road on left bank Nirmali-Kunauli embankment road on right bank and NH-57
	Nearest Village	Old Bhaptiahi on left Bank
	Airport	Patna-250 km
	Nearest Rail Head	Raghopur-3 km on left bank Nirmali-15 km on right bank
	Port	Kolkata
2.0	SCHEME	
	Type	Run-off-the River
	Installed Capacity	17 x 7.65 MW (130 MW)
3.0	HYDROLOGY	
	Catchment Area	61, 992 sq. km.
	Maximum Annual Rainfall	2191 mm
	Minimum Annual Rainfall	1291 mm
	Maximum Intensity (1 Day) at Birpur	318.5 mm
	Maximum Design Flood	27000 cumec
	Annual Average Sediment Load (1973-81)	650 m ³ /MSqm/year
4.0	POWER POTENTIAL	
	Pond Level	RL 65.50 m
	MDDL	RL 64.5 m
	Gross Head	5.87 m

	Net Head	5.28 m
	Discharge available for power generation	2739 m ³ /sec
	Installed Capacity	17 x 7.65 MW
	Annual Energy Generation	366.83 MU
5.0	DIVERSION STRUCTURE	
	Type of Diversion Structure	Barrage
6.0	POWER HOUSE	
	Type	Surface Type
	Service Bay	2 nos. (20 m width on each side)
	Total length of Power House including service bay	381.5 m
	Centre to centre spacing of each unit	12.5 m
	Turbine Centre Line Level	EL 52.95 m
	Machine Hall Level	EL 60.82 m
	Service Bay Level	EL 67.50 m
	Design Discharge per unit	105.30 Cumecs
7.0	TYPE OF TURBINE	
	Type	Pit Type Bulb
	Rated Discharge	105.30 cumecs
	Number	17
	Capacity	5400 KW
8.0	GENERATOR	
	Type	Synchronous
	Capacity	5550 KVA each
	Number	17
	Power Factor	0.9
	Frequency	50 Hz
	Number of Phases	3
	Voltage	11 KV
9.0	STEP UP TRANSFORMER	
	Type	Outdoor type (ONAN/ONAF)
	Quantity	6
	Capacity	40/50 MVA, 3-Phase
	Voltage Ratio	11/132 KV
10.0	TIME OF COMPLETION	60 Months including 6 Months of Pre Construction Period
11.0	TAIL POOL AND DRAFT TUBE GATE	
	Width and Length of Tail Pool	381.5 m x 48.70 m
	No of Draft tube Gates Provided	17
	No. of Draft Gate Openings	17
	Size of Draft Tube Gate	11.25 m (L) x 5.20 m (H)
	Sill Level of DT Gate	EL56.50 m
	Design Discharge per unit	105.30 cumecs
	Bottom of Draft Tube	EL 49.95 m
	Max TWL/Flood Level	EL 61.62 m
	Normal TWL	EL 59.30 m
12.0	INTAKE CHANNEL	
	Width of Intake channel	381.50 m
	Length of Intake channel	89.5 m
	Design Discharge per unit in the channel	105.30 cumec
	No of intake gates	17 nos
	Size of Intake gates	11.25 m (L) x 6.55 m (H)

	Sill Level of Intake Gate	EL 58.95 m
	Intake Level - a) Overt b) Invert	EL 58.57 m EL 47.95 m
13.0	SWITCHYARD	
	Type	Open
	Size	40.0 m x 70.0 m
	Location	On the Left Bank side
14.0	TRANSFORMER LINE	
	Voltage for Transmission line	132 KVA
	Length of Transmission Line	4 Kms LILO
	Name of Substation where power is finally dispatched	Tapping on Supaul-Kataiya 132 kV Double Circuit Line (Under construction)
15.0	BARRAGE	
	Length	945.50 m
	Type	R.C.C Raft with piers & gates
	Top Elevation of Pier	EL 67.0 m
	Crest Elevation for Spillway bays	EL 57.50 m
	Crest Elevation for under sluice bays	EL 56.50 m
	Total Length of concrete floor in under sluice	93.40 m
	Total Length of Concrete Floor in Spillway	87.40 m
	Length of downstream concrete floor in spillway bays	75.50 m
	Length of each span between piers	18.0 m
	No of spans in Spillway	40
	No of Span in under sluice	8 + 2 nos. for bypass gates + 1 fish ladder
	Thickness of upstream floor	1.50 m
	Thickness of downstream floor	3.0 m (Average)
	Thickness of pier	2.5 m
	Height of Barrage gates	8.30 m in spillway and 9.30 m in under sluice
	Design Discharge of spillway and under sluice bays	27000 cumecs
	Energy Dissipater	Hydraulic jump type Stilling Basin
16.0	DIVERSION ARRANGEMENT	
	Type	Diversion Channel and Cofferdam
	Diversion Capacity	3160 cumecs
	Diversion Flood	1 in 25 Yrs Flood
	Cofferdam type	Earthen with clay blanket on upstream side
	Height of Cofferdam	3.5 m
17.0	BARRAGE POND	
	Full Pond Level (FLR)	EL 65.5 m
	Min Draw Down Level (MDDL)	EL 64.5 m
	Gross Storage	255.83 MCM
	Live Storage between MDDL and FLR	29.7 MCM
	Area under submergence at FRL	7790 ha

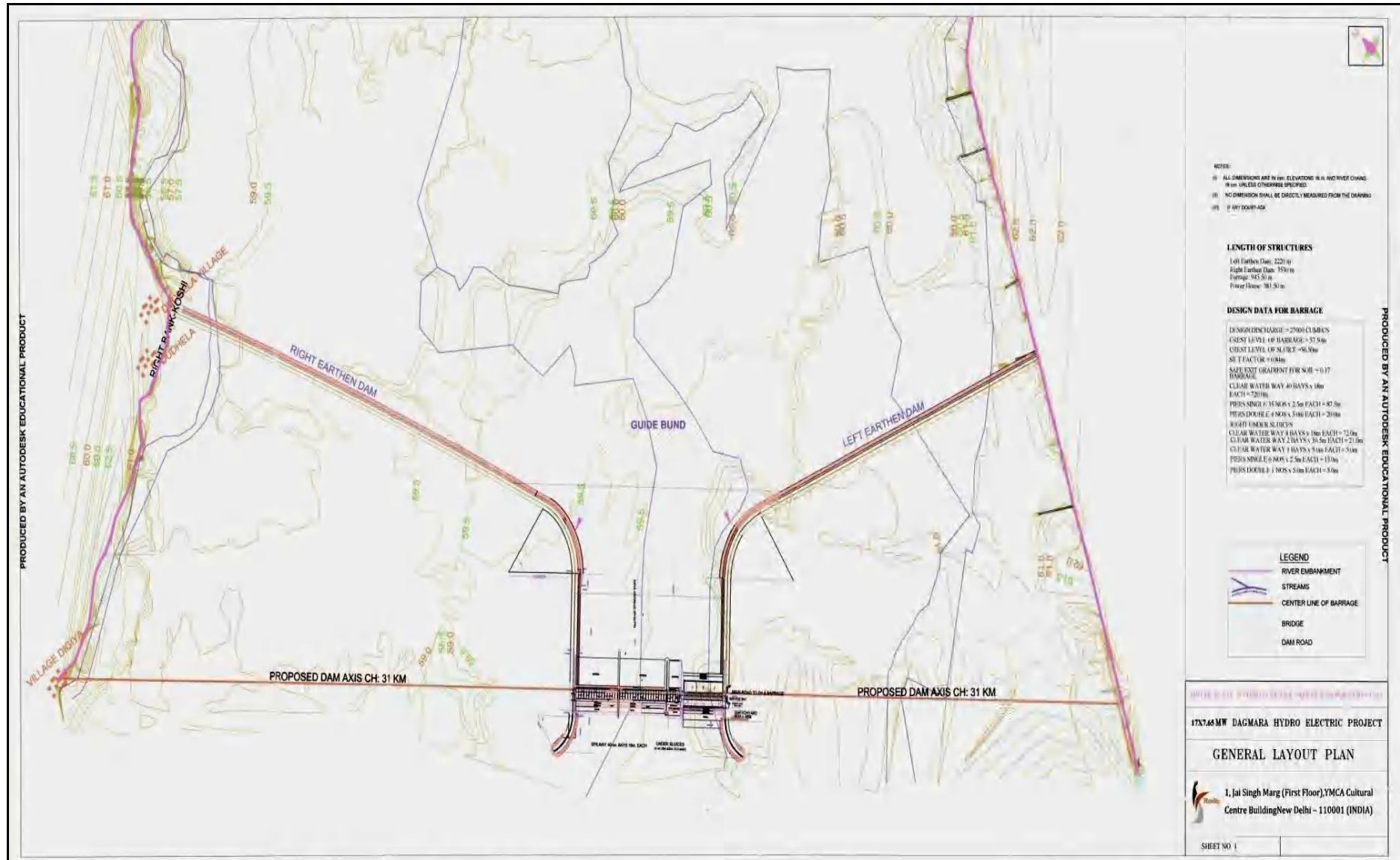


Figure 2-3: Tentative layout of the project

2.6 Machinery required:

A limited workshop facility will be provided in the power house for carrying out the normal O&M of various Electro-mechanical equipment. The workshop will be equipped with the following machine tools.

- ✓ Lathe machine
- ✓ Shaper
- ✓ Bench grinder
- ✓ Power Hacksaw
- ✓ Radial Drilling machine
- ✓ Welding sets

The workshop will also be provided with a remotely operated EOT crane of adequate capacity.

2.7 Manpower Requirement

The peak labour strength likely to be employed during project construction phase is about 600 workers and 200 technical staff. During project construction phase, worker will be hired from the nearby village.

2.8 Raw material required along with estimated quantity, likely source, marketing area of final products, Mode of transport of raw Material and Finished Products

The main raw materials required for the construction of dam are steel, cement, coarse aggregates & fine aggregates. The aggregates can be easily obtained from nearby feasible locations, which are acquired by the department.

The cement required can be easily brought to site from Sahrsa or from nearby available location. The approximate quantity of materials required for construction is tabulated in Table 2.2.

Table 2-2: Tentative quantity of materials required for construction of dam

Material	Quantity*
Cement	234060 Tons
Fine aggregate (M-Sand)	343172 Cum
Coarse aggregate (Stone)	652794 Cum
Steel	20565 Tons

Note Quantities are tentative and subject to change*

2.9 Resource optimization/recycling and reuse envisaged in the project, if any, should be briefly outlined

Resource Optimization / recycling and reuse is envisaged in this project as the surface excavation in the river bed and other components of project shall result in generation of excavated muck. The excavated material shall be consumed in formation of coffer dam, guide bunds/marginal/ afflux bunds.

2.10 Availability of water its source, Energy/power requirement and source should be given

2.10.1 Water Requirement

The domestic water required has been estimated as 0.182mld. Water will be used from Kosi River for the construction and other activity and for drinking purpose water will be used from Tanker supply.

2.10.2 Power

Power is required for operating the construction machineries during the construction phase, which can be met from Bihar electricity Board (NBPDC) or by DG set.

2.11 Quantity of wastes to be generated (liquid and solid) and scheme for their management/disposal.

The average per capita solid waste generated is of the order of 210 gm/day/person. The solid waste likely to be generated from labour camps shall be of the order of 0.52 tonnes/day.

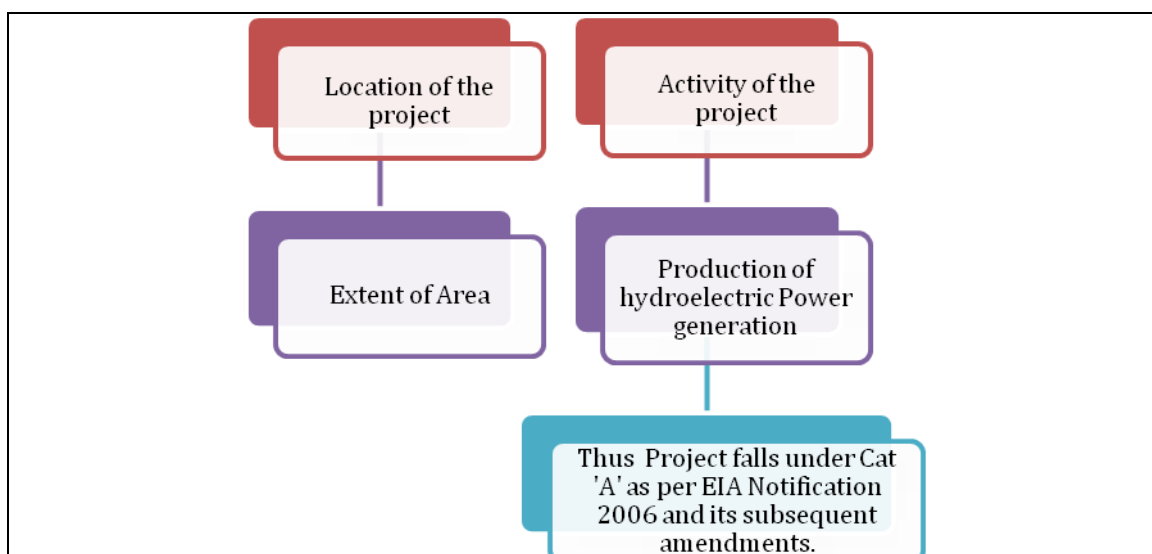
For solid waste collection, 15 number of masonry storage vats, each of 2m capacity shall be constructed at appropriate locations in various labour camps.

These vats shall be emptied at regular intervals and the waste so collected can then be transported to landfill site.

Two covered trucks to collect the solid waste from common collection point and transfer it to the disposal site shall be put to service. A suitable landfill site shall be identified and designed to contain municipal waste from Project Township, labour colonies, etc.

To ensure that the sewage from the labour camps do not pollute the river water, it has been estimated that about 130 community latrines and oxidation ditch are proposed to be constructed.

2.12 Schematic representations of the feasibility drawing which give information of EIA purpose



Chapter 3 SITE ANALYSIS

3.1 Connectivity

Both the flood embankments of Kosi have motorable roads and connect to important places like Bhimnagar barrage, Nirmali, Birpur, Raghapur etc via link roads.

The project site is about 250 km away from Patna and well connected by road. National Highway NH-57, which connects Purnea to Muzaffarpur via Forbesganj and Darbhanga is crossing the Kosi river just 10 km downstream of proposed Dagmara barrage, and is approachable from both ends of the proposed barrage via embankment roads.

The site is also well connected by rail. Nearest rail head (Meter Gauge) on left bank is Raghapur (about 3 Km) and on right bank is Nirmali (about 25 km). On Broad Gauge, nearest rail head on left bank is Forbisganj (about 60 km) and at right bank is Jhanjhaipur (about 60 km).

3.2 Landform, Land use & Land Ownership

About 7860.35 ha of land proposed to be acquired for the proposed Dagmara Hydro Electric project. The details of land acquisition, project appurtenances wise in Bihar are summarized as below.

Table 3-1: Details of land to be acquired for various project appurtenances

S. No.	Project Appurtenance	Area (ha)
1	Submergence	7790
2	Barrage	27.20
3	Dam	39.00
4	Powerhouse	2.15
5	Switchyard	2.00
	Total	7860.35

About 12 ha of land (other than the land required within the flood plain for construction of barrage, power house, reservoir submergence area etc.) will be required for infrastructure i.e. for different project component and other basic requirements of the project.

3.3 Topography

Kosi River flows in a southern direction near the barrage site in an almost straight stretch. The bed width of the river at the barrage site is about 8557.40 m and the flow is confined between eastern and western embankments. The topography is of the proposed site is 72-84m MSL. No tributary or nalla joins the river between proposed barrage and existing Bhimnagar barrage.

3.4 Existing land use pattern (agriculture, non-agriculture, forest, water bodies (including area under CRZ), shortest distances from the periphery of the project to periphery of the forests, national park, wild life sanctuary, eco sensitive areas, water bodies (distance from the HFL of the river), CRZ. In case of notified industrial area, a copy of the Gazette notification should be given.

The proposed project of dam is to be built on water body itself and a flood prone area. The project does not attract CRZ conditions.

3.5 Existing Infrastructure

Private land is likely to be acquired from 20 villages, of which 10 are fully affected and 10 villages are partially affected. Socio-economic survey of project affected families has been conducted and a detailed Resettlement & Rehabilitation Plan is to be prepared and incorporated in the EIA report.

3.6 Soil Classification

Nine holes were drilled in the barrage location from RD 4390.5 m to RD 5336 m including one bore hole in Desilting Basin. One Plate Load Test has been conducted at RD-4680. The samples collected from the bore holes indicated presence of different soils which have been identified from the analysis of the samples and the data was examined and utilized for the soil classification and their characteristics. The classification has been done as per IS: 1498-1970 "Classification & Identification of Soils for General Engineering Purposes" and these are in Table: 3.2.

Table 3-2 Soil Classification and Their Characteristics

Bore Hole No.	Location in meter from left embankment)	Depth (m)	Ground Level (m)	Water table Depth (m)	SPT		Depth (m)	Soil Classification
					Test depth (m)	N value		
BH-27	4420	30.45	58.51	0.42	4.50 24.0	04 45	0-30.0	SW SW
BH-28	4520	30.45	58.94	0.90	6.0 27.0	06 51	0-30.0	SW SW
BH-29	4170	15.45	58.76	2.00	1.5 9.0	05 28	0-15.0	SW SW
BH-30	4620	0.45	58.95	0.80	3.0 15.0	07 40	0-6.0 6.0-21.0	SM SW
BH-31	4745	0.45	58.95	0.75	6.0 21.0	09 38	0-3.0 3.0-30.0	SW SW
BH-32	4870	0.45	58.95	0.82	3.0 15.0	05 40	0-4.0 4.0-27	SW-SM SW
BH-33	4810	5.45	58.95	1.30	3.0 15.0	05 36	0-3.0 3.0-15	SW SW
BH-34	4995	0.45	58.95	0.76	4.50 27.0	06 37	0-4.50 4.50-30	SM SW-SM
BH-35	5120	0.45	58.95	0.66	7.50 15.0	16 37	0-4.50 4.50-15	ML SW

(AD dimensions are in meters, RD is from Left Embankment)

- ✓ **SM:** Silty sands, poorly graded sand-silt mixtures
- ✓ **SW:** Well-graded sands, gravelly sands; little or no fines.
- ✓ **ML:** Inorganic silts and very fine sands, silt flour, silty or clayey fine sands or Clayey silts with none to low plasticity
- ✓ **CI:** Inorganic clays, gravelly clays, sandy clays, lean clays of medium plasticity
- ✓ **CL:** Inorganic clays, gravelly clays, sandy clays, silty clays, lean clays of low Plasticity.

3.7 Climatic data (Secondary sources)

3.7.1 Rainfall

The Kosi catchment receives rainfall due to effect of S-W monsoon which sets in the middle of June and retreats by middle of October to provide 79% of the annual rainfall. The winter rainfall in short spell during Jan to March is due to the influences of western disturbance. The annual

rainfall in the catchment increases from 120 cm at foothills to more than 350 cm on southern slope of Great Himalayan range and then decreases across the Himalayas to less than about 25 cm in the Tibetan portion.

3.7.2 Temperature

The hottest month in catchment is May and the coldest is January. There is a mild variation in the monthly values of mean maximum and minimum temperature during the period from December to February as also from June to September. The mean diurnal variation is of the order of 10°C during June to September and 13°C during December to February.

3.7.3 Humidity

The humidity is the highest during the months of July to September and lowest during March to April. A second maximum in relative humidity occurs in January-February.

3.7.4 Wind

The surface wind blows with mean speed of 3 to 5 km/hr. in varying directions in different part of the catchment.

3.8 Social infrastructure available

The left and right bank of the river is covered by the habitation. Proper R&R plan is to be prepared and incorporated in the EIA.

Chapter 4 PLANNING BRIEF

4.1 Planning Concept (type of industries, facilities, transportation etc) town and country planning/development authority classification

The proposed project site is located 31 km downstream of existing Bhimnagar barrage, near old Bhaptiahi Village on left Bank of distt. Supaul of Bihar in the upper reaches of Kosi River and is close to India -Nepal Boarder.

The installed capacity of the proposed Dagmara H.E. Project is 130 MW (17 X 7.65 MW). The project is proposed to be completed within a time span of 60 Months including about 6 months of pre-construction and infrastructure activities.

Project Headquarter is proposed to be located at Birpur and the site office at village Bhaptiahi. The project is connected with two railway heads one is at Raghopur about 3 km from the project site on left bank and the other is at Nirmali on right bank about 25 km from the project site. Both the railway heads are on Metre Gauge.

The project site is connected with the head quarter by road. Both Raghopur (MG) railway station and Nirmali (MG) railway station are well connected to NH-57 (East-West corridor). Another National Highway NH-106 which is passing from Madhepura to Birpur is crossing the NH-57 at Bhaptiahi.

For the construction of various components of the project, the work shall be allotted to the contractors on Turnkey basis. The contractors will mobilize the latest equipment in order to get consistent quality and faster progress rate. Contractors will be asked to pay special attention for the equipment planning for the excavation work so as to optimize the equipment cost and to extract faster progress rate.

It is essential to optimize the construction cost and construction period taking into consideration, price escalation and interest during construction as well as cost benefit due to delay in completion. Hence, it is important to strictly follow the construction schedule to restrict the cost of the project.

4.2 Population projection

The study area comprises of 132 villages, spread over in Bharphori, Andhramath, Dakahi , Bikramsher, Neur, Burhbiko, Kukur दौरा, Jiroga, Matahi, Dharhara, Narindarpur, Chandarpatti, Kulhadia, Barmotar, Mahadeomath, Baruwar, Narahi, Bajuband, Gidrahi, Mahthour got, Barmotar, Kaudihar laukahi, Mahthour, Dhanchhiha, Hardoarlaukaha, Bajdari chakla, Bahuarwa, Takia, Kamalpur, Dharhara, Harpur, Dagmara, Laukaha, Gopalpur, Sikrahata, Korhali, Hariraha, Uganipatti, Chhithi hanuman nagar, Simri, Kabiahi , Baisa, Bajdari chakla, Karhari, Kleanpur, Sitaram chakla, Hanriahi, Bhulia, Baltharwa, Majhari, Tharia, Raharia, Banainia, Durgapur, Sait, Dudhaila, Shahpur pirthipatti, Karhari, Dighia, Nonpara, Siani, Bela, Motipur, Berdah, Dhadi, Gidhani, Sadanandpur, Jhila dumri, Norha, Bishunpur, Bhaptiahi, Phenglas, Kataia bhulia, Jhahura, Lagunia, Parsarman, Simrahi, Imamganj, Piprakhurd, Dharpatti, Ram bishunpur, Naraenpur, Garhia, Piprahi, Rampur, Asanpur kupaha, Aurahi, Katmungra, Baghi, Lachhminia, Murli, Gamharia, Raghopur, Saraigarh, Murli milik, Haripur, Sonpataha, Debipur, Gadahwa, Mahi sardar chakla, Jiwachhpur, Dharahara, Itahari, Chandpipar, Kamaldaha, Sukhasan Radhe nagar Arraha Kulipatti Hulas, Nawabakhar, Andauli, Phulwaria, Dumri, Malar Satkodaria, Achalpur, Maheshpur, Mehasimar, Lalpur, Saheb chakla, Barhatha, Bolhar,

Rajarampatti, Motipur, Maura, Manik chand chakla, Sarhochia, Singiawan villages falls within Madhubani and Supaul district.

4.3 Land use planning (breakup along with green belt etc.)

The plantation shall be at a spacing of 2.5*2.5 m. About 1,000 trees per hectare will be planted. The plantation and maintenance of the plantation area shall also be done by the project proponents in association with the forest department. The selection of species for greenbelt development and afforestation shall be done in consultation with state Forest Department.

4.4 Assessment of Infrastructure Demand (Physical & Social)

The infrastructure will be assessed in the nearby villages. As per the reconnaissance survey conducted till present, improvement in the health and education is envisaged. The area is considered among one of the backward areas of Bihar, a detailed and comprehensive infrastructure development plan will be prepared as per the ToR granted by MoEFCC for conducting the EIA studies and preparation of various management plan for EMP.

4.5 Amenities/Facilities

Proper site services such as First Aid, Canteen/Rest Shelter, Drinking Water, Residential complex etc. will be provided to the construction workers. Various facilities to be provided during construction and operation of the project are as follows:

1. Electricity shall be provided by transmission lines and DG sets.
2. Drinking water will be provided to the workers by Tankers during construction. During O&M stage, bore wells shall be used for drinking water supply.
3. To provide the first aid for any sort of injuries encountered during the mining operation, one small first aid room shall be provided. First aid kit and sufficient stock of material/medicines needed for first aid shall be provided as per requirement.
4. In future if women workers are employed, arrangement for a small crèche shall be made as per the requirement.
5. Necessary arrangement shall be made for conducting refresher course as laid down in vocational training rules to upgrade skills of the persons involved in the project.

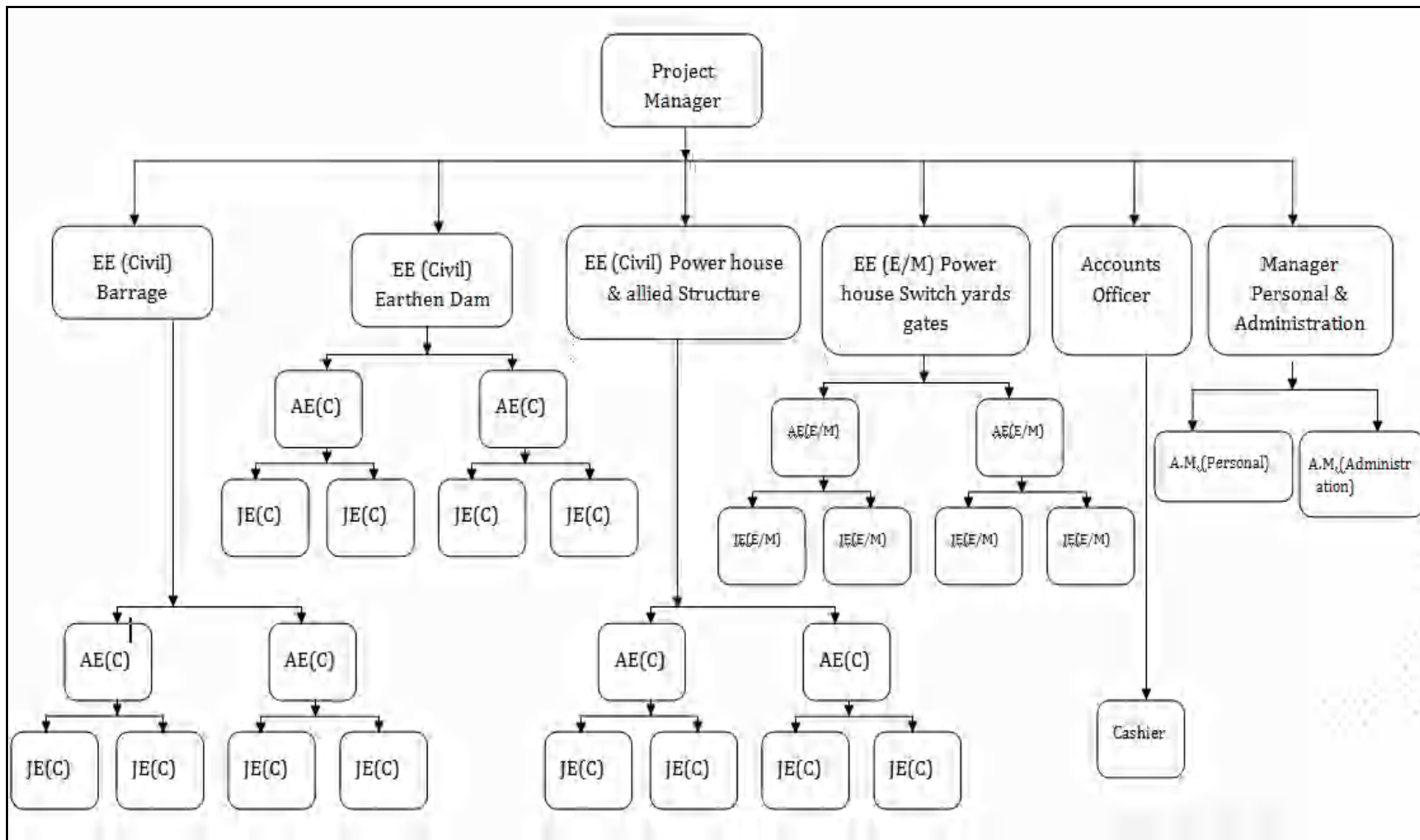


Figure 4-1 Organization Chart of DMHPP

Chapter 5 PROPOSED INFRASTRUCTURE

5.1 Industrial Area (Processing area)

The project works are planned to be awarded on contract. The earth moving and other equipment required for the works are to be procured and maintained by the Contractors. The project will have at its disposal only small and minimum equipment required for support services, maintenance of transports for project personnel and powerhouse. As such, small workshops are planned for repair and maintenance purpose only. Besides workshops, construction of explosive magazine, warehouse or storage area for cement, steel and other construction material are envisaged.

5.2 Non Processing Area/Residential Area

Most of the requirement of residential & nonresidential buildings will be met by acquiring existing vacant buildings of Water Resources Department, Bihar. These buildings are located near the Project site, and suitable to meet the requirement of the Project, after their repair & renovation. These buildings were constructed at Birpur at the time of construction of Bhimnagar Barrage on river Kosi. Residential accommodation of 4310 sq.m has been considered under permanent residential building and 1150 sq. m for permanent non-residential buildings, which shall be utilized fully during the O&M phase of the plant. 2783 sq.m of residential accommodation have been considered under temporary residential building and 900 sq. m for temporary non-residential buildings.

5.3 Green Belt

It is proposed to develop greenbelt wherever possible around the perimeter of various project appurtenances, selected stretches along the periphery of water spread area, etc.

The general consideration involved while developing the greenbelt are

Local/nature trees growing upto 10 m or above in height with perennial foliage shall be planted around various appurtenances of the proposed project.

- Planting of trees shall be undertaken in appropriate encircling rows around the project site.
- Generally fast growing trees shall be planted
- Since, the tree trunk area is normally devoid of foliage upto a height of 3 m, it may be useful to have shrubbery in front of the trees so as to give coverage to this portion.

The plantation shall be at a spacing of 2.5 * 2.5 m. About 1,000 trees per hectare will be planted. The plantation and maintenance of the plantation area shall also be done by the project proponents in association with the forest department. The selection of species for greenbelt development and afforestation shall be done in consultation with state Forest Department.

5.4 Social Infrastructure

About 1500 households located on the temporary islands within the river would fall in the submergence area of the proposed project. They will be rehabilitated and resettled by Bihar State Hydro Electric Power Corporation.

5.5 Connectivity (traffic and transportation road/ Rail/ Metro/ Water ways etc.,)

Road transport network is good covering almost all places in Bihar. National Highway-57 (East-West corridor) is only 1 km from the project site. A well-developed road along eastern flood

embankment connects the project site with this highway at Bhaptiahi village. So, there is no need of any improvement or development of this road for carrying of heavy machineries and equipments.

The project site is about 250 km away from Patna and well connected by road. National Highway NH-57, which connects Purnea to Muzaffarpur via Forbesganj and Darbhanga is crossing the Kosi river just 10 km downstream of proposed Dagmara barrage, and is approachable from both ends of the proposed barrage via embankment roads.

5.6 Drinking Water management (Source & Supply of water)

The domestic water required has been estimated as 0.182mld. Water will be used from Kosi River for the construction and other activity and for drinking purpose water will be used from Tanker supply.

5.7 Sewerage System

It is assumed that about 80% of the water supplied will be generated as sewage. Thus, total quantum of sewage generated is expected to be of the order of 0.15 mld. The quantum of sewage generated is not expected to cause any significant adverse impact on riverine water quality. Adequate facilities for sewage treatment including secondary treatment units shall be commissioned to ameliorate whatever marginal impact that is expected to occur.

5.8 Industrial Waste Management

No industrial waste will be generated from the project.

5.9 Solid Waste Management

The average per capita solid waste generated is of the order of 210 gm/day/person. The solid waste likely to be generated from labour camps shall be of the order of 0.52 tonnes/day. Adequate facilities for collection, conveyance and disposal of solid waste needs to be developed.

For solid waste collection, IS number of masonry storage vats, each of 2 m capacity shall be constructed at appropriate locations in various labour camps.

These vats shall be emptied at regular intervals and the waste so collected can then be transported to landfill site.

5.9.1 Muck Management

Muck generated from the construction activities will be used as aggregate for construction to the maximum possible extent, if found suitable from laboratory tests. The balance muck will be dumped in a proper manner with due compaction in layers in the designated dumping areas. Further, after completion of excavation works of the major components, the dump areas will be covered with vegetation and side slope with or stone pitching to minimize rain cut/soil erosion thus making the slope stable. The generated muck to some extent will be useful for the construction of roads, land development of low-lying areas, aggregate for concrete work etc.

5.10 Power Requirement & Supply / source

Power is required for operating the construction machineries during the construction phase, which can be met from Bihar electricity Board (NBPDC) or by DG set.

Chapter 6 REHABILITATION AND RESETTLEMENT (R&R) PLAN

6.1 Policy to be adopted (Central/State) in respect of the project affected persons including home oustees, land oustees and landless laborers (a brief outline to be given)

The private land required for project mainly lies within the flood plain of the river. The total private land requirement under the project covered under 20 villages, of which 10 are fully affected and 10 villages are partially affected. Socio-economic survey of project affected families has been conducted and a detailed Resettlement & Rehabilitation Plan is to be prepared and incorporate in the EIA report

The landowners were compensated for the assets acquired and grants as mentioned under:

- R&R policy, 2009
- Land acquisition Act 2013

Table 6-1: Details of land to be acquired for various project appurtenances

S. No.	Project Appurtenance	Area (ha)
1	Submergence	7790
2	Barrage	27.20
3	Dam	39.00
4	Powerhouse	2.15
5	Switchyard	2.00
Total		7860.35

Chapter 7 PROJECT SCHEDULE & COST ESTIMATES

7.1 Likely Date of Start of Construction and Completion

As the project is in stage of DPR preparation and the tentative project construction period is considered as 54 months that will be 60 months including pre-construction period of 6 months.

7.2 Estimated project cost along with analysis in terms of economic viability of the project.

Cost estimation of Dagmara HE Project, Bihar has been worked out by calculating the quantities of different items of work involved and multiplying the respective items with the applicable unit rates. The applicable unit rates, in turn are based upon cost of material, cost of transportation as prevailing in the state of Bihar; and the labour rates. The rates adopted in the estimate have been taken from the limited schedule of rates for works of Water Resources Department, Bihar (SOR 2011) and revised in November 2012. Due to very high per unit cost of power the project could not be financially viable. The DPR is being updated to optimize the design and reduce the per unit cost to make it a viable proposition.

Total estimated cost of the project is Rs. 2553.63 Crores. Summary of cost is given as under:

Table 7.1. Summary of Cost

Sl. No.	Description	Amount (in Rs. Crores)
1	Civil Works*	2299.13
2	Electro-Mechanical Works	249.50
3	Cost of Transmission Lines	5.00
	Total	2553.63

Chapter 8 Analysis of Proposal (Final Recommendations)

8.1 Financial and social benefits with special emphasis on the benefit to the local people including tribal population, if any, in the area.

The proposed multipurpose Dagmara Hydro Electric project envisaged several development, facilities and recreational scope as follows;

- There will be enhancement in the Flood control of Kosi River.
- Dam will also bridge both banks with road connectivity.
- The project will bring social development and prosperity in area.
- The project will provide employment to the local population in construction phase and in operation phase as well.
- The CSR will help in the development of the required facilities for the general public of the area.
- There will be good opportunities for ecotourism that will also create employment for the local population.
- The availability of the electricity will be highly beneficial for the cost effective industrial activities which will bring further prosperity in the area.
- Possibilities for enhanced and well managed fisheries.
- Possibilities of floating solar panel installation.
- Possibilities of canal and irrigation facilities in future.

8.2 Conclusion

Proposed Multipurpose project will not only arrest the Kosi flood events but will also develop the scope for several development and recreational activities. The project will be a boost to power generation status of the Bihar. This will create opportunities of employment and will encourage eco-tourism in the area.

The CSR associated activities will add several kinds of facilities in the area that will improve the quality of life by providing, primary education, primary health care, woman and child welfare practices, medical camp etc.

Therefore, the implementation of the proposed project is highly recommended in the favour of society and in the state as well as national.