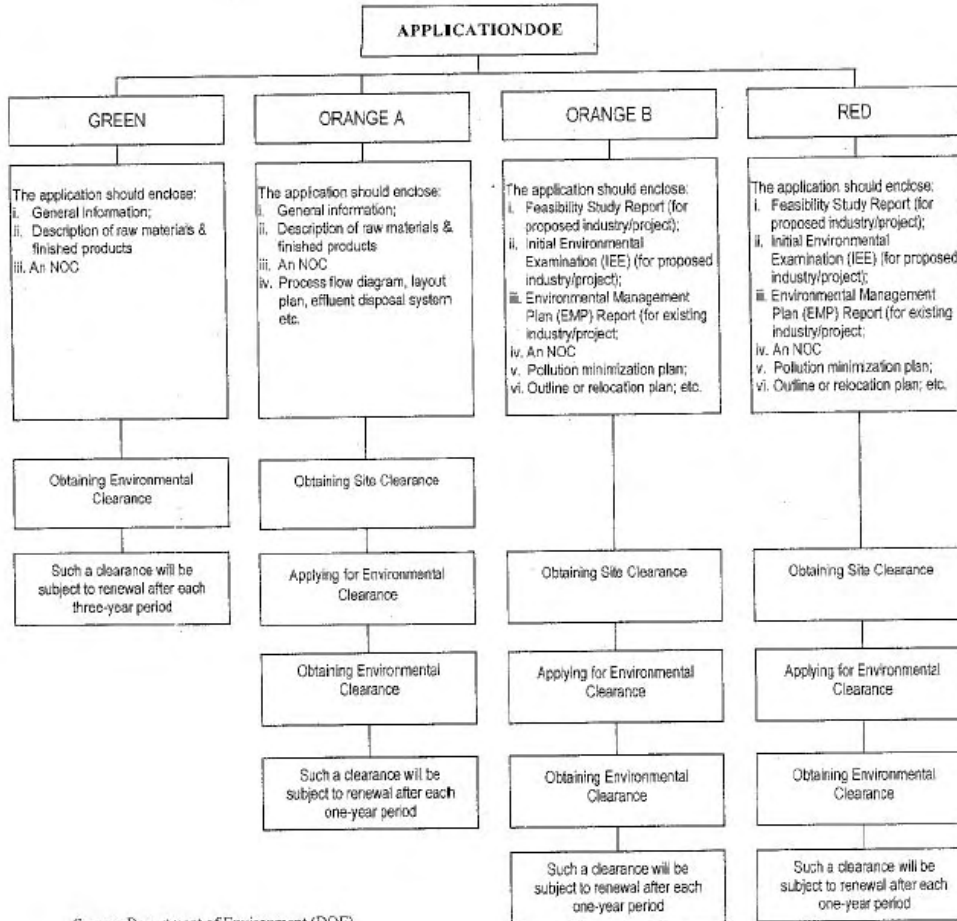


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Source: Department of Environment (DOE)

Figure 2.2: Steps Involved in Environmental Clearance

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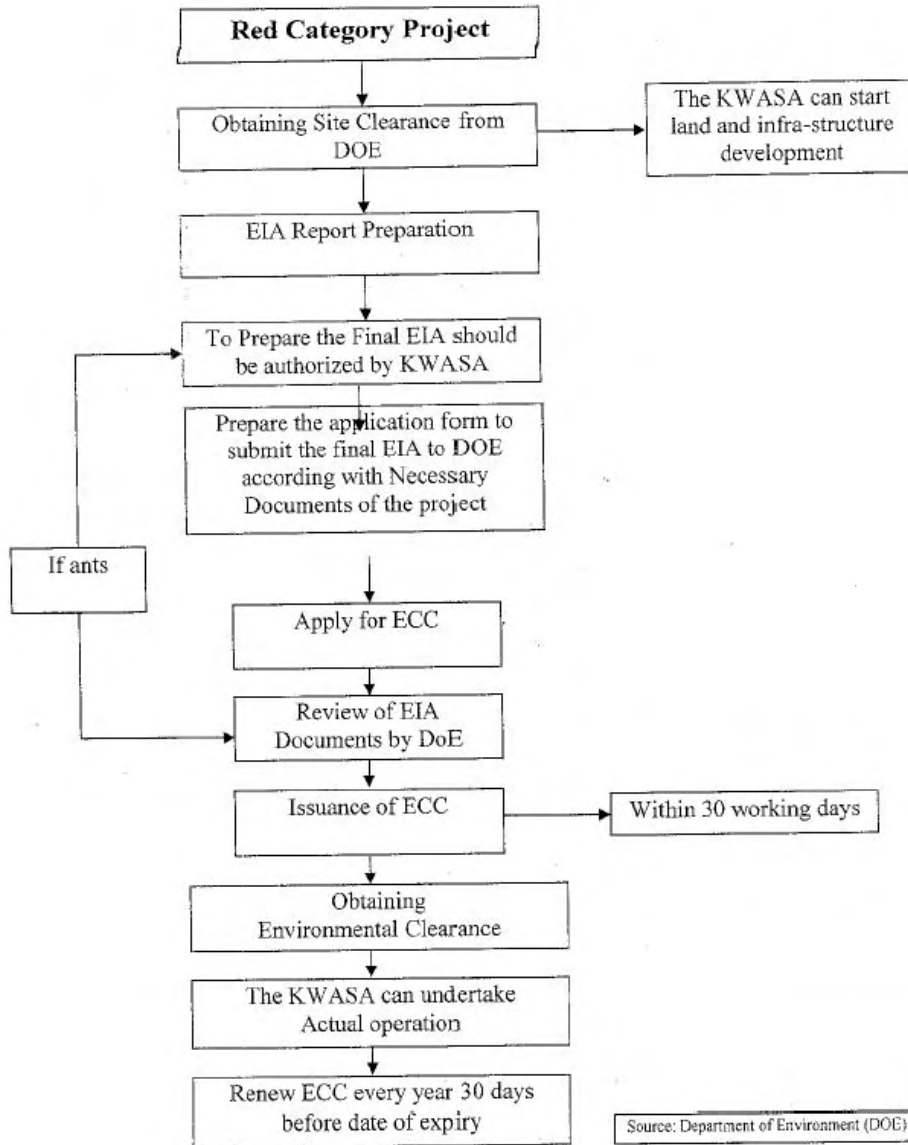


Figure 2.3 Flow Chart of Environmental Clearance Procedure

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2.11 Compliance with International Requirement

Bangladesh has agreed to, approved or signed a number of major international treaties, conventions and protocols related to environment protection and conservation of natural resources.

2.11.1 Rio Declaration 1992

United Nations Conference on Environment and Development (UNCED) adopted the global action program for sustainable development called 'Rio Declaration' and 'Agenda 21'. Principle 4 of the Rio Declaration, 1992, to which Bangladesh is a signatory along with a total of 178 countries, states, "In order to achieve sustainable development, environmental protection should constitute an integral part of the development process and cannot be considered in isolation from it".

2.11.2 Convention on Biological Diversity, Rio de Janeiro, (1992)

The convention on Biological Diversity, Rio de Janeiro, 1992 was adopted on 05 June, 1992 and entered into force on 29 December 1993. Bangladesh ratified the Convention on 20 March, 1994. This is the overarching framework for bio-diversity and the signatories are required to develop a National Bio-diversity Strategy and Action Plan that incorporates the articles of the convention into national law and statutes.

Obligation has been placed on State parties to provide for environmental impact assessments of projects that are likely to have significant adverse effect on biological diversity.

2.11.3 Convention on Wetland of International Importance Especially as Waterfowl Habitats, Ramsar (1972)

The Ramsar Convention was adopted on 02 February 1971 and entered into force on 21 December 1975. Bangladesh has ratified the Convention on 20 April 2002. This provides a framework for national action and international cooperation for the convention and wise use of wetlands and their resources. There are 172 parties with 1085 wetland sites designated as 'Wetlands of International Importance'.

This is an intergovernmental treaty, which provides the framework for international cooperation for the conservation of wetland habitats. Obligation for Contracting Parties include the designation of wetlands to the "List of Wetland of International Importance", the provision of wetland considerations within their national land use planning, and the creation of Natural Reserves.

Bangladesh has two Ramsar Sites- (i) Parts of Sundarban Reserved Forest (Southwest of Bangladesh) and (ii) Tanguar Haor (Northeast of Bangladesh).

2.11.4 Others (Convention and Agreements)

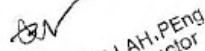
The following conventions and agreements may include provisions relevant to different aspects of project operations for environmental management, nature protection, and biodiversity conservation:

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- Convention relating to the Preservation of Fauna and Flora in their Natural State 1993;
- *International Convention for the Protection of Birds, Paris, 1950;*
- International Plant Protection Convention, Rome, 1951;
- Convention concerning the Protection of the World Cultural and Natural Heritage, Paris, 1972 has been ratified by 175 states. This defines and conserves the world's heritage by drawing up a list of natural and cultural sites whose outstanding values should be preserved for all humanity. Of the 730 total sites, there are currently 144 natural, 23 mixed and 563 cultural sites that have been inscribed on the World Heritage List (distributed in 125 State parties);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973 (known as CITES): this provides framework for addressing over harvesting and exploitation patterns which threaten plant and animal species. Under CITES governments agree to prohibit or regulate trade in species which are threatened by unsustainable use patterns; and
- Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 1979 (Amended 1988): This provides a framework for agreements between countries important to the migration of species that are threatened.



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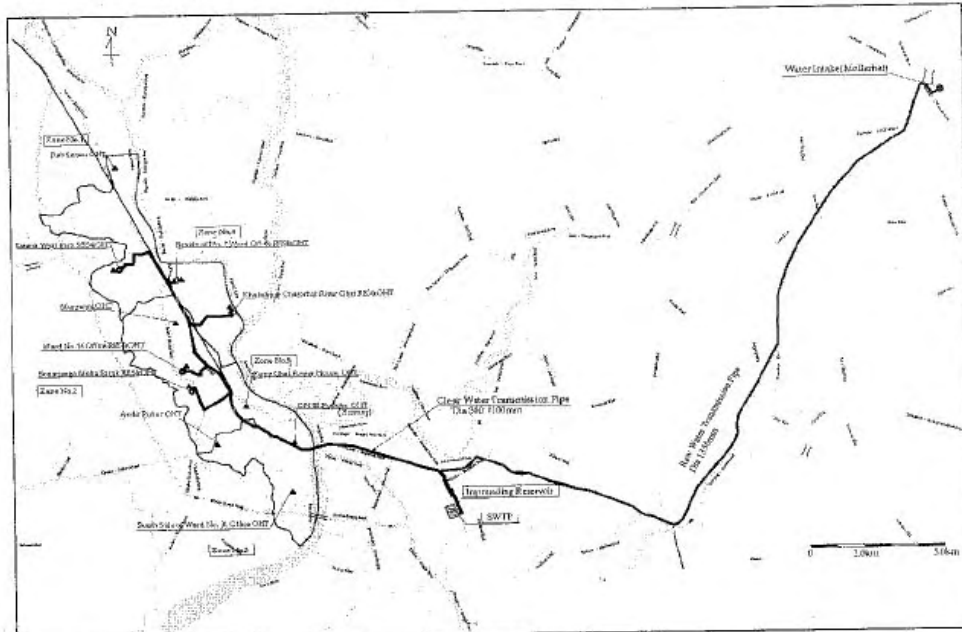
PROJECT DESCRIPTION

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CHAPTER 3 THE PROJECT DESCRIPTION

3.1 Project Locations

The project covers the whole area of Khulna City Corporation (KCC) and a part of Phultala Thana. The Location of proposed water supply systems are shown in **Figure 3.1**



Source: Feasibility Study for Khulna Water Supply Improvement Project, 2010 JICA Study Team

Figure 3.1 Project Location Map

3.2 Project Components

The “Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team”, has proposed several project components as follows:

- Raw water is collected from the Madhumati River at Mollarhat
- The collected water is sent to a Surface Water Treatment Plant (SWTP) at Samanto Sena by a raw water transmission pipe of the diameter 1,350 mm and the length 33km.
- An impounding reservoir at Samanto Sena is necessary to store non saline raw water during wet season when salinity concentration is less than 1000 mg/L in the river.
- Treated water at the SWTP is sent to five distribution reservoirs in Khulna city by clear transmission pipe of diameter 300 mm to 1,100 mm.
- The length of clear water transmission pipe is about 25 km in total.
- Store clear water in distribution reservoir in order to proper distribution of water in response to water demand for five service zones in Khulna city.
- Eleven (11) overhead tanks are use for sufficient water pressure and also for some water reserve required for the consumers. The overhead tanks are filled with clear water pumping from distribution reservoir.

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> Distribution pipe will be constructed to supply water to the consumer end.

Table 3.1 shows a summary of the proposed water supply facilities for year of 2025.

Table 3.1 Summary of Proposed Water Supply Facilities

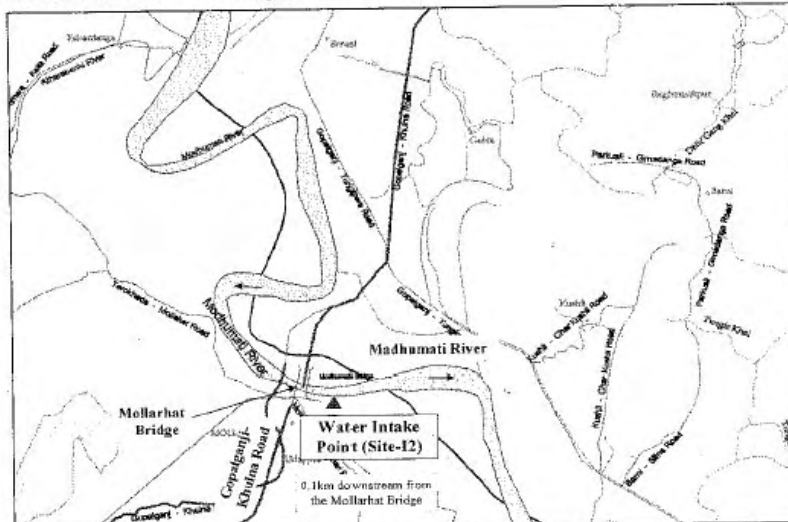
Project Components	Capacity	Quantity	Dimension (m)	Area	Location
1 Water Intake Facility	110,000m ³ /day	1 nos	75 x 125 + Access Road 120m	1.0ha	Madhumati River at Mollarhat
2 Raw Water Transmission Pipe	-	ø1,350mm, L=33km		See Figure 10.1.1	
3 Impounding Reservoir	775,200m ³	1 nos	400 x 400	16ha	Samanto Sena
4 SWTP	110,000m ³ /day	1 nos	250 x 400	10ha	Samanto Sena
5 Clear Water Transmission Pipe	-	Ø300mm-1100mm, L=25km		See Figure 10.1.2	
6 Distribution Reservoir & Overhead Tank (5 nos)	Reservoir (5,000m ³ - 18,000m ³) OHT (300m ³ - 500m ³)	Deana West Para Reservoir	100 x 70	0.7ha	Paddy Land
		Ward No.16 Office Reservoir	100 x 70	0.7ha	KCC Land
		Somadanga Moha Sarak Reservoir	100 x 90	0.9ha	Private Land
		Beside of No.7 Ward Office Reservoir	100 x 70	0.7ha	Personal Land
		Khadishpur Charehat River Ghat Reservoir	100 x 90	0.9ha	Government Land (KASS)
7 Overhead Tank (6 nos)	300m ³	Rab Sarani OHT	45 x 30	0.14ha	Private Land
	300m ³	Mujganji OHT	45 x 30	0.14ha	KCC land
	300m ³	Ferry Ghat Power House OHT	45 x 30	0.14ha	KCC land
	500 m ³	Andir Pukur OHT	50 x 35	0.18ha	Private Land
	500 m ³	South Side of Ward No.31 Office OHT	50 x 35	0.18ha	Paddy land
	500 m ³	DPHE Rupsha OHT	50 x 35	0.18ha	DPHE
8 Distribution Pipe Network	-	ø50mm-400mm, L=700km		See Figure 3.7	

Source: Feasibility Study for Khulna Water Supply Improvement Project, 2010 JICA Study Team

3.2.1 Water Intake Facility

(1) Water Intake Facility in Morallahat

Water intake site was selected at Mollarhat of which detail location is selected Site-I2 (0.1 km downstream from the Mollarhat Bridge) shown in Figure 3.2.



Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

Figure 3.2 Location of Water Intake Point

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(2) River Water Level

BWDB has been conducted water level measurement at Mollarhat along the Madhumati River since 1929 to present. Table 3.2 shows the High and Low water level at Mollarhat.

Water Level	m (PWD)
High Water Level (HWL)	+4.60
Low Water Level (LWL)	-0.20

Source : Calculated by JICA study team based on BWDB DATA

(3) Ratio of River Water Flow and Water Abstraction

The project plans that the ratio for Mollarhat point requires 0.52%. Therefore, it can be mentioned here that 5% abstraction of water is considered safety amount to intake water from the river.

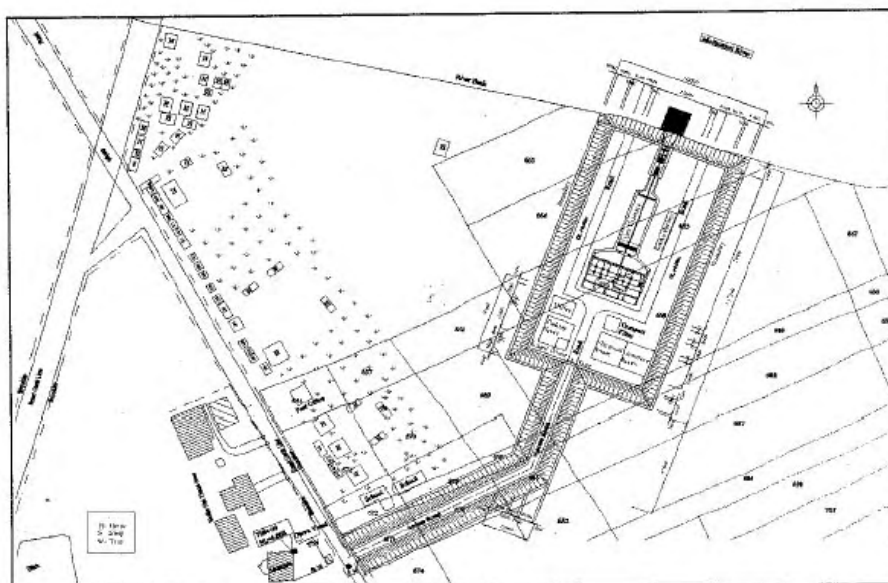
(4) Proposed Ground Level

JICA Study Team proposed that the Ground level of water intake facility is +6.00 m (PWD), based on following investigation and examination.

- Existing road level in front of water intake is +5.50 m.
- Past record of flood level based on interview of 10 residents around proposed water intake site is +4.50 m. (1m below from existing Road)
- High water level measured by BWDB from 1929 to 2008 is +4.53 m.

(5) Layout plan for Water Intake Facility

Figure 3.3 shows a Layout Plan for the water intake in Mollarhat.



Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

Figure 3.3 Layout of Water Intake

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(6) Elector-Mechanical Equipment for Intake

Several electro-mechanical equipment for the water intake facility are proposed to be installed as shown in Table 3.3.

Table 3.3 Electro-Mechanical Equipment for Intake

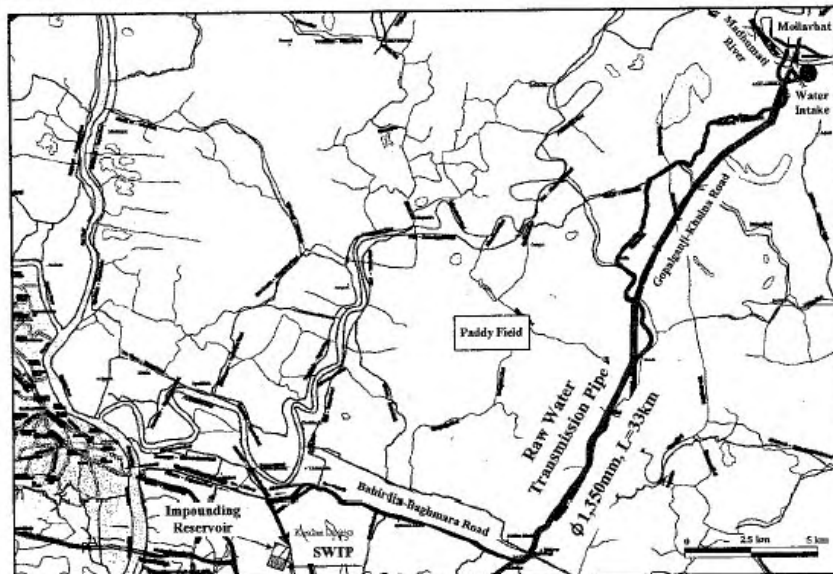
Item	Description
Intake Pump	Intake pumps are Vertical double suction volute pump with dry sump selected by safety against flood, high efficiency, superior cavitations characteristic, O&M, etc
Inflow Screen and Grit Chamber	The raw water will be introduced from the river to pump well through the gate, inflow screen with opening 100 mm, grit chamber. Inlet and outlet gates will be provided with each chamber for maintenance
Power Receiving Facilities	Taking into account the situation of power distribution one line incoming system is applied for the power receiving method with power generator for backup in case of power failure. The total capacity is 1.5 times of the calculated capacity. Two transfers are to be installed in case one of them is out of order the other one will cover 75 % of the total capacity.
Standby Generator	Diesel engine generator will be applied for standby power generator. For water intake, two sets of diesel engine generator cubicle package type will be applied so as to ensure the failure of the synchronizer and or one strain operation.
Motor Control and Operation	Power control panel will be applied for water intake because the loads number is comparatively few and almost loads are large capacity that is not able to built-in the motor control center (MCC). Automatic operation should be applied for water intake facilities and central operation from the surface water treatment plant will not be adopted. For water intake, the river water level meter, pump pit water level meter and water transmission flow meter will be installed. The type of river water level meter is submersible and pump pit water level meters are both submersible type and differential pressure type. Water transmission flow meter is applied for electro-magnetic type.

Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

3.2.2 Raw Water Transmission Pipe

(1) Route of Raw Water Transmission Pipe

The routes of raw water transmission pipes are proposed to be installed in the Gopalganj-Khulna Road and Bahirdia-Baghmara Road as shown in Figure 3.4. This pipe is planned to be constructed under the existing roads.



Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

Figure 3.4 Raw Water Transmission Pipe, Impounding & SWTP

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(2) Pipe Material for Raw Water Transmission Pipe

Ductile cast iron pipes (DIP) is selected for raw water transmission pipe considering durability, pipe joint work, soft soil condition and cost. Diameter of the proposed raw water transmission pipes is 1,350mm.

3.2.3 Impounding Reservoir

(1) Location of Impounding Reservoir

Location of proposed impounding reservoir is at Samanto Sena near Bahirdia-Baghmara Road southern of Khulna city as shown in Figure 3.4.

(2) Design Condition of Impounding Reservoir

Table 3.4 shows design condition for impounding reservoir.

Table 3.4 Design Condition for Impounding Reservoir

Item	Design Condition
Effective Water Depth:	12.0 m
Required Land Area:	16 ha (including 6 ha for expected future expansion)
Area of Impounding Reservoir:	10 ha

Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

(3) Mechanical Equipment

A single pipe of 1,100 mm dia. and of about 100 m long is planned to be installed for the project flow (110,000 m³/d) from the impounding reservoir to the SWTP.

(4) Electrical Equipment

Table 3.5 shows electrical equipment to be installed in the Impounding reservoir.

Table 3.5 Electrical Equipment for Impounding Reservoir

Equipment	Description
Power Receiving Facilities	Taking into account the situation of power distribution one line incoming system is applied for the power receiving method with power generator for backup in case of power failure. The total capacity is 1.5 times of the calculated capacity. Two transfers are to be installed; in case one of them is out of order the other one will cover 75 % of the total capacity.
Standby Generator	Diesel engine generator will be applied for standby power generator.
Motor Control and Operation	Power control panel will be applied for impounding reservoir because the loads number is comparatively few and almost loads is large capacity that is not able to built-in the motor control centre (MCC) same as water intake.
Instrumentation	For impounding reservoir, the reservoir water level meter and raw water transmission flow meter will be installed. The type of level meter is submersible and raw water transmission flow meter is applied for electro-magnetic type.

Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

3.2.4 Surface Water Treatment Plant (SWTP)

(1) Location of SWTP and Ground Level

Location of proposed SWTP is at Samanto Sena near Bahirdia-Baghmara Road southern of Khulna city as shown in Figure 3.4.

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(2) Ground level

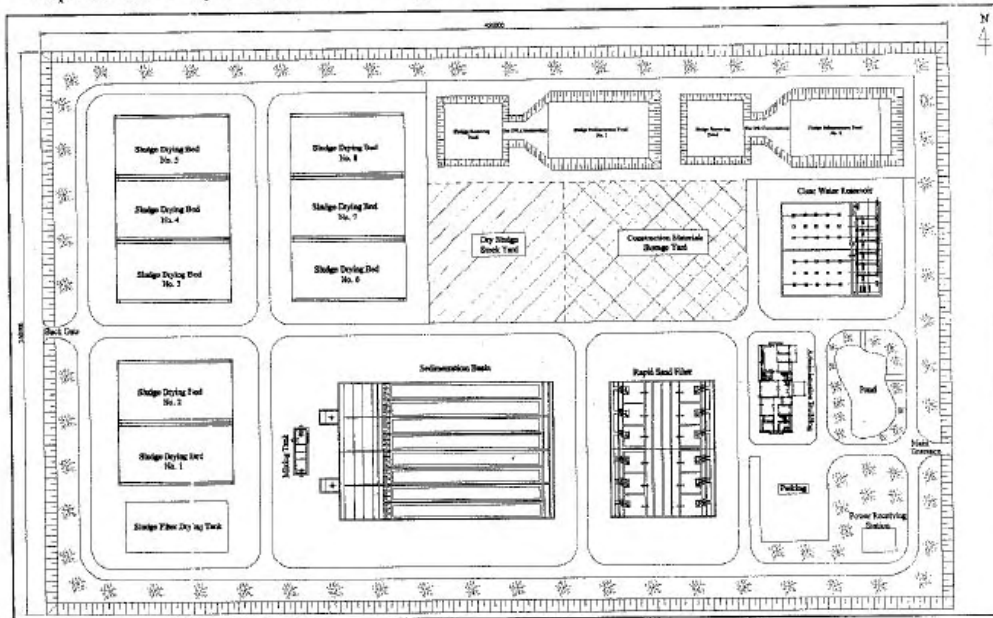
Ground level of SWTP is set +4.10 m (PWD) considering road level (+4.059 m) near by SWTP and the highest flood level (+3.360 m) in past record.

(3) Layout Plan of SWTP

SWTP layout plan is conducted by following conditions.

- Buffer zone is ensured at south side area since the impounding reservoir constructed neighboring SWTP is 12 m of depth
- Layout plan is considered future expansion plan. Expansion area is used for the sludge drying bed at present.
- As facility arrangement, administration building and power receiving facility are arranged near the entrance gate, sludge drying bed is arranged deep into SWTP site, and clear water reservoir will be constructed near the clear water transmission pipe route considering water flow.

Proposed SWTP layout is illustrated in Figure 3.5.



Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

Figure 3.5 Layout Plan of SWTP

(4) Design Criteria for SWTP

Table 3.6 summarizes design criteria for SWTP.

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Table 3.6 Design Criteria for SWTP

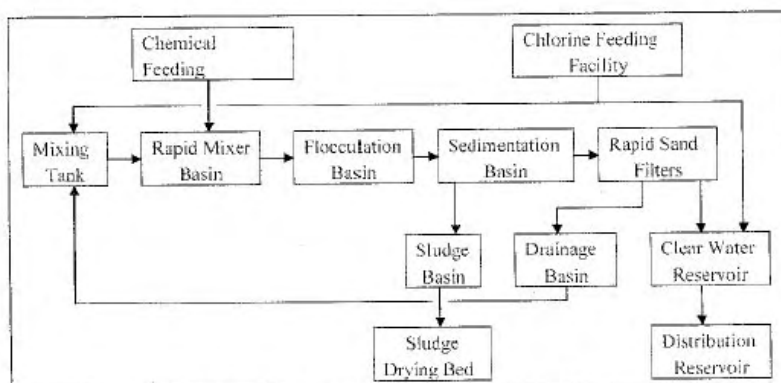
	Mixing Tank	Flocculation Basin	Sedimentation Basin	Rapid Sand Filter	Clear Water Reservoir
Type/ Shape	Vertical Channel Bend	Vertical Channel Bend	Rectangular	Gravity Type	Rectangular
GT Value ^{*)}	More than 23,000	-	-	-	-
Retention Time	3 min	30 min	-	-	More than 1.0 hr
Velocity	-	15 – 30 cm/sec	Less than 0.28 m/min	-	-
Surface Loading	-	-	26 mm/min	120 m/day	-
Effective Depth	-	-	4.0 m	-	4.0 m

*) GT Value: Indicator for effectiveness of flocculation mixing

Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

(5) Water Treatment Method

Coagulation-Sedimentation + Rapid Filter Process are applied as a water treatment method. Flowchart of water treatment is illustrated as shown in Figure 3.6.



Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

Figure 3.6 Flowchart of Surface Water Treatment Plant

(6) Mechanical Equipment

Table 3.7 shows mechanical equipment to be installed in the Impounding reservoir.

Table 3.7 Mechanical Equipment for SWTP

Equipment	Description
Clear Water Pump	A single pipe of 1,100 mm diameter and about 10,000 m long will be installed for the project flow of 110,000 m ³ /day from the clear water pump station to distribution reservoir, which would transfer clear water to the five distribution reservoir, by clear water pump.
Chemical Dosing Facilities	<ul style="list-style-type: none"> - Alum: As coagulation, alum dosing facilities consist of dissolving tanks and dosing devices. Diaphragm pump is recommended for chemical pump due to simple and economy. - Lime: As pH control, lime dosing facilities consist of dissolving tanks and dosing devices. Diaphragm pump is recommended for chemical pump, due to less clogging. - Chlorination: The chlorination will be done at two dosing points in the proposed SWTP. One of the dosing points is at receiving well as pre-chlorination and the other is at filter outlet as post-chlorination.

Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

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(7) Electrical Equipment

Table 3.8 shows electrical equipment to be installed in SWTP.

Table 3.8 Electrical Equipment for SWTP

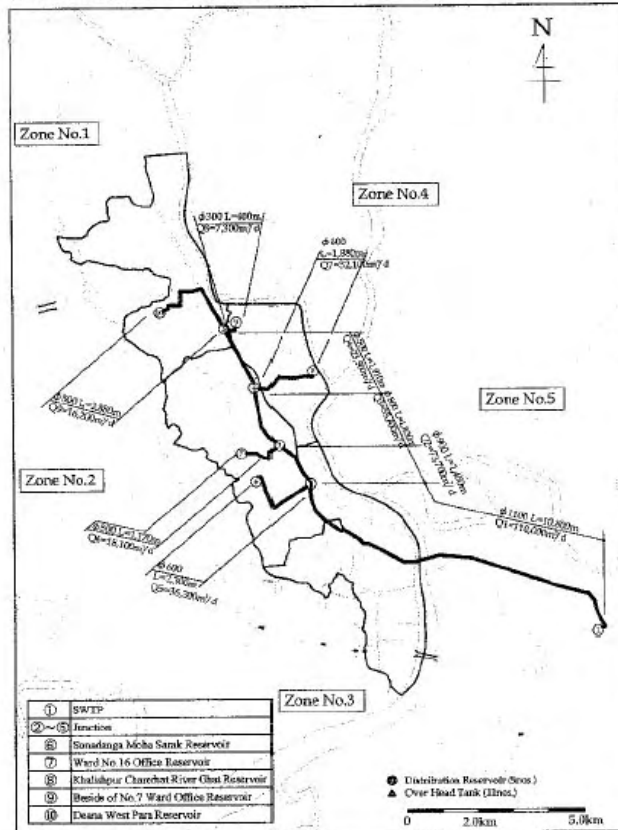
Equipment	Description
Power Receiving Facilities	Taking into account the situation of power distribution, medium voltage one line incoming system is applied for the power receiving method with power generator for backup in case of power failure same as water intake. The total capacity is 1.5 times of the calculated capacity. Two transfers are to be installed; in case one of them is out of order the other one will cover 75 % of the total capacity
Standby Generator	Diesel engine generator will be applied for standby power generator.
Motor Control and Operation	Motor control center (MCC) will be applied for the facilities there locate many numbers and small load like a rapid filter of SWTP. Site control panel will be applied for the load, the starter of it is installed in MCC.
Instrumentation	For SWTP, inflow meter, wash wastewater return flow meter, clear water transmission flow meter and water level meter for each tank will be installed. Water turbidity, pH, water temperature, salinity, chromaticity, conductivity, alkalinity measurements for raw water, salinity for filtrated water and turbidity and residual chlorine will be measured once a day by laboratory instrument equipment.

Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

3.2.5 Clear Water Transmission Facility

(1) Diameter and Route of Clear Water Transmission Pipe

The clear water transmission pipe line with pipe length of 24.6 km is shown in Figure 3.7.



Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

Figure 3.7 Clear Water Transmission Pipe

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(2) River Crossing Method

As river crossing method, "pipe jacking method" has been selected by the advantage of construction work taking into account of environmental impact, simplified or temporary work and construction cost.

(3) Transmission Method

Clear water transmission facility is the pipeline to send clear water from SWTP to distribution reservoir. Direct transmission method by pump is adopted since ground level from SWTP to Khulna city is almost flat.

(4) Mechanical Equipment

Table 3.9 shows mechanical equipment to be used for the Clear Water Transmission Facilities.

Table 3.9 Mechanical Equipment for Clear Water Transmission Facilities

Equipment	Description
Distribution Pumps	A single pipe of 250 - 400 mm dia and about 100 - 8200 m long will be installed for the project total amount flow rate of 110,000 m ³ /day from the distribution reservoir to overhead tank, which would transfer clear water to the eleven overhead tanks by distribution pump. Dry well horizontal end suction volute pumps are recommended for the clear water transmission. The proposed specifications for the Distribution Pumps will be as follows in Table 3.10.
Chlorination	The chlorination facilities will be installed in five distribution reservoir because underground water is transferred to the distribution reservoir from existing tube well. The chlorination facilities consist of chlorine cylinders, weighing devices, chlorinators, injectors and safety devices. Specification of chlorinator shall be design considering wide range.

Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

Table 3.10 Proposed Specification of Distribution Pump

Reservoir zone	Zone 1	Zone 1	Zone 2	Zone 2	Zone 3	Zone 3	Zone 3	Zone 4	Zone 5	Zone 5	Zone 5
Overhead Tank Name	Raj Sarani	Deena West Para	Muggani	Ward No.16 Office	Sonadeng Moha Sarak	Andir Pukur	South Side of Ward No.11 Office	Beside of No.7 Ward Office	Chaitshpur Charehat River Ghat	Pony Ghat Power House	DPHE Rupaha
Pump Type	End suction	End suction	End suction	End suction	End suction	End suction	End suction	End suction	End suction	End suction	End suction
Capacity (m ³ /min)	3.2	5	3.1	3.3	4.5	3.7	2.3	5.1	4.6	2.6	3.8
Pump Number	2D +1S	1D +1S	2D +1S	2D +1S	2D +1S	2D +1S	4D +1S	1D +1S	2D +1S	2D +1S	3D +1S
Rated Head	56.0	35.0	53.0	34.0	34.0	52.0	72.0	33.0	34.0	70.0	65.0
Motor Power (kW)	55	45	45	30	45	55	45	45	45	55	55

* D means drive, S means stand-by regarding Pump Number.
Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

3.2.6 Electrical Equipment

Table 3.11 shows electrical equipment to be used for the Clear Water Transmission Facilities.

Table 3.11 Electrical Equipment for Clear Water Transmission Facilities

Equipment	Description
Power Receiving Facilities	Taking into account the situation of power distribution, one line incoming system is applied for the power receiving method with power generator for backup in case of power failure. One transformer will be installed because of the small scale facility and also damage scale is comparatively small when the accident will occur.
Standby Generator	Diesel engine generator will be applied for standby power generator. Fuel storage capacity is the tank capacity that is built-in the cubicle package.
Motor Control and Operation	Power control panel will be applied for distribution reservoir because the loads number is comparatively few. Automatic operation should be applied for distribution reservoir and overhead tank facilities. The water level of distribution reservoir is controlled mechanically by float valve.

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Instrumentation	For distribution reservoir and overhead tank, inlet water flow, distribution water flow, distribution reservoir water level and the water level of overhead tank will be installed. The type of water level meter is differential pressure type because of its simple mechanism and high accuracy. Residual chlorine shall be measured once a day by laboratory instrument equipment.
Supervisory System	The overhead tank water level will be sent to the distribution reservoir by radio detector and this information will be sent to SWTP with the information of distribution reservoir like water level, inlet water flow etc., two or four times a day. An emergency such as failure, alarm information and the signal that is necessary to control pump will be sent at any time to the SWTP.

Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

3.2.7 Water Distribution System

Water Distribution system is functioning storage, transmission, distribution and supply for clear water. It consists of distribution reservoir, overhead tank, distribution pipe network, pumps, valve and other equipment. Distribution system is designed taking into account of the following matters.

- Water must be supplied with safety and proper water pressure corresponding to the demand which changes hourly
- Operation and maintenance is done by effective and simple
- To prevent clear water from pollution and change in water quality

(1) Distribution Reservoir and Overhead Tank

Table 3.12 summarizes function and water level of distribution reservoir and overhead tanks which are utilized as water distribution system.

Table 3.12 Function and water Level of Distribution Reservoir and Overhead Tank

	Distribution Reservoir	Overhead tank
Function	To respond to the time fluctuation, it also retains a role of reservation of water for emergency. Therefore following points have been taken into account to determine its location and capacity. <ul style="list-style-type: none"> • Distribution reservoir is located centre or near each distribution zone. • The volume of distribution reservoir is aimed at 12 hours for storage, which considered time fluctuation and countermeasure for emergency • Structure is considered durability, quake proof and water proof. 	To adjust distribution flow and water pressure. The purposes of overhead tank installation are as follows. <ul style="list-style-type: none"> • To adjust water distribution amount • To adjust water pressure in pump pressurization area • To use adjustment of both as distribution amount and pressurization
Water Level	Distribution reservoir will be constructed in underground, and the level of upper slab is set 1.0 m lower than average ground level GL+4.0 m. On the condition that thickness of upper slab is 0.3 m, allowance to the HWL is 0.3 m and effective depth is 5.0 m. Then the water levels of distribution reservoir are HWL+2.40 m, and LWL -2.60 m	Many buildings in Khulna city are two-story and three-story buildings. To supply water properly the height of overhead tank is set about 30 m from +4.0 m average ground level in Khulna city. Considering effective water depth 4.0 m the water levels of overhead are: HWL +27.4 m and LWL +23.4 m.

Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

(2) Volume of Distribution Reservoir and Overhead Tank

Table 3.13 summarizes the capacity of distribution reservoir and overhead tanks to be installed by the project and those locations are shown in Figure 3.8.


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Table 3.13 Capacity Distribution Reservoir & Over Head Tank

Zone	Block	Distribution Capacity (m ³)	Over Head Tank Capacity (m ³)
No.1	No.1-1	8,000	300
	No.1-2		300
No.2	No.2-1	9,000	300
	No.2-2		500
	No.2-3		500
No.3	No.3-1	18,000	500
	No.3-2		500
No.4	No.4-1	5,000	500
	No.4-2		500
No.5	No.5-1	15,000	300
	No.5-2		500

Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

(3) Water Distribution Network

Pipe diameter and length are decided by distribution network basis, and repetitious calculation is conducted until necessary water pressure is acquired. Distribution pipeline is classified four types; distribution trunk pipe, distribution main pipe, distribution branch pipe and small distribution pipe. Basic Design of Water Distribution Network is shown in Table 3.14.

Table 3.14 Water Distribution Network

Pipes	Description
Distribution Trunk Pipe:	Installation of Overhead Tank to Water Supply Zone, ϕ 350 to 400mm
Distribution Main Pipe:	Installation of Pipeline as Circular or to the Centre in the Zone. ϕ 300
Distribution Branch Pipe:	Pipeline is diverged from Distribution Main Pipeline, ϕ 200 to 150 mm

Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

Pipe material of distribution network is adopted DIP (ductile cast iron pipe) for main pipes. Pipe material of small distribution pipe with diameter of less than ϕ 200 mm is used PVC pipe and/or HDPE pipe.

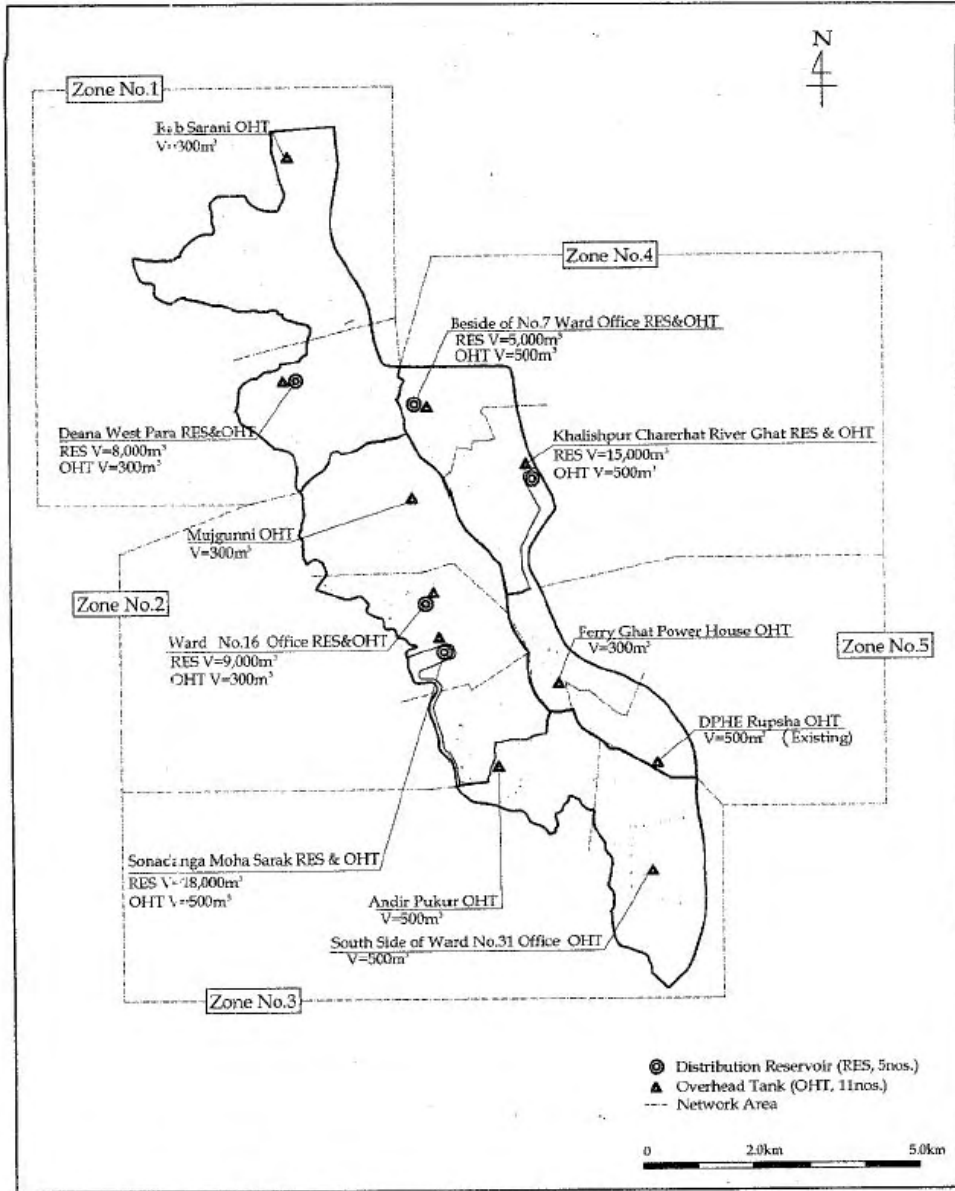
(4) Water Distribution Zones

The zones adjoin is connected by connection pipe each other to avoid the risk in order that water distribution network can be distributed or supply a certain volume of water at an emergency as shown in Figure 3.8.


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Source: Feasibility Study for Khulna Water Supply Improvement Project 2010 JICA Study Team

Figure 3.8 Zone Systems, Distribution Reservoir & Over Head Tank

3.17

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CHAPTER-04

**ENVIRONMENTAL BASELINE EXISTING
ENVIRONMENT**

CHAPTER 4 ENVIRONMENTAL BASELINE AND EXISTING CONDITIONS

4.1 Physical Environment

The physical environment refers to the external, tangible surroundings in which an organism exists and which can influence its behavior and development. It includes landforms, soil types and climate.

4.1.1 Location Map and Survey information

The project area comprises Khulna and Bagerhat district. The project activities are planned to be limited to Garfa Mouza of Mollahat thana in the Bagerhat District and Patharghata & Tilak Mouza of Rupsha Thana; Deyana mouza of Doulatpur Thana; Goalpara & Boira mouza of Khalishpur Thana; Choto Boira mouza of Sonadanga thana; MirerDanga mouza of Khanjahan Ali thana; Labarchora, Tutpara & Baniakhamar mouza of Khulna Sadar thana in the Khulna District. The details are attached in Appendix-4.1. Project location in south Asia is shown in Figure-4.1.

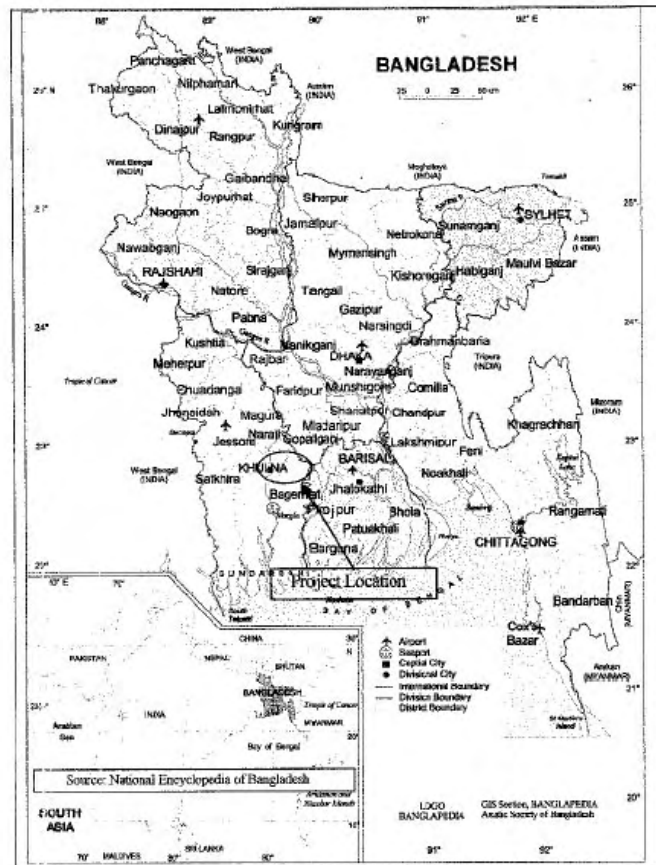


Figure-4.1: Project Location Map

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4.1.2 Geology and Soil Condition

The Structure and surface geology of Bangladesh are related to its tectonic evolution, which started during late Cretaceous period when the northward moving Indian plate collided with Eurasian plate. The collision caused the northern extremity of Bengal to separate into gulf of Assam and Burma. The tectonic map of Bangladesh shows that most of the west Bengal of India and whole Bangladesh are occupied by Bengal Basin, where the Precambrian basement lies more than 3 km below mean sea level. The Basin is bordered on the western side by the peninsular shield of India and on the eastern side by the Tripura-Naga Orogenic Belt. On the northeast, the basin is bordered by the Shillong Massif.

The surface geology of Bangladesh is essentially the geology of the sediment of only the Cenozoic era. The geological succession of Bangladesh shows that the sub-surface stratigraphy includes: the Precambrian, the Permian Gondwana sediments, the upper Jurassic Volcanic rocks, and a thin mantle of Cretaceous sedimentary rocks originating mainly from deposition of the denuded volcanic. Overlaying these deposits are the Tertiary limestones, sandstones and shales. Thus surficial geology of the country consist of Holocene deposits (80%), Tertiary sedimentary rocks (12%) and uplifted Pleistocene clay residual (8%). The Holocene deposits, consisting of unconsolidated sand, silt and clay of varying amounts, are the products of piedmont alluvial, fluvial, deltaic or coastal activities (Karim, 1999). Physiographic unit map of Bangladesh is shown in the **Figure- 4.2**.

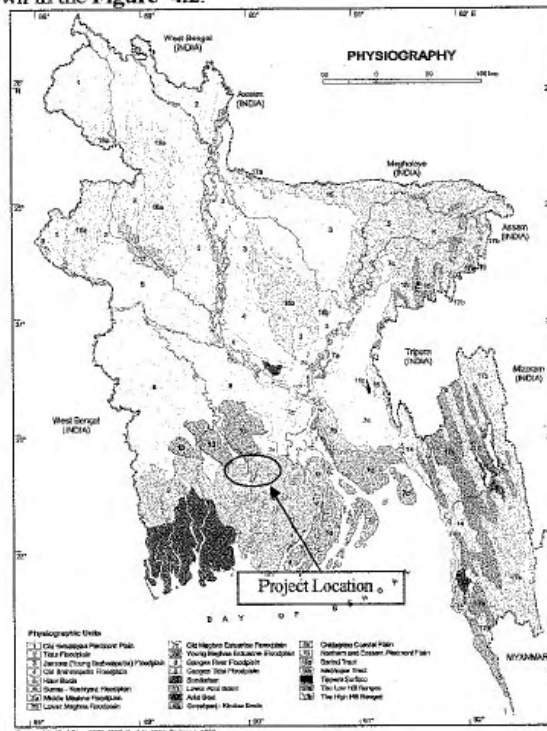


Figure 4.2: Physiographic Unit Map of Bangladesh

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(i) Khulna City: The Khulna City area consists of late Holocene to Recent Alluvium of the Ganges deltaic plain in north and tidal plain in south. The area is composed of sand, silt and clay in various proportions with small amount of coarse sand, which is classified into seven litho-stratigraphic units from base to top. Complexes of channels of fluvial/tidal origin, natural levees, bars, swamps and plains like floodplain, deltaic plains, estuarine plains or coastal plain constitute the Khulna City area. Channels (tidal as well as fluvial), natural levee, flood plain, flood basin, ox-bow lake, abandoned channels, bars, swamps/ flood basins and estuarine plain have been recognized as geomorphologic units within the Khulna City area.

(ii) Earthquake: Although Bangladesh is extremely vulnerable to seismic activity, the nature and the level of this activity is yet to be defined. In Bangladesh complete earthquake monitoring facilities are not available. The Meteorological Department of Bangladesh established a seismic observatory at Chittagong in 1954. This remains the only observatory in the country.

Accurate historical information on earthquakes is very important in evaluating the seismicity of Bangladesh in close coincidences with the geotectonic elements. Information on earthquakes in and around Bangladesh is available for the last 250 years. The earthquake record suggests that since 1900 more than 100 moderate to large earthquakes occurred in Bangladesh, out of which more than 65 events occurred after 1960. This brings to light an increased frequency of earthquakes in the last 30 years. This increase in earthquake activity is an indication of fresh tectonic activity or propagation of fractures from the adjacent seismic zones.

Before the coming of the Europeans, there was no definite record of earthquakes. From 1548 to 2010 earthquake history no major earthquake is found in the project area. Figure-4.3 the project area is comparatively in safe zone considering earthquake disaster.

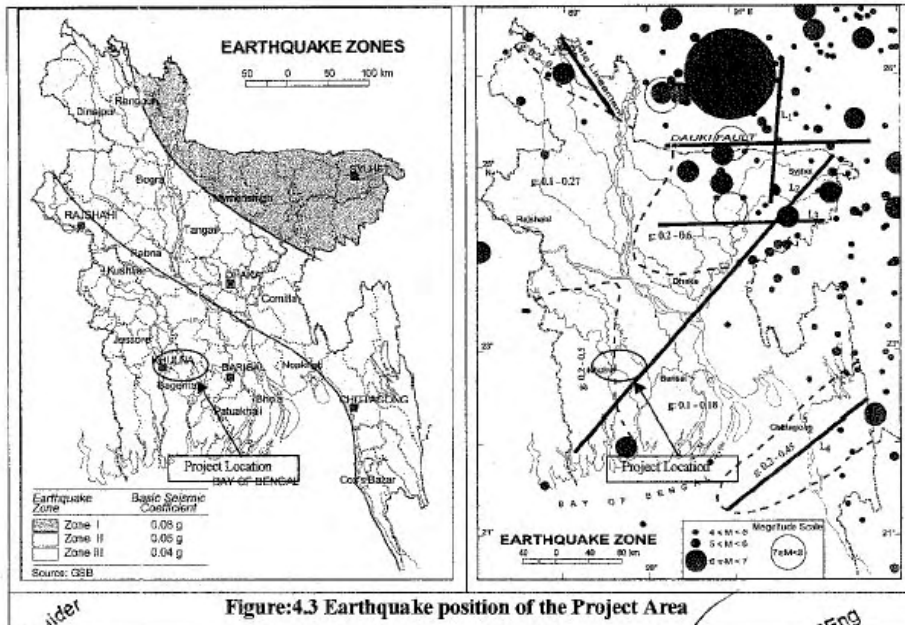


Figure:4.3 Earthquake position of the Project Area

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(iii) Soil in Khulna: The soil in Khuna Area is mostly saline soil. For saline soils the electrical conductivity (EC) of a saturated extract of the soil is more than 4 dS/m. The exchangeable sodium percentage is less than about 15 and the pH usually is less than 8.5 because the salts are neutral. The sodium adsorption ratio (SAR) is less than 13.

Saline soils occur mainly in the Ganges Tidal Floodplain, Young Meghna Estuarine Floodplain and in the Tidal Floodplain areas of the Chittagong Coastal Plains and OFFSHORE ISLANDS. High salinity, low fertility with respect to organic matter, nitrogen, zinc and copper, scarcity of quality irrigation water during winter, variability in rainfall from year to year, short winter season, heavy texture (silty clay to clay) and perennial water-logging due to inadequate drainage hamper crop growth. Cultivation of salt tolerant crops, mulching in the summer, improvement of drainage and prevention of intrusion of saline water from sea will improve these soils. Figure-4.6 shown problem soil in Bangladesh.

The deltaic coastline of Bangladesh can be recognised as consisting of two basic physiographic units: the inactive or abandoned Ganges tidal plain and the active Meghna deltaic plain. While the Ganges tidal plain is relatively old, the Meghna deltaic plain is geologically very young. Broad map comparisons indicate that the delta of the Ganges-Brahmaputra rivers has not grown significantly toward the sea over last two centuries. The project is not at the riverbank erosion prone area as pictured in the Figure:4.4.

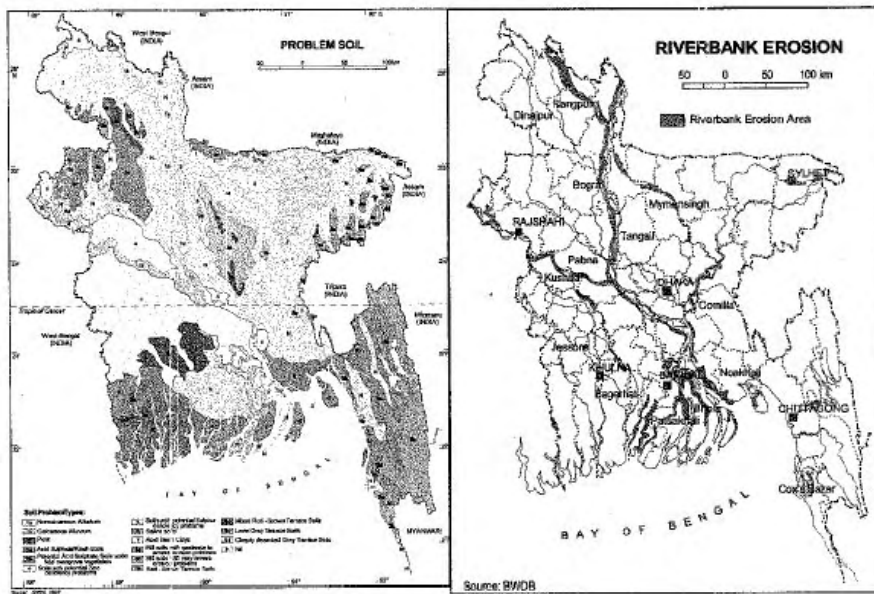


Figure-4.4 Problem Soil in Bangladesh

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4.1.3 Hydrology and Drainage

Hydrology covers the movement, distribution, and quality of water throughout the earth, and *includes the hydrologic cycle, water resources and environmental watershed sustainability*. The management of water resources is now a crying need in Bangladesh because of rapid growing demand for water and increasing conflict over its alternative uses. According to the National Water Policy, 1999 the ownership of water resources not vested in an individual but in the State. The Government reserves the right to allocate water to ensure equitable distribution, efficient development and use, and make sure the sustainable development. To do so the hydrological and drainage condition of the project area are studied by the consultant with good sense and utmost caring.

(i) River water abstraction and water quality

The project area has East-west rivers which interconnects the north-south rivers. Flows of these east-west rivers are very important for the complete circulation of tide all over the tidal flat. Seasonal variation of river water quality is common particularly the concentration of salinity of the river i.e. in rainy season, water becomes fresh to slightly salty and in the dry season full of salty. Bhairab, Rupsha and Modhumoti are three surface water sources of the KWASA. Modhumoti at the Mollahat upazila are planned to be used as a source of KWASA water supply.

According to the water quality standard of inland surface water as scheduled in Schedule-3 of ECR'97 the JICA study (attached appendix-4.2) found that the surface water of Modhumoti river at Mollahat upazila might be useable as a source of drinking water after conventional treatment.

DOE conducted continuous four years (2005 to 2008) study on surface water of Modhumoti river at Mollahat upazila (attached appendix-4.2). In this study it would be noteworthy that average, maximum and minimum values of pH, BOD, DO are within the standard inland surface water quality range which can be conventionally treated. Turbidity, suspended solid, total dissolved solid are reasonably high. Chloride concentration is within drinking water standard.

Eight cycle water quality test result of Rupsha river (attached appendix-4.2), most of the parameters i.e. pH, TDS, Mercury, Lead, Arsenic, Hexavalent Chromium, Cooper, Zinc, Cadmium, Sulfate, Phosphate, Nitrate, Nitrite, Ammonia, Manganese, and Dissolved Oxygen concentrations are within the guideline value. Turbidity, TDS, SS, COD, BOD, Calcium, Chloride, DO and Iron of the river water found reasonably high. The same observation gathered from the Modhumoti river water quality test but some of the important water parameters i.e. TDS, DO, Calcium, Chloride and DO concentration deemed within the standard limit of acceptability. The water quality of the Madhumoti river in comparison of Rupsha river convincingly better to use as a source water for treatment.

The salinity of surface water of the project area is of utmost concern for treatment. The DOE study on the salinity of the project area in the period of 2005 to March, 2010 found that the salinity of Bhairab and Rupsha river basically exceed the acceptable limit from February to Jun of a calendar year. Interestingly, the salinity of the Madhumoti river found within the acceptable limit.

JICA study team conducted study on the salinity of the river water at three location of the project area from April 2010 to June 2010 considering the tidal effect. The onsite river water

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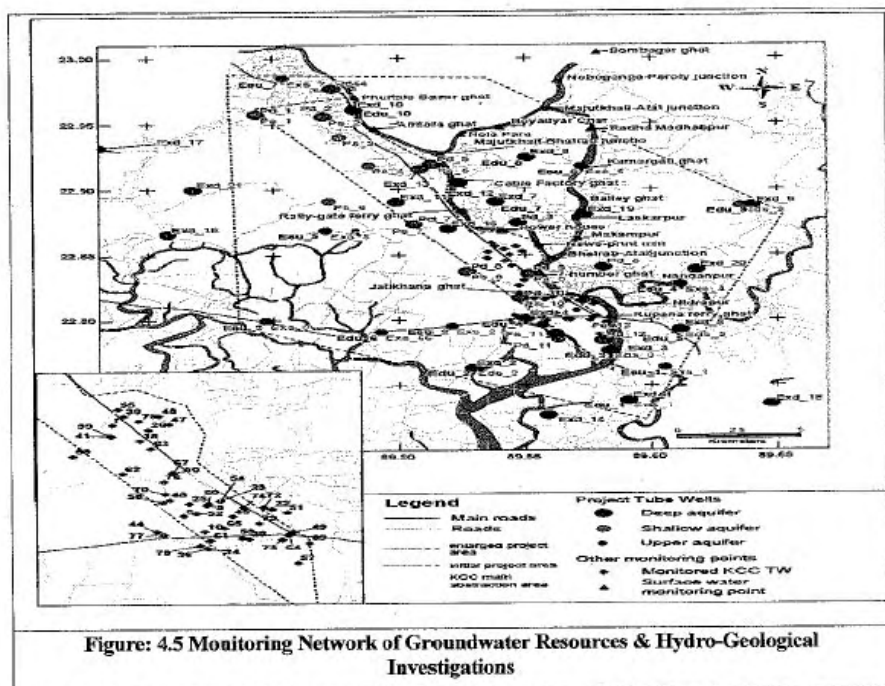
testing points were 220 49' 27" N & 890 33' 36" E (Rupsha river, Khulna); 220 55' 52" N & 890 48' 29" E (Madhumoti river Mollahat); 220 59' 01" N & 890 47' 50" E (Madhumoti river, Chapailghat). The results and analysis are attached in **appendix-4.2**.

The JICA team has experiential the water level at Modhumoti river in Mollahat from April, 2010 to June, 2010. The average water level coincidentally remains 4 (high tide) and 3 (low tide) for the pragmatic three months though the maximum high and low tide observed in June.

The discharge of Modhumoti, Rupsa and Bhairab rivers were measured in two phases. In phase-1 the flow measurement was completed by 31st March, 2010 to 2nd April, 2010. The Phase II discharge measurement was done from 29th April, 2010 to 1st May, 2010 by the JICA study team. The flow measurement details are attached in **appendix-4.2**.

(ii) Groundwater

The KCC water supply mostly depends on the ground water as the surface water supply is limited. The available fresh water pocket is possibly at around 350m depth located mostly at the centre of the Khulna city. The shallow and upper aquifer water is not potable as the mineral (salt) content is very high. Iron and manganese in the ground water is also a problem whereas arsenic is within the acceptable range.



Source: Groundwater Resources & Hydro-Geological Investigations in and around Khulna City/ Municipal Services Project (MSP) /Final Report in May 200

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4.1.3 Water Quality of the project area

The Ministry of Water Resources of GOB identified 19 districts of Bangladesh those are facing or having proximity to the Bay of Bengal and exclusive economic zone. The districts are Bagerhat, Barguna, Barisal, Bhola, Chandpur, Chittagong, Cox's Bazar, Feni, Gopalganj, Jessore, Jhalkati, Khulna, Lakshmipur, Narail, Noakhali, Patuakhali, Pirojpur, Satkhira and Shariatpur. Together these districts account for 32 percent of the area and 28 percent of the population of Bangladesh as shown in the Figure-4.6. Considering the population and economic condition the chloride content of drinkable water kept high by the DOE in the ECR'97 DWQS. The chloride content in the drinking water for coastal zone is 1000mg/l.

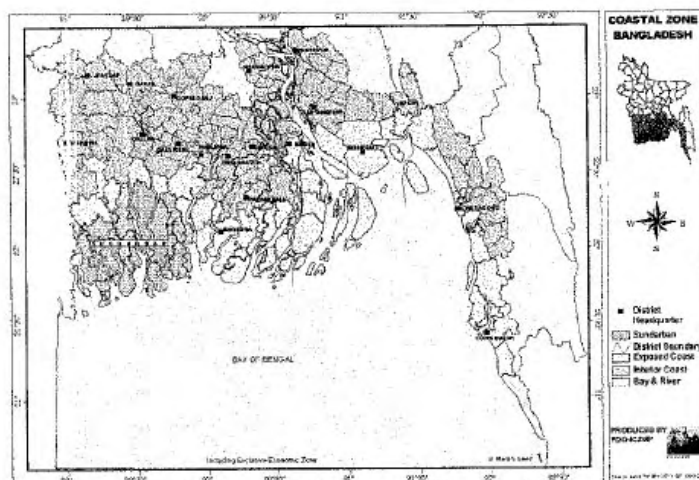


Figure-4.6 Map of Coastal Zone of Bangladesh

4.1.4 Climate and Air Quality

(i) **Climate in Bangladesh:** Bangladesh is located at the central part within the Asiatic monsoon region where the climate is tropical. Being relatively small size of the country and generally low-lying area causes moderate variation in terms of temperature, precipitation, relative humidity and wind speeds.

Monsoon climate: The mean annual rainfall in the area is 1946mm (year 2004-2008), with peak rainfalls occurring in July and August. The mean monthly maximum temperature for Khulna varies from 26.3 °C in January to 34.6 °C in April. A maximum daily of 40.6 °C and minimum 7.2°C have been recorded. The mean daily maximum temperatures rise during March and April as a prelude to the oncoming monsoon.

The region has a tropical monsoon climate. There are two marked seasons: the rainy seasons from May to October, during which more than 85% of the total annual rainfall occurs and the dry season from November to April. The beginning of the rainy season vary from year to year; heavy rains may commence anywhere between mid April and early June and may end anywhere between the end of September and mid November.

In more detail, mid November to February is the coolest and driest period; March to May is the hottest period with periodic heavy thunderstorms; June to mid September is the most

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rainy and humid period; and mid September to early November is a transitional period with decreasing rainfall, often with association of thunder but with relatively high temperature and humidity. **Figure-4.7** shows the climate of Bangladesh as well as the project area. In the climatic sub-region classification the project area falls mainly in the south central zone and a little bit south western zone.

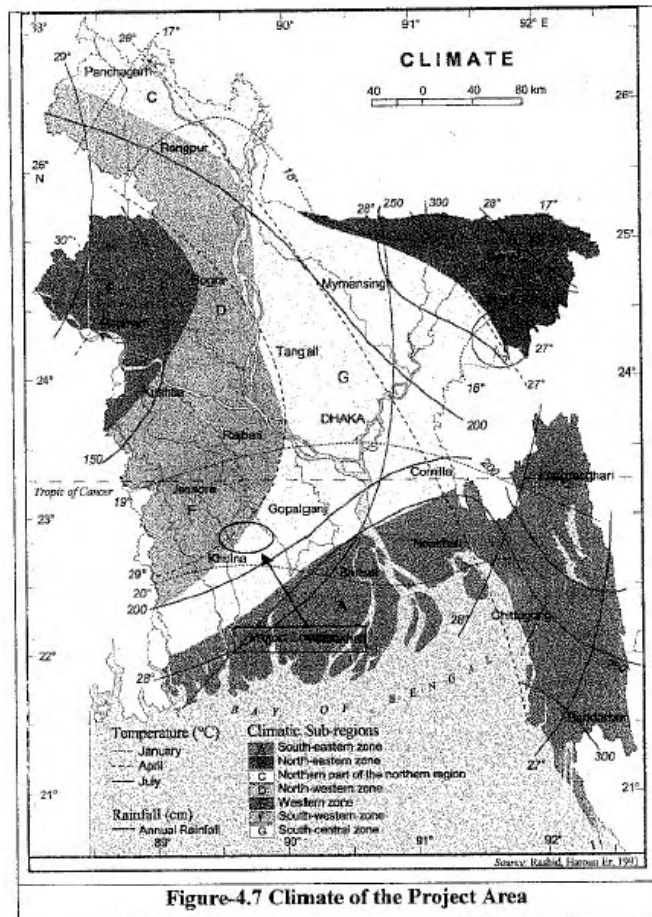


Figure-4.7 Climate of the Project Area

Squally winds of up to 50 mph or occasionally more, usually from the northwest, often accompanying thunderstorms (Nor'-wresters) in the pre-monsoon period may damage property and crops. Cyclonic storms occurring in the Bay of Bengal in April-May and October-November rarely penetrate as far as Narayangonj district, but these may cause serious damage to property, crops, livestock as well as human casualties when they do so. Monsoon rains are generally not stormy, but downpours of 2-3 inches (50-75mm) per day are not uncommon and rain falls of more than 10 inches (250 mm) in a day are occasionally experienced. The evaporation regime over, the area is fairly high and consistent with the maximum extending over March through May when the temperature is at the highest but dropping slightly during the monsoon and gradually decreasing during the dry season. The

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project area is in the **normal flood** area and never been affected by flash flood due uneven rainfall of upstream river basin.

Because of the funnel shaped coast of the Bay of Bengal, Bangladesh very often becomes the landing ground of cyclones formed in the Bay of Bengal. Most of the damage occur in the coastal regions of Khulna, Patuakhali, Barisal, Noakhali and Chittagong. The chronological cyclone history of 1585 to 1998 the project area has experienced cyclonic attack several times.

- 1909 (16 October) Khulna; cyclonic storm-waves; killed 698 people and 70,654 cattle. 1942 (October) sundarbans; severe cyclonic storm; number of human lives, exact figures of the loss of wildlife and boats are not available.
- 1977 (9-12 May) Khulna, Noakhali, Patuakhali, Barisal, Chittagong and offshore islands; cyclonic storm with a wind speed of 112.63 km/hr; exact figures of the loss of lives and cattle are not available.
- 1977 (9-12 May) Khulna, Noakhali, Patuakhali, Barisal, Chittagong and offshore islands; cyclonic storm with a wind speed of 112.63 km/hr; exact figures of the loss of lives and cattle are not available.
- 1998 (19-22 November) Offshore islands and chars of Khulna, Barisal and Patuakhali; cyclonic storm with maximum wind speed of 90 km/hr, storm surge of 1.22 to 2.44m.

Figure-4.8 shows the cyclone and flood picture of the project area.

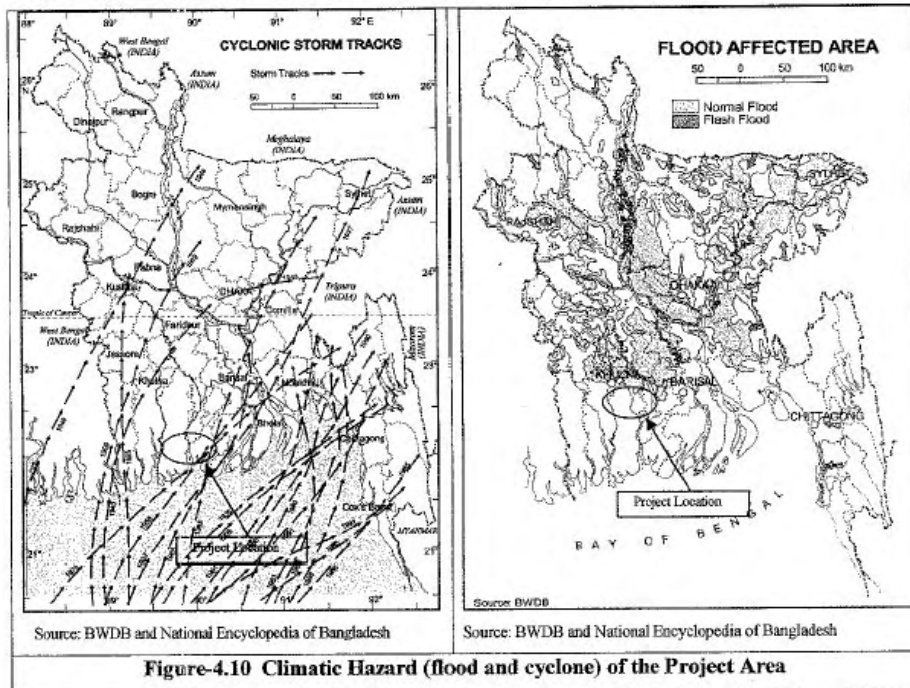


Figure-4.10 Climatic Hazard (flood and cyclone) of the Project Area

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(ii) **Climate in Khulna:** The relevant climatic data of the Khulna and its adjacent areas e.g., precipitation, temperature, relative humidity, wind speeds and sunshine are described below.

Annual rainfall in Khulna is shown in Table. The average annual rainfall during 2004 to 2008 is 1,946 mm.

Table-4.1: Rainfall in Khulna

Unit: mm

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	0	0	7	85	180	383	253	266	621	183	0	0
2005	15	0	148	43	215	102	435	194	410	420	0	0
2006	0	0	5	19	230	262	522	364	579	79	1	0
2007	0	54	14	92	119	374	591	160	397	197	113	0
2008	66	36	48	36	151	190	301	202	379	187	0	0
Average (2004-2008)	16	18	44	55	179	262	420	237	477	213	23	0

Source: Metrological Department Climate Division

Table-4.2 : Evaporation in Khulna

Unit: mm


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	60	85	143	156	169	110	110	116	93	69	78	73
2004	69	110	166	151	179	108	109	91	94	105	91	72
2005	56	71	117	129	134	112	82	71	78	75	77	64
2006	78	83	118	142	121	95	81	96	89	101	87	88
2007	83	72	106	135	139	111	80	106	96	102	77	67
Average (2003-2007)	57	67	101	111	115	85	70	73	71	77	66	58


Source: Metrological Department Climate Division

Table-4.3: Temperature, Relative Humidity, and Wind in Khulna/Sunshine Duration in Jessore

Temperature °C of Khulna												
Item	J	F	M	A	M	J	J	A	S	O	N	D
Highest	32.2	36.1	39.4	40.6	41.7	39.4	37.2	36.1	37.2	36.1	34.4	31.7
Av. Max	26.3	29.2	33.4	34.6	34.3	32.6	31.2	31.3	31.7	31.3	29.1	26.7
Av. Min	13.6	16.1	21.0	24.2	25.6	26.1	26.2	26.2	26.0	24.3	19.1	14.7
Lowest	7.2	7.2	10.0	17.8	18.3	21.7	21.7	22.2	22.8	17.8	11.7	7.2
Relative Humidity in % of Khulna												
9 A.M.	73	71	73	76	78	83	86	85	83	78	62	72
6 P.M.	62	55	55	65	74	82	84	84	83	78	69	67
Average wind velocity of Khulna												
Km/hr	3.0	3.9	5.8	7.8	8.9	7.4	7.8	6.9	5.6	3.9	3.2	3.0
mi/hr	1.9	2.4	3.6	4.8	5.6	4.6	4.8	4.3	3.5	2.4	2.0	1.9
Sunshine Duration of Jessore												
Hours of bright sunshine.	9.1	9.5	8.7	8.9	9.7	4.8	5.1	5.7	5.9	8.2	9.3	9.4
Day (Length) (hours)	10.9	11.4	12.0	12.7	13.3	13.6	13.4	13.0	12.3	11.7	11.1	10.7
Sunshine as % of Day Length	83	83	72	70	73	35	38	44	48	70	84	88

Source: Metrological Department Climate Division


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(iii) **Air quality in Khulna:** The project and its adjacent areas may be classified as mixed industrial area. In 1999-2000 two session of air pollution survey conducted i.e. mid-monsoon and after monsoon period on two sites of the Rupsa bridge are given in the following tables **Table-4.4 and Table-4.5**. The seasonal variation of the air quality is noticeable. The observed variation found more than 20% based on after-monsoon data.

Table-4.4: Air Quality of Rupsa Bridge Site (mid-monsoon data)

Date	Location	Ambient Air Pollution Concentration in $\mu\text{g}/\text{m}^3$		
		SPM	NO _x	SO _x
21.8.99 (Holiday)	Krishna Nagar (Khulna-Satkhira Road)	306 (400)	56.02 (100)	29.42 (100)
25.8.99 (Working Day)	Krishna Nagar (Khulna-Satkhira Road)	318 (400)	59.86 (100)	32.18 (100)
21.8.00 (Holiday)	Char Rupsa (near Jahanabad Sea Food Factory)	491 (500)	47.99 (100)	43.30 (100)
25.8.99 (Working Day)	Char Rupsa (near Jahanabad Sea Food Factory)	364 (500)	60.22 (100)	43.04 (100)

Source: EIA Rupsa Bridge

Note:- SPM - Suspended Particular Matter; SO₂ - Sulphur di Oxide; NO_x - Oxides of Nitrogen. Figures in () indicate limit values of Standard.

Table-4.5: Air Quality of Rupsa Bridge Site (after-monsoon data)

Date	Location	Ambient Air Pollution Concentration in $\mu\text{g}/\text{m}^3$		
		SPM	NO _x	SO _x
20.10.99 (Holiday)	Krishna Nagar (Khulna-Satkhira Road)	216 (400)	10.88 (100)	23.6 (100)
19.10.99 (Working Day)	Krishna Nagar (Khulna-Satkhira Road)	265.7(400)	12.49 (100)	26.5 (100)
21.8.00 (Holiday)	Char Rupsa (near Jahanabad Sea Food Factory)	319.1(500)	15.76 (100)	29.46 (100)
25.8.99 (Working Day)	Char Rupsa (near Jahanabad Sea Food Factory)	799.5 (500)	15.37 (100)	34.49 (100)

Source: EIA Rupsa Bridge

Note:- SPM - Suspended Particular Matter; SO₂ - Sulphur di Oxide; NO_x - Oxides of Nitrogen. Figures in () indicate limit values of Standard.

4.1.5 Noise Pollution in Khulna

Noise pollution is a serious threat to the quality of environment. High-intensity sound, such as that emitted by machines used for excavating earth and welding pipes, for long periods of time is disturbing and potentially damaging to nearby human populations and wildlife. When continued for long periods of time it can also permanently damage the hearing of workers engaged in the area. While 50 dBA (decibels) creates discomfort, 85dBA is usually considered as the critical level for ear damage. The noise level study of Rupsa Bridge in 1999-2000 considering motor vehicle or mechanized vessels is listed below. These data correlate with the project area roadside noise levels. In comparison of two season's data the after monsoon max. average noise level is within the recommended standard (schedule-5 of ECR'97), whereas the mid monsoon data exceeded the standard limit. The project area is relatively far away from the Rupsa bridge and silent in comparison of vehicular movement

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but during the construction phase the noise level might goes up and possibly be more than the present condition.

Table-4.6 : Noise level Rupsa Bridge Site (mid-monsoon data)

Date	Location	Min. Average	Max. Average
21.8.99 (Holiday)	Krishna Nagar (Khulna-Satkhira Road)	49.16	89.00
25.8.99 (Working Day)	Krishna Nagar (Khulna-Satkhira Road)	49.75	98.30
21.8.00 (Holiday)	Kudir Battala (Rupsa-Mongla Road)	60.58	95.75
25.8.99 (Working Day)	Kudir Battala (Rupsa-Mongla Road)	68.00	97.23
21.8.00 (Holiday)	Rupsa Ferray Ghat	70.40	97.50
25.8.99 (Working Day)	Rupsa Ferray Ghat	71.83	96.08

Source: EIA Rupsa Bridge

Table-4.7: Noise level Rupsa Bridge Site (after-monsoon data)

Date	Location	Min. Average	Max. Average
19.10.99 (Working Day)	Laban Chara	35.0	52.6
20.10.99 (Holiday)	Laban Chara	34.33	54.00
19.10.99 (Working Day)	Harin Tana	36.9	52.8
20.10.99 (Holiday)	Harin Tana	33.41	56.25
19.10.99 (Working Day)	Jabusa (near Unique Ice Factory)	33.6	53.83
20.10.99 (Holiday)	Jabusa (near Unique Ice Factory)	30.86	49.83
19.10.99 (Working Day)	Jabusa (near Elipur Wagon Para)	30.75	83.66
20.10.99 (Holiday)	Jabusa (near Elipur Wagon Para)	33.33	81.33

Source: EIA Rupsa Bridge

4.2 Ecological Environment

In the historical past the Lower Ganges Tidal Floodplain consisted of two distinctly different land types (i) narrow fine loamy ridges along the banks tidal channels and (ii) extensive flat tidally flooded clayey basins. The ridges were covered by extensive grass land while the basins were covered by littoral forests with 384 species of Hydro-halophytes. Early settlements on these landscapes started since 150 years back by clearing the grassland on ridges that occurred above tidal flood level. Mangrove forests on basin flats were cleared initially to reclaim land for agriculture. The Khulna division is prominent to the world for her largest mangroves forest i.e. Sundarban. This mangroves forest is defined as an ecologically critical area (ECA) by the Ministry of Environment and Forest. More on Government kept the Sundarban area as a wildlife sanctuary and provided protection accordingly. **Figure-4.11 & 4.12** shows the project location in satellite image and in IUCN map respectively and it is evident that the project activities be out of the Sundarban buffer zone and will not make any negative impact.

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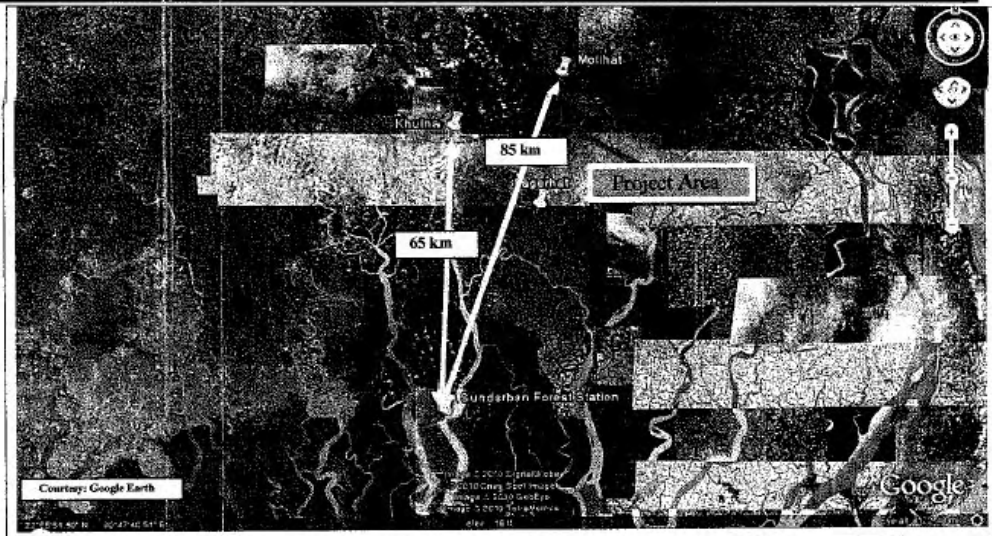


Figure:4.11 Relative Position of Project Site and Sundarban Forest

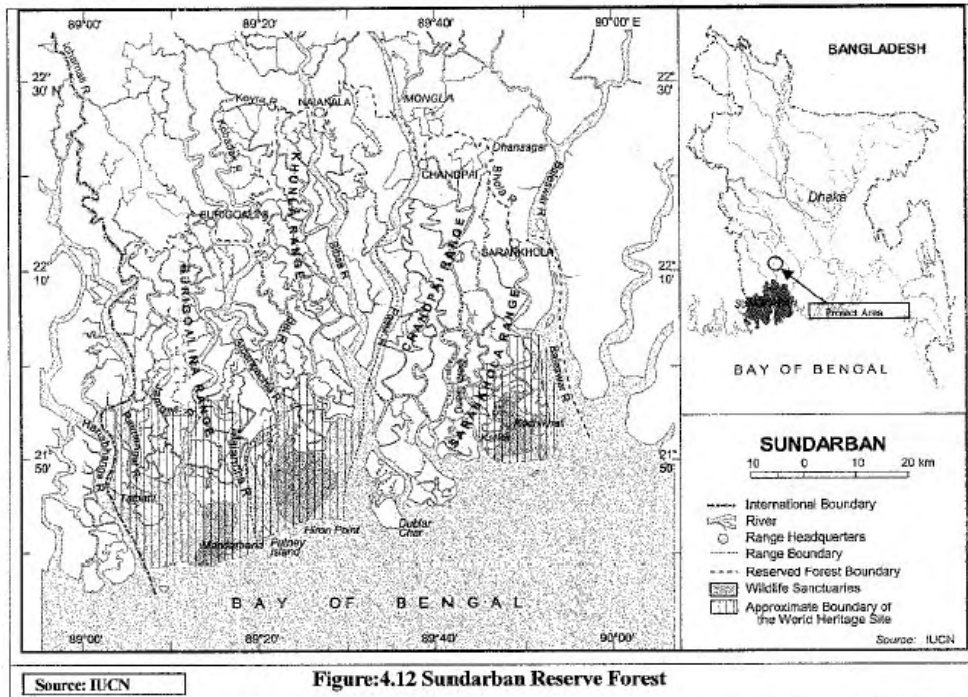




Figure:4.12 Sundarban Reserve Forest


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4.2.1 Habitats

A habitat (which is Latin for "it inhabits") is an ecological or environmental area that is inhabited by a particular species of animal, plant or other type of organism. It is the natural environment in which an organism lives, or the physical environment that surrounds (influences and is utilized by) a species population.

The habitats of the study area sustain wildlife as well as plant communities. But many of these remain unrecognized. Verities of plant species and wild animals have been identified and recorded during IEE study for the project.

Every species play an important role in its natural community and ecosystem and removal of that species is likely to have adverse impact.

Bio-habitat of the project area may be divided into two major types viz-terrestrial habitat and wetland (aquatic) habitat.

(1) Wetland Habitat

1) Wetland Flora

Wetland flora plays a vital role in nature. It grows mainly in aquatic habitats viz. beels, ponds, canals ditches or low lying cultivated fields. From different wetland and aquatic habitat, a number of species have been identified as shown in Table-4.8.

Table-4.8: Aquatic flora of the project

Sl. No.	Local Name	Scientific Name	Status
1.	Dholkalmi	<i>Ipomoea fistulosa</i>	Common
2.	Sheola	<i>Byssa octandra</i>	Common
3.	Shapla	<i>Nymphaea nouchali Burm.f</i>	Common
4.	Kachuripana	<i>Lemna Spp</i>	F. Common
5.	Kalmi	<i>Ipomoea alba.L</i>	F. Common

Note: F = Fairly, Source: Field Investigation


2) Wetland Fauna


The wildlife that fully or partially depends on water reservoir such as river, canal and pond etc. for life, shelter, food, nesting, breeding and reproduces inside the water reservoir is known as wetland fauna. Important aquatic fauna comprises some species of amphibians, reptiles, birds and mammals. Aquatic fauna may act as sensitive bio-indicators of the altered state of the ecosystem resulting from human influence. The survey area represents two major type of wetland's namely permanent wetland (rivers, canals and fishponds) and seasonal wetland (agricultural land during flood).

(2) Terrestrial Habitat

1) Terrestrial Flora

Terrestrial flora is classified according to their habitats. In the study area, terrestrial floras are present mainly in the homestead regions, roadsides, village groves, playgrounds, upland/high cultivated lands. Human being as well as wildlife uses these floral species for different purposes. They play an important role in the socio-economic and ecological balance. From a rapid field survey in different terrestrial habitats of the study area, a number of species have been identified.


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Homesteads and Orchards: betel nut, kadam, Coconut, Date palm, Sofeda, Mango, Jackfruit, Fig, Pome granade, Guava, Grapefruit, Lemon, Blackberries, Plum, Toddy palm, Koroï, Shisoo, Shirish, Rain tree, evcaiytta, bamboo, babla, jeol, neem, tamarind, banana, ipil-ipil, papya, mehganî, debdaru, shimul, akashmoni, khai babla, jamrul, chalta, bel, amra, amloki, segun, etc.

Roadside Plantation: datepalm, road chambol, koroï, krishnachura, rain free, banian, shisoo, babla, akashmoni, banian, eucalyptus, mango, blackberries, raj koroï, etc.

Table-4.9: Terrestrial flora

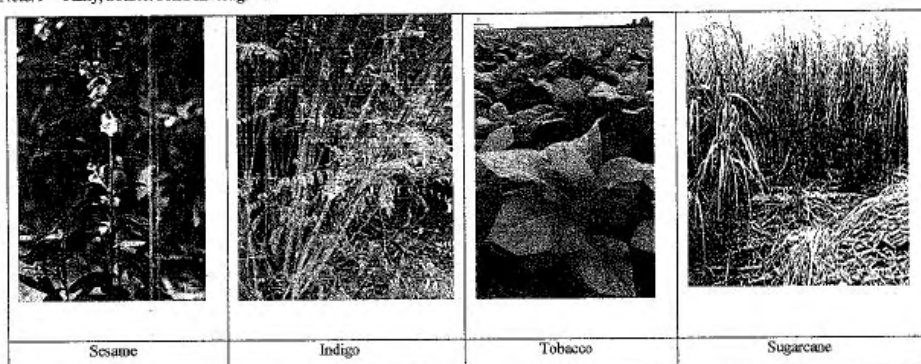
Sl. No.	Local Name	Scientific Name	Status
1.	Betel nut	<i>Areca catechu</i>	F. Common
2.	Mashkalai (one kind of pulse)		F. common
3.	Potato	<i>Solanum tuberosum</i>	F. Common
4.	Ground nut	<i>Arachis hypogea</i>	F. Common
5.	Ci iger	<i>Zingiber officinale</i>	F. Common
6.	Wheat		F. Common
7.	Til		F. Common
8.	Kunra	<i>Cucurbita maxima</i>	F. Common

Note: F = Fairly, Source: Banglape

Table-4.10: Threatened flora (Extinct and nearly extinct crops)

Sl. No.	Local Name	Scientific Name	Status
1.	Sesame	<i>Sesamum indicum</i>	Extinct
2.	Indigo	<i>Indigofera sumatrana</i>	Extinct
3.	Tobacco	<i>Nicotiana tabacum</i>	Extinct
4.	Sugarcane	<i>Saccharum bengalense</i>	Extinct
5.	Masria		

Note: F = Fairly, Source: Field Investigation



2) Terrestrial Fauna

Wildlife that fully depends on the terrestrial ecosystems for life, shelter, food, breeding is called terrestrial fauna. A number of terrestrial species have been identified during the brief and rapid assessment in the project area as shown in the Table-4.11 to Table-4.14 .

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Table-4.11: Terrestrial Fauna Reptiles

Sl. No	Local Name	Scientific Name	Status
1.	Anjila	<i>Mobya carinata</i>	Common
2.	Dhura Shap	<i>Amphisma stolata</i>	Common
3.	Matia Shap	<i>Aretion schistosum</i>	Common
4.	Tikiiki	<i>Hemidactylus brookei</i>	Common
5.	Daraish Shap	<i>Ptyas mucosus</i>	F. Common
6.	Gui Shap	<i>Varanus rubulosus</i>	F. Common

Note: F = Fairly, Source: Field Investigation

Table-4.12: Terrestrial Fauna Mammals

Sl. No	Local Name	Scientific Name	Status
1.	Babur	<i>Pteropus giganteus</i>	Common
2.	Idur	<i>Mus musculus</i>	Common
3.	Shial	<i>Vulpes bengalensis</i>	Common
4.	Chika	<i>Pipistrellus. Sp</i>	Common
5.	Boji	<i>Herpestes</i>	F. Common

Note: F = Fairly, Source: Field Investigation

Table-4.13 Terrestrial Fauna Birds

Sl. No	Local Name	Scientific Name	Status
1.	Choroi	<i>Passer domesticus</i>	Common
2.	Doyel	<i>Oryzopsis sularis</i>	Common
3.	Kak	<i>Corvus splendens</i>	Common
4.	Ghughho	<i>Streptopelia Orientalis</i>	Common
5.	Shalik	<i>Stuna contra</i>	Common
6.	Tuntuni	<i>Orthotomus sutorius</i>	Common
7.	Machranga	<i>Halcyon smyrrensis</i>	F. Common
8.	Haludpakhi	<i>Oriolus chinhorius</i>	F. Common
9.	Katthokra	<i>Picus canus</i>	F. Common
10.	Pecha	<i>Tyto alba</i>	Rare

Note: F = Fairly, Source: Field Investigation

Table-4.14 Terrestrial Fish

Sl. No.	Local Name
1.	Rui
2.	Katal
3.	Thai Puti
4.	Minar Cup
5.	Silver Cup
6.	Shrimp

Note: F = Fairly, Source: Field Investigation

Terrestrial Fauna list extinct or nearly extinct:

There are twelve (12) extinct species in Bangladesh according to the 1985 Kazi Zakir Hossain and Shorab Hossain studies. The extinct species include Great One – horned Rhinoceros (*R. unicornis*), Lesser One – horned Rhinoceros (*r. sondasicus*), Asiatic Two – horned Rhinoceros (*Didemnoceros sumatrensis*), Nilgai (*Bos gaurus*), Bantong (*Bos javnicus*), Swamp Dear (*Carvus duvauceli*), Hog Dear (*Axis porcinus*), Wolf (*Canis lupustris*), Pink Head Duck (*Rhodonessa caryophyllacea*), and Marsh Crocodile (*Crocodylus palustris*). The endangered

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and threatened terrestrial species are Marbled Cat (*Felis Marmorator*), Golden Cat (*Felis Temmuncki*), Common Langur (*Presbytes entallus*), Hisped Hare, Serow, Asiatic Elephant, Comb Duck (*Sarkidiornis melantos*), Pea Fowl, Wood Duck, Greater Adjutant (*Leptoptilos dubius*), *Garial (Garialis Gangeticus)*, *Bengal Florican*, and *Bostomi Turtle (Trionix nigricans)*. In addition, there are 20 mammals, 19 reptiles and 20 avifaunas in Bangladesh are either threatened or endangered. (source: Kazi Zakir Hussain and Shorab Hussain (1985))

In the study area no endangered species is found as studied from different sources. The IUCN study didn't identify any endangered species in the study area.

4.3 Socioeconomic Conditions

For a better understanding of the different demographic, socio-economic and health related information about the population and the community in and around the project area, a closer look may be achieved from different tables cited in this section.

It may be observed that, these has covered both area specific and project specific information including the ones about the project affected persons, their community, socio-economic living standard and their attitude towards implementation of the project

The project area comprises of rural and urban economy. The urban and rural portion of the project area is KCC and Rupsha & Mollahat thana respectively. KCC economy mainly leads by some small industrial activity. The economy of the rural portion of the project area depends on agriculture and fish gher. The socio-economic infrastructure of Khulna City Corporation, Rupsha thana and Mollahat thana are attached in **appendix- 4.3**.

4.3.1 Population

Khulna town consists of 38 wards and 183 mahallas spacing 20.60 sq.km areas. The town population is about 52.57% of the district population (2334285).

Table: Population scenario at Three Locations

Location	Area (km2)	Population (No)	Density of Population (km2)	Male (%)	Female (%)
Khulna City	20.60	1227239	59574	52.79	47.21
Rupsa Upazila	120.15	150185	-	51.98	48.02
Mollahat Upazila	8.79	116729	1218	51.52	49.48

Source: Banglapedia

(1) **Mollahat-Intake site survey data (Population)**

1) **Composition of Household Members**

Table4.15: Household composition by household head

Household Surveyed	H/H No.	%
Male Headed Household	6	85.71
Female Headed Household	1	14.29
Total	7	100.00

Source: Banglapedia


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Table 4.16: Household composition by sex

Sex	No. of Family Member	% of Family Member	Average HH Size
Male	20	57.14	5.00
Female	15	42.86	
Total	35	100.00	

Source: Banglapedia

The data shows that the 85.71% of sample household is comprised of the male heads and in the family member 57.14% are male and 42.86% are female.

2) Age Sex Distribution

Age Sex distribution of the household members is presented in Table-4.17.

Table 4.17 Age-sex distribution of households

Age Group	Male	%	Female	%	Total	%
1-4	0	0.00	0	0.00	0	0.00
5-9	0	0.00	1	6.67	1	2.86
10-14	1	5.00	0	0.00	1	2.86
15-19	3	15.00	2	13.33	5	14.29
20-49	12	60.00	8	53.33	20	57.14
50-60	0	0.00	3	20.00	3	8.57
Above 60	4	20.00	1	6.67	5	14.29
Total	20	100.00	15	100.00	35	100.00

Source: Field Survey

The table shows the distribution of the age groups of the household members by their sex. From the table we can see that children of age groups 10 to 14 is about 2.86%, household members of age groups 20 to 49 (main work force) is 57.14%, those of age group above 60 is about 14.29%.

2) Samantho Sena-Impounding Reservoir and Surface Water Treatment Plants site survey data
(Population)

1) Composition of Household Members

Table 4.18: Household composition by household head

Household Surveyed	H/H No.	%
Male Headed Household	30	100.00
Female Headed Household	0	0.00
Total	30	100.00

Source: Field Survey

Table 4.19: Household composition by sex

Sex	No. of F Member	% of F Member	Average HH Size
Male	73	59.35	4.10
Female	50	40.65	
Total	123	100.00	

Source: Field Survey

The data shows that the 100% of sample household is comprised of the male heads and in the family member 63% are male and 37 are female

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2) Age Sex Distribution

Age Sex distribution of the household members is presented in Table-4.20.

Table 4.20: Age-sex distribution of households

Age Group	Male	%	Female	%	Total	%
1-4	6	8.22	1	2.00	7	5.69
5-9	1	1.37	2	4.00	3	2.44
10-14	3	4.11	0	0.00	3	2.44
15-19	5	6.85	2	4.00	7	5.69
20-49	42	57.53	33	66.00	75	60.98
50-60	12	16.44	12	24.00	24	19.51
Above 60	4	5.48	0	0.00	4	3.25
Total	73	100.00	50	100.00	123	100.00

The table shows the distribution of the age groups of the household members by their sex. From the table we can see that children of age groups 10 to 14 is about 2.44%, household members of age groups 20 to 49 (main work force) is 60.98%, those of age group above 60 is about 3.25%.

(3) **Khulna City Corporation- Overhead tank and reservoir sites survey data** (Population)

There are 11 (Eleven) sites inside the city corporation area among them 5 (Five) sites is for reservoir and 11 (Eleven) sites for overhead tank.

Name	Proposed Location
Deana West Para Overhead tank and Reservoir	Personal Land
No.16 Ward office Overhead tank and Reservoir	KCC Land
Sonadanga Moha Sarak Overhead tank and Reservoir	Personal Land
Beside of No.7 Ward office Overhead tank and Reservoir	Personal Land
Khalishpur Charehat River Ghat Overhead tank and Reservoir	Government Land (BIWTA)
Rob Sarani Overhead tank	Personal Land
Mujgani Overhead tank	KCC Land
Ferry Ghat Power House Overhead tank	KCC Land
Andir Pukur Overhead tank	Personal Land
South Side of Ward No. 31 Office Overhead tank	Personal Land
DPHE Rupsa Overhead tank	Government Land (DPHE)

According to the above table 6 (Six) sites are owned by Khulna City Corporation and 5 (five) sites are private land. Among the 5 (five) private lands 3 (three) household surveys was completed and other two they disagree with us to give any information. The three land owner's information is presented in the Table-4.21. These three household surveyed data are presented in the tabular form.

Table-4.21: Identity of the Household (City)

Household Identity	Thana	District
*HH-1	Dhaulapur	Khulna
HH-2	Khulna City (sonadanga)	Khulna
HH-3	Khanjahan Ali	Khulna

Source: field information * instead of name HH is mentioned

1) Composition of Household Members

Distribution of household members with household heads and family members are presented in Table-4.22 and Table-4.23.

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Table-4.22 Household Surveyed

Household Surveyed	H/H No.	%
Male Headed Household	3	100
Female Headed Household	0	0
Total	3	100

Source: Field Survey

Table-4.23 Total Family Members

Sex	No. of F Member	% of F Member	Average HH Size
Male	12	63	6
Female	7	37	
Total	19	100	

Source: Field Survey

The data shows that the 100% of sample household is comprised of the male heads and in the family member 63% are male and 37 are female.

2) Age Sex Distribution

Age Sex distribution of the household members is presented in Table-4.24.

Table-4.24 Age Structure of the Population

Age Group	Male	%	Female	%	Total	%
1-4	0	0.00	0	0.00	0	0.00
5-9	0	0.00	1	14.29	1	5.26
10-14	3	25.00	1	14.29	4	21.05
15-19	1	8.33	0	0.00	1	5.26
20-49	4	33.33	3	42.86	7	36.84
50-60	3	25.00	1	14.29	4	21.05
Above 60	1	8.33	1	14.29	2	10.53
Total	12	100.00	7	100	19	100


Source: Field Survey

The table shows the distribution of the age groups of the household members by their sex. From the table we can see that children of age groups 10 to 14 is about 21.05%, household members of age groups 20 to 49 (main work force) is 36.84%, those of age group above 60 is about 10.53%.

4.3.2 Health and Education

The Khulna city has the following health and educational institution and mostly the Rupsa and Mollhat upazila people like to come to the city point in emergency cases.


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Table-4.25 Khulna City health

Sl. No.	Name	Number
1	Medical college hospital	1
2	District sadar hospital	1
3	Upazila health complex	9
4	TB hospital	1
5	Infectious disease hospital	1
6	Christian missionary hospital	1
7	Chest disease niramoy centre	1
8	Railway hospital at kopitmoni	1
9	Jail hospital	1
10	Police hospital	1

Source: Banglapedia

Table-4.26 Rupsha and Mollahat health and Education facilities

Location	Primary School		High school	College	Madrasa	Health centres	
	Government primary school	Non-government primary school				Upazila health complex	Union health family planning centre
Rupsa Upazila	46	14	-	-	23	1	5
Mollahat Upazila	58	19	13	3	8	1	6

Source: Banglapedia

Table-4.27 Literacy rate of the Project Area

Location	Literacy (%)
Khulna City	59.1
Rupsa Upazila	40.4
Mollahat Upazila	31.6

Source: Banglapedia

(1) **Mollahat-Intake site survey data** (Main Health Service Facilities; Educational Status of the Population)

Responses by sample households on their main health service facilities in the area are presented in Table-4.28.

Table-4.28: Main Health Service Facilities of the Area

Source	Households Coverage	%
Facilities from Govt. Hospital	7	100
Facilities from Private Hospital	7	100
Union Health Clinic	0	0
NGO Clinic	0	0
Private Doctor	0	0
Pharmacy	0	0
Quack	0	0

Source: Banglapedia

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The table shows affected household opinions on their main health service facilities in the area, where 100% of them go to the Govt. Hospital and private hospital.

The educational status of the members of the household has been summarized in **Table-4.29**.

Table-4.29: Educational Status of the Population

Educational status	Male	%	Female	%	Total	%
Illiterate	0	0.00	0	0.00	0	0.00
Can read only	0	0.00	0	0.00	0	0.00
Can read & Write	0	0.00	0	0.00	0	0.00
Children <4 years	0	0.00	0	0.00	0	0.00
Primary (Class I-V)	0	0.00	1	6.67	1	2.86
Secondary (VI-X)	1	5.00	0	0.00	1	2.86
SSC Equivalent	4	20.00	3	20.00	7	20.00
HSC Equivalent	0	0.00	1	6.67	1	2.86
HSC +	0	0.00	0	0.00	0	0.00
Graduate	6	30.00	5	33.33	11	31.43
Masters +	9	45.00	5	33.33	14	40.00
Others	0	0.00	0	0.00	0	0.00
Total	20	100.00	15	100.00	35	100.00

Source: Field Information

The table shows the distribution of the educational status of the household members by sex. This reveals that about 0% of the sample population is totally illiterate (who cannot read and write), primary level is 2.86%, secondary level is 2.86%, and also graduate and above is about 31.43%.

Samantho Sena- Impounding Reservoir and Surface Water Treatment Plants site survey data (Main Health Service Facilities; Educational Status of the Population)

Responses by sample households on their main health service facilities in the area are presented in **Table-4.30**.

Table-4.30: Main Health Service Facilities of the Area

Source	Households Coverage	%
Facilities from Govt. Hospital	30	100
Facilities from Private Hospital	0	0
Union Health Clinic	0	0
NGO Clinic	0	0
Private Doctor	0	0
Pharmacy	0	0
Quack	0	0
Total Sample Household	30	100

Source: Field Information

The table shows affected household opinions on their main health service facilities in the area, where 100% of them go to the Govt. Hospital.

The educational status of the members of the household has been summarized in **Table-4.31**.

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Table-4.31: Educational Status of the Population

Educational status	Male	%	Female	%	Total	%
Illiterate	5	6.85	0	0.00	5	4.07
Can read only	0	0.00	0	0.00	0	0.00
Can read & Write	9	12.33	1	2.00	10	8.13
Children <4 years	6	8.22	1	2.00	7	5.69
Primary (Class I-V)	14	19.18	10	20.00	24	19.51
Secondary (VI-X)	13	17.81	15	30.00	28	22.76
SSC Equivalent	18	24.66	14	28.00	32	26.02
HSC Equivalent	4	5.48	7	14.00	11	8.94
HSC +	4	5.48	2	4.00	6	4.88
Graduate	0	0.00	0	0.00	0	0.00
Masters +	0	0.00	0	0.00	0	0.00
Others	0	0.00	0	0.00	0	0.00
Total	73	100.00	50	100.00	123	100.00

Source: Field Information

The table shows the distribution of the educational status of the household members by sex. This reveals that about 4.07% of the sample population is totally illiterate (who cannot read and write), about 8.13% can read and write without any formal education, primary level is 19.51%, secondary level is 22.76%, and also graduate and above is about 0%.

Khulna City Corporation - Overhead tank and reservoir sites Survey data (Main Health Service Facilities; Educational status of population)

Responses by sample households on their main health service facilities in the area are presented in **Table-4.32**.

Table: 4.32 Access to Health Facilities

Source	Households Coverage	%
Facilities from Govt. Hospital	3	100
Facilities from Private Hospital	2	67
Union Health Clinic	0	0
NGC Clinic	0	0
Private Doctor	0	0
Pharmacy	1	33
Quack	0	0
Total Sample Household	3	

Source: Field Information

The table shows affected household opinions on their main health service facilities in the area, where 100% of them go to the Govt. Hospital, and 67% of them go to the Private Hospital, 33% goes to Pharmacy.

The educational status of the members of the household has been summarized in **Table-4.33**.

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Table- 4.33 Level of Education of the Populations (city)

Educational status	Male	%	Female	%	Total	%
Illiterate	0	0.00	2	28.57	2	10.53
Can read only	0	0.00	0	0.00	0	0.00
Can read & Write	1	8.33	0	0.00	1	5.26
Children <4 years	0	0.00	0	0.00	0	0.00
Primary (Class I-V)	1	8.33	0	0.00	1	5.26
Secondary (VI-X)	5	41.67	4	57.14	9	47.37
SSC Equivalent	2	16.67	0	0.00	2	10.53
HSC Equivalent	2	16.67	1	14.29	3	15.79
HSC +	0	0.00	0	0.00	0	0.00
Graduate	1	8.33	0	0.00	1	5.26
Masters +	0	0.00	0	0.00	0	0.00
Others	0	0.00	0	0.00	0	0.00
Total	12	100.00	7	100.00	19	100.00

Source: Field information

The table shows the distribution of the educational status of the household members by sex. This reveals that about 10.53% of the sample population is totally illiterate (who cannot read and write), about 5.26% can read and write without any formal education, primary level is 5.26%, secondary level is 47.37%, and also graduate and above is about 5.26%.

4.3.3 Socio-cultural and religious activities

People residing in the surrounding areas of the project location are of different religions; Muslims, Hindus, Christians, and Buddhist, etc. Besides the general culture and heritage of the area, culture also differs due to the difference of the communities built-up by these religions in different locations of the project. The Muslims pray in the mosques and observe their religious festivals like Eid, the Hindus observe their Pujas (Durga puja, Kali puja, etc.) in the temples and the Christians observe their prayer in the church and observe Christmas. There are special gatherings among the people where cultural events are performed and special foods are prepared. **In the project area no ethnic/tribal or indigenous people is found.**

Table-4.34 Project Areas Religious Feature

Location	Muslim %	Hindu %	Christian %	Buddhist %	Others %
Khulna City	73.49	25.74	0.67	0.04	0.06
Rupsa Upazila	82.28	17.55	-	-	17.55
Mollahat Upazila	75.01	24.87	-	-	0.12

Source: Bangladesh

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Table-4.35 Cultural and social association in the project area

Khulna City	Social Association	Public library	Museum	Drama Stage	Cinema Hall	Theater group	Magie Organization	Literary Society	Cultural Organization
	345	5	1	5	21	100	3	15	21
Rupsa Upazila	Social Association	Public library		Cinema Hall		Theater group		Women Organization	
	28	1		1				100	
Mollahat Upazila	Rural Social Association		Play ground						
	8		20						

Source: Banglapedia

(1)Mollahat- Intake site survey data (Religious and Ethnic Composition)

Religious and Ethnic Composition

Distribution of the households by their religion is summarized in Table-4.36.

Table 4.36: Religious and Ethnic Composition of households

Religion	No. of House holds	% of Households
Muslim	7	100.00
Hindu	0	0.00
Christian	0	0.00
Buddhist	0	0.00
Others	0	0.00
Total	7	100.00

It shows that the sample households are comprised of 100% Muslims.

(2)Samantho Sena- Impounding Reservoir and Surface Water Treatment Plants site survey data (Religious and Ethnic Composition)

Distribution of the households by their religion is summarized in Table-4.37.

Table 4.37: Religious and Ethnic Composition of households

Religion	No. of Households	% of Households
Muslim	7	23.33
Hindu	23	76.67
Christian	0	0.00
Buddhist	0	0.00
Others	0	0.00
Total	30	100.00

It shows that the sample households are comprised of 100% Muslims.

(3)KCC-Overhead tank and reservoir sites Survey data (Religious and Ethnic Composition)

Distribution of the households by their religion is summarized in Table-4.38.

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Table-4.38 Religious Character of the Affected Area

Religion	No. of Households	% of Households
Islam	3	100.00
Hindu	0	0.00
Christian	0	0.00
Buddhist	0	0.00
Others	0	0.00
Total	3	100.00

It shows that the sample households are comprised of 100% Muslims.

4.3.4 Livelihood practices and economic activities

In the project area the main occupation of the Khulna city and Mollahat upazila people is agriculture as cited from the data. Most of the Rupsa upazila peoples are in different types of business.

Table-4.39 professional practices of the project area

Location	Agriculture %	Fishing %	agricultural labourer %	wage labourer %	Industries %	Commerce %	Transport %	Service %	constructions %	Others %
Khulna City	25.11	1.66	11.3	7.15	16.38	-	4.09	18.93	1.53	12.22
Rupsa Upazila	18.02		6.6	11.81	2.87	20.91	6.35	17.10	2.09	14.25
Mollahat Upazila	53.61	1.71	22.15	2.02	1.6	5.93	1.21	6.2	-	5.57

Source: Banglapedia

(1) Mollahat Intake site survey data (Main Occupation of the Household Members; Monthly Income Patterns; Quality of life value)

Main occupations of the household members are summarized in Table-4.40 by their sex.

Table 4.40: Main Occupation of the Household Members

Occupation	Male	%	Female	%	Total	%
Farmers	0	0.00	0	0.00	0	0.00
Fisher worker	0	0.00	0	0.00	0	0.00
Agricultural Labor	0	0.00	0	0.00	0	0.00
Non-agricultural Labor	0	0.00	0	0.00	0	0.00
Service	12	60.00	5	33.33	17	48.57
Small Business	1	5.00	0	0.00	1	2.86
Households Works	0	0.00	5	33.33	5	14.29
Student	3	15.00	4	26.67	7	20.00
Children (< 5 years)	1	5.00	1	6.67	2	5.71
Retired/Handicapped	3	15.00	0	0.00	3	8.57
Unemployment	0	0.00	0	0.00	0	0.00
Overseas Work	0	0.00	0	0.00	0	0.00
Others	0	0.00	0	0.00	0	0.00
Total	20	100.00	15	100.00	35	100.00

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The table shows that the maximum of 20.00% is student, 14.29% in household work, 2.86% as small business, 48.57% in service and 5.71% are children of less than 5 years.

Monthly income pattern of the sample households are presented in **Table-4.41**.

Table-4.41: Monthly Income Patterns

Income Level	No. of Household	% of Income
Tk. 1000 - Tk. 5000	0	0.00
Tk. 5001 - Tk. 10000	0	0.00
Tk. 10001 - Tk. 15000	1	14.29
Tk. 15001 - Tk. 20000	1	14.29
Tk. 20001 - Tk. 25000	0	0.00
Tk. 25001 and Above	5	71.43
Total	7	100.00

The Table shows that the range of monthly income of 14.297% of the sample house hold is Tk. 10001-15000, 14.29% of the sample household is 15001-20000 and 71.43% is 25,001 and above range.

House Ownership

The distribution of the sample households by types of their residential house with respect to ownership and construction is presented in **Table-4.42**

Table-4.42 : House Ownership

House Ownership	No. of Households	% of Households
Self owned	7	100.00
Rented	0	0.00
Others	0	0.00
Total	7	100.00
Type of Housing structure		
Katcha	0	0.00
Semi Pucca	2	28.57
Pucca	5	71.43
Others	0	0.00
Total	7	100.00

The table also shows that 28.57% of the houses are Semi pucca (CI sheet roof with brick wall), 71.43% is pucca and 100% houses are self owned by the land owners.

(2)Samantho Sena- Impounding Reservoir and Surface Water Treatment Plants site survey data (Main Occupation of the Household Members; Monthly Income Patterns; Quality of life value)

Main occupations of the household members are summarized in **Table-4.43** by their sex.

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Table 4.43: Main Occupation of the Household Members

Occupation	Male	%	Female	%	Total	%
Farmers	45	61.64	0	0.00	45	36.59
Fisher worker	0	0.00	0	0.00	0	0.00
Agricultural Labor	0	0.00	0	0.00	0	0.00
Non-agricultural Labor	0	0.00	0	0.00	0	0.00
Service	5	6.85	1	2.00	6	4.88
Small Business	3	4.11	0	0.00	3	2.44
Households Works	0	0.00	41	82.00	41	33.33
Student	11	15.07	7	14.00	18	14.63
Children (< 5 years)	6	8.22	1	2.00	7	5.69
Retired/Handicapped	1	1.37	0	0.00	1	0.81
Unemployment	0	0.00	0	0.00	0	0.00
Overseas Work	2	2.74	0	0.00	2	1.63
Others	0	0.00	0	0.00	0	0.00
Total	73	100.00	50	100.00	123	100.00

Source: Field Information

The table shows that the maximum of 14.63% is student, 33.33% in household work, 2.44% as small business, 4.88% in service and 5.69% are children of less than 5 years.

Monthly Income Patterns

Monthly income pattern of the sample households are presented in Table-4.44.

Table 4.44: Monthly Income Patterns

Income Level	No. of Household	% of Income
Tk. 1000 - Tk. 5000	0	0.00
Tk. 5001 - Tk. 10000	6	20.00
Tk. 10001 - Tk. 15000	9	30.00
Tk. 15001 - Tk. 20000	4	13.33
Tk. 20001 - Tk. 25000	3	10.00
Tk. 25001 and Above	8	26.67
Total	30	100.00


Source: Field Information

The Table shows that the range of monthly income of 20% of the sample house hold is Tk. 5001-10000, 30% of the sample household is 15001-20000 and 26.67% is 25,001 and above range.

House Ownership

The distribution of the sample households by types of their residential house with respect to ownership and construction is presented in Table-4.45.


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Table 4.45: House Ownership

House Ownership	No. of Households	% of Households
Self owned	30	100.00
Rental	0	0.00
Others	0	0.00
Total	30	100.00
Type of Housing structure		
Katcha	0	0.00
Semi Pucca	30	100.00
Pucca	0	0.00
Others	0	0.00
Total	30	100.00

Source: Field Information

The table also shows that 100% of the houses are Semi Pucca (CI sheet roof with brick wall) and self owned.

(3)KCC- Overhead tank and reservoir sites Survey data (Main Occupation of the Household Members; Monthly Income Patterns; Quality of life value)

Main occupations of the household members are summarized in **Table- 4.46** by their sex.

Table-4.47 Occupational Pattern


Occupation	Male	%	Female	%	Total	%
Farmers	0	0.00	0	0.00	0	0.00
Fishermen	0	0.00	0	0.00	0	0.00
Agricultural Labor	0	0.00	0	0.00	0	0.00
Non-agricultural Labor	0	0.00	0	0.00	0	0.00
Service	1	8.33	0	0.00	1	5.26
Small Business	3	25.00	0	0.00	3	15.79
Households Works	0	41.67	5	71.43	5	26.32
Student	5	0.00	1	14.29	6	31.58
Children (<5 years)	0	0.00	1	14.29	1	5.26
Retired/Handicapped	0	0.00	0	0.00	0	0.00
Unemployment	1	8.33	0	0.00	1	5.26
Overseas Work	0	0.00	0	0.00	0	0.00
Others	2	16.67	0	0.00	2	10.53
Total	12	100.00	7	100.00	19	100.00

Source: Field Information

The table shows that the maximum of 31.58% is student, 26.32% in household work, 15.79% as small business, 5.26% in service, 10.53% in others work, small trade, 5.26% are children of less than 5 years and 5.26% are unemployed.

Monthly income pattern of the sample households are presented in **Table-4.48**.


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Table-4.48 Income Level of Household

Income Level	No. of Household	% of Income
Tk. 1000 - Tk. 5000	0	0.00
Tk. 5001 - Tk. 10000	1	33.33
Tk. 10001 - Tk. 15000	0	0.00
Tk. 15001 - Tk. 20000	1	33.33
Tk. 20001 - Tk. 25000	0	0.00
Tk. 25001 and Above	1	33.33
Total	3	100.00

Source: Field Information

The Table shows that the range of monthly income of 33.33% of the sample house hold is Tk. 5001-10000, 15001-20000 and 25,001 and above.

House Ownership

The distribution of the sample households by types of their residential house with respect to ownership and construction is presented in Table-4.49.

4.49 Housing Pattern and Ownership in the Affected Area

House Ownership	No. of Households	% of Households
Self owned	3	100.00
Rented	0	0.00
Others	0	0.00
Total	3	100.00
Type of Housing structure		
Katcha	0	0.00
Semi Pucca	1	33.33
Pucca	1	33.33
Others	1	33.33
Total	3	100.00

Source: Field Information

The table also shows that 33.33% of the houses are Semi Pucca (CI sheet roof with brick wall) and 33.33% are Pucca (reinforced concrete roof with brick wall) and 33.33% are staying in apartment building.

4.3.5 Historical and Archeological Features

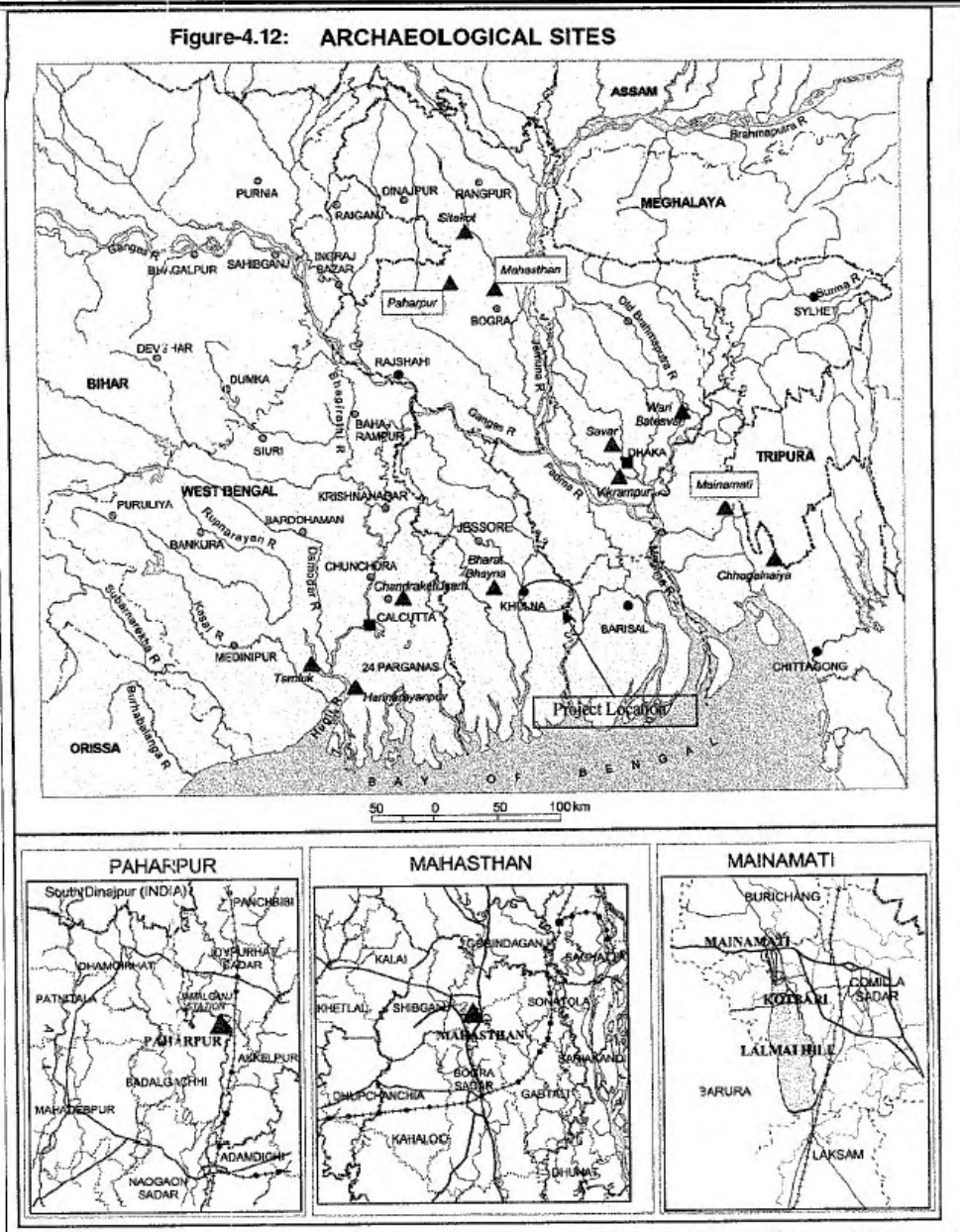
The Khulna divisional Archeological Museum is in the Khulna city. In the museum good number of historical and archeological subject is available for the interested people. Bir Bangali sculpture is a unique feature of Khulna. More on five monuments and three mass graves of the martyrs of liberation war are in the Khulna city. A memorial monument at Chakulia in Mollahat upazilla recalls the indomitable fighting of freedom fighters against Pakistani in 1971. No Special archeological feature is found in the project area. Some archeological sites of Bangladesh are shown in Figure-4.12.

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Figure-4.12: ARCHAEOLOGICAL SITES



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4.4 Infrastructure and Utilities

Infrastructure of the project area is shown in the Upazila map attached in the **appendix-4.3**.

4.4.1 Water Supply and Sanitation

(1) Mollahat- Intake site survey data (water and sanitation)

1) Sources and Use of Water by Purpose

Sources of water and their use were investigated and the results are summarized in **Table-4.50**.

Table-4.50: Sources and Use of Water by Purpose

Type of Sources	Drink ing No. H/H	(%) H/H	Cooking/ Washing No. H/H	(%) H/H	Bathing No. H/H	(%) H/H	Cattle Washin g No. H/H	(%) H/H
Tube well (STW)	0	0.00	0	0.00	0	0.00	0	0.00
Deep Tube well (DTW)	6	85.71	6	85.71	6	85.71	6	85.71
Supply Water	1	14.29	1	14.29	1	14.29	1	14.29
Well	0	0.00	0	0.00	0	0.00	0	0.00
Pond	0	0.00	0	0.00	0	0.00	0	0.00
Khal/River	0	0.00	0	0.00	0	0.00	0	0.00
Total	7	100.00	7	100.00	7	100.00	7	100.00

The Table shows that around 85.71% of the households collect drinking water use water for cooking/ washing, bathing & cattle washing from deep tube wells water.

2) Sanitation

The sanitation practice of the sample households and the types of latrines used are shown in **Table-4.51**

Table 4.51: Sanitation

Types of Latrines Used	No. of Households	% of Households
Sanitary	7	100.00
Pit	0	0.00
Hanging	0	0.00
Open space	0	0.00
Others	0	0.00
Total	7	100.00

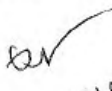
The Table shows that 100% of the project affected households have sanitary latrines.

(2) Samanth Sena- Impounding Reservoir and Surface Water Treatment Plants site survey data (water and sanitation)

1) Sources and Use of Water by Purpose

Sources of water and their use were investigated and the results are summarized in **Table-4.52**.


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Table 4.52: Sources and Use of Water by Purpose

Type of Sources	Drinking No. HH	(%) 100%	Cooking/ Washing No. H/H	(%) 100%	Bathing No. H/H	(%) 100%	Cattle Washin g No. H/H	(%) 100%
Tubewell (STW)	26	86.67	26	86.67	23	76.67	23	76.67
Deep Tubewell (DTW)	4	13.33	4	13.33	4	13.33	4	13.33
Supply Water	0	0.00	0	0.00	0	0.00	0	0.00
Well	0	0.00	0	0.00	0	0.00	0	0.00
Pond	0	0.00	0	0.00	3	10.00	3	10.00
Khal/River	0	0.00	0	0.00	0	0.00	0	0.00
Total	30	100.00	30	100.00	30	100.00	30	100.00

Source: Field Information

The Table shows that around 79.67% of the households collect drinking water from swallow tube wells water and 13.33% of the households drink water from deep tube well.

2) Sanitation

The sanitation practice of the sample households and the types of latrines used are shown in Table-4.53

Table 4.53: Sanitation

Types of Latrines Used	No. of Households	% of Households
Sanitary	30	100.00
Pit	0	0.00
Hanging	0	0.00
Open space	0	0.00
Others	0	0.00
Total	30	100.00

Source: Field Information

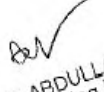
The Table shows that 100% of the project affected households have sanitary latrines.

(3) KCC- Overhead tank and reservoir sites Survey data (water and sanitation)

1) Sources and Use of Water by Purpose

Sources of water and their use were investigated and the results are summarized in Table-4.54.


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Table-4.54 Sources of Water and Uses

Type of Sources	Drinking No. H/H	(%) H/H	Cooking/Washing No. H/H	(%) H/H	Bathing No. H/H	(%) H/H	Cattle Washing No. H/H	(%) H/H
Tube well (STW)	1	33.33	0	0.00	0	0.00	0	0.00
Deep Tube well (DTW)	0	0.00	0	0.00	0	0.00	0	0.00
Supply Water	2	66.67	2	66.67	2	66.67	0	0.00
Well	0	0.00	0	0.00	0	0.00	0	0.00
Pond	0	0.00	1	33.33	1	33.33	0	0.00
Khal/River	0	0.00	0	0.00	0	0.00	0	0.00
Total	3	100.00	3	100.00	3	100.00	0	0.00

Source: Field Information

The Table shows that around 33.33% of the households drink tube wells water, around 66.67% of the households drink water from supply water by KWASA.

2) Sanitation

The sanitation practice of the sample households and the types of latrines used are shown in Table-4.55.

Table-4.55 Access to Sanitary Latrine

Types of Latrines Used	No. of Households	% of Households
Sanitary	3	100.00
Pit	0	0.00
Hanging	0	0.00
Open space	0	0.00
Others	0	0.00
Total	3	100.00

Source: Field Information

The Table shows that 100% of the project affected households have sanitary latrines.

4.4.2 Roads and culverts

The project area road and culverts are listed in the Table 4.56.

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Table: 4.56 Existing communication facilities of the project area

Location	Road (km)			Waterways (nautical mile)	Rail line (km)
	Pucca	Semi pucca	Mud		
Khulna City	400	350	3575	470	36
Rupsa Upazila	19	26	257		
Mollahat Upazila	34.41	12	269		
River Crossing with Road from Mollahat to Rupsha River					
Location	From Mollahat to Fakirhat Crossing		From Fakirhat Crossing to Rupsha River		
Box Culverts (nos.)	4		23		
Bridge (for irrigation cannel and stream) (nos.)	14		3		

Source: Field Information


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CHAPTER-05

PUBLIC CONSULTATION

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CHAPTER 5 Public Consultations

5.1 Public Consultation

Khulna Water Supply and Sewerage Authority (KWASA) recognize the importance of social and environmental factors for successful implementation of the proposed project. As such, it has retained a specific provision of public consultation, focus group discussion (FGD) and environmental investigation in the EIA process which is in consonance with principles and policies of JICA and simultaneously for preparing the Land Acquisition Plan / Resettlement Action Plan (RAP) report to plan and execute the project per procedures of ADB. On the other hand, the structure of EIA prescribed by DOE has to contain 'Public Opinion' as one of its component too. Accordingly, a comprehensive program was undertaken so that study on both the aspects may proceed simultaneously.

In fact, an organized consultation with parties and persons interested in or affected by project activities, forms a critical part of best practice project planning and environmental impact assessment. Early and participative engagement of stakeholders in the project planning phase not only increases the likelihood of approval by regulatory authorities, but also ensures smooth implementation of project activities. Further, since this water supply improvement project and its associated facilities being financed by the JICA and ADB, it was keenly felt necessary to have investigated about the qualitative and quantitative impact of the project on each and every project affected person (PAP) and its surrounding community & public amenities and the environment as per guidelines of JICA and ADB.

5.2 Approach & Methodology

The process of public consultation was initiated and conducted in two stages. This was done in the both Stages, during earlier EIA & LAP/RAP studies through public consultation and focus group discussion (FGD) at and around different locations of the water intake and impounding reservoir and Surface water treatment plant land sites.

5.3 Focus Group Discussions and Meetings


The consultant arranged 5 such consultation meetings with the local stakeholders for information dissemination and community participation with the concerned entity and probable affected persons. The consultant and investigators investigated all the relevant matters regarding the project by arranging these meetings and group discussions for people's awareness.

Representative(s) of JICA Study Team, KWASA, District Commissioner land section and local government were also present in these meetings to understand the people's views and suggestions. An open discussion was made on the proposed project and its positive and negative impacts, and their people's perceptions were written by the JICA Study Team representatives for record and reference.

The details of the public consultation and FGD meeting in both stages are recorded.

These meetings were held at 5 different places of the 2 districts on different dates commencing from 21st August, 2010 during field survey at previously designated places. These meetings were attended by different cross sections of persons. These public consultation meetings of the land owners, local elite and general members of the public were also attended on occasions by the City Mayor, ADC Revenue Bagerhat, Managing Director, KWASA, ADC (Land


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Acquisition) Khulna and the officials of JICA Study Team & KWASA including elected representatives, local leaders, women groups, representatives of professional groups like businessmen, farmers, teachers, religious leaders and public representatives as well as members and chairman of the Union and Upazila Councils and the consultant.

All of the participants have carefully studied all types of impacts in the locality of the proposed water supply project as explained JICA Study Team and voiced their opinion which was duly recorded. The details of the venue of meetings, participants at different dates have been incorporated in the report in a summary format and also presented in tabular forms. The public consultation meeting minutes and participation list are presented in the Annex-9.

Table-5.1: Details of Public Consultation at Different Sites

a. Stakeholders meeting

Sl. No.	Date	Places	Affected PAP & Focus Group/ Local People	KWASA Staff	JICA Staff	Others	Total
1	12-08-2010	KWASA office	2	4	4	14	24
2	21-08-2010	Patharghata High School, Rupsha	150	3	3	3	159

b. Focus Group Discussion and Public Consultation

Sl. No.	Date	Places	Affected PAP & Focus Group/ Local People	KWASA Staff	JICA Staff	Others	Total
1	7-10-2010	Patharghata	7	1	1	-	9
2	9-10-2010	Samonto Sena Bazar	7	1	1	-	9
3	9-10-2010	Mollarhat Technical College	7	1	1	-	9

Source: Field Survey

Table-5.2: Focus Group Discussion at Patharghata

Date: 7.10.2010 Interviewer: Mr. Humayon kabir Venue: Patharghata

Sl. No.	Name and Address of Key Informants	Profession	Issues Discussed/ Suggestion	KWASA Response
1	Md. habibur Rahman Samontosena	Farmer	Proper Compensation	Compensation
2	Abdus sobhan, Samontosena	..	Manage alternative land	Not beyond the Law
3	Krisnapad roy, pathorghata	..	Full compensation	Compensation
4	Shubrata kumar sarke, pathorghatar	..	Manage alternative land	Not beyond the Law
5	Prakash halder pathorghata	..	Manage alternative land	Not beyond the Law
6	Nani Gopal duit, pathorghata	..	Manage alternative land	Not beyond the Law
7	Md. rani, Lakpur	Share cropper	Manage alternative land	Not beyond the Law

Source: Field Survey

Table-5.3: Focus Group Discussion at Samontosena Bazar

Date: 09.10.2010 Interviewer: Mr. Humayon kabir Venue: Samonto Sena Bazar

Sl No	Name and Address of Key Informants	Profession	Issues Discussed/ Suggestion	KWASA Response
1	Abdul majid fakir, samontosena	Ag/Shrimp	Proper compensation	Compensation
2	md. Jakir hossain Sh. samontosena	Up member	Under ground water extraction, turnor	Good response
3	Moju Shekh, Pathorghata	Share cropper	Provide job	Under Consideration
4	Palash Halder, pathorghata	Ag/Sharecropper	Livelihood damage	Under Consideration
5	Jahangir Shekh, pathorghata	Shrimp gher	They will be landless	Under Consideration
6	Shawapan, pathorghata	Shrimp gher	Proper compensation	Compensation
7	Satter shekh	Farmer	Proper compensation	Compensation

Source: Field Survey

Table-5.4: Focus Group Discussion at Mollarhat Technical College

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Date: 09.2010 Interviewer: Mr. Humayon Kabir Venue: Mollarhat Technical College

Sl No	Name and Address of Key Informants	Profession	Issues Discussed/ Suggestion	KWASA Response
1	Shekh Mosta Gausul Hoq, Garfa	Chairman, Garfa UP	Land price should be at least upto market level, Demand of pure drinking water, the area is arsenic contaminated	Under Consideration
2	Md. Jurnul, Mollarhat	UP member	Proper compensation at market price	Compensation
3	Mr. Al Marun Shimul, Mollarhat	College teacher	Full compensation and project for the community	Compensation
4	Md. Faruque, Mollarhat	businessman	Timely and proper compensation	Compensation
5	Chowdhury Ziaul Islam, Mollarhat	Local elite	Public in getting payment shouldn't be harassed	Good idea
6	Sri Amitosh, Mollarhat	Service	Proper compensation	Compensation
7	Md. Shahidul Islam, mollarhat	Service	Proper compensation, road side land price is Tk.1,00,000	Under Consideration

Source: Field Survey

Table-5.5: Focus Group Discussion Summary (Public Consultation)

Sl. No.	Date	Place	Participants										Opinion Expressed		
			Chairman	Elite Person	Business	Service	Shrimp	Other	Farmer	UP Member	Share	Teacher		Total	
3	7 th October, 2010	Pothaighata							6			1		7	<p>Requested For: Proper compensation has to be given. Opportunity should be given to use water as saline free water in the locality. Shrimp cultivation is one of the major income sources of the PAP's, so need proper compensation required. Some of them wanted compensation as per market price or more. Shall co-operate if they are either properly compensated or secure good advantages.</p> <p>Comments: Those persons will be exclusively losers, whose total land will be damaged by the water supply project. But other than them, some of the locality will be affected due to the construction stage. Price of land will increase with water supply project passing through. There will be no disadvantage Shall generate employment opportunity for men and women. Saline free water is needed for the Khulna dwellers. Economic problem may be solved by availing this opportunity. The water supply project will help improving social & economic conditions. In future the water supply project will be of advantage to the local people. There will not be any disadvantage. This project will create employment opportunities for the people.</p> <p>Suggestions: KWASA the project proponent will take care all the issues raised by the local and PAP's will be solved as per under GOB's rules and regulations.</p>
4	9 th October, 2010	Sema Sompoto Bazar					3	1	1		2		7		
5	9 th October, 2010	Technical Mollarhat College	1	1	1	2			1			1	7		
Total:													21		

Source: Field Survey

5.6.1 Checklist Used for Public Consultation and Key Informant Interview

For uniformity and clarity in conducting the public consultation meetings, a checklist was devised by the consultants and was used to enable the participants to comprehend the issues easily. This has helped them so much so that they could effectively participate in the discussions

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and express their opinions from objective points of views. This participatory approach contained in the Checklist so devised and given below was well accepted by all the participants:

Consultants Checklist:

- Location of consultation
- Name and occupation of the participants
- Awareness of the participants about the Project
- Description of the Project
- Benefits of the Project
- Impacts of the Project on social and environmental components
- Concerns about the Project
- Expectations from the Project
- Suggestions about the Project

During the public consultations, social, environmental as well as cross-cutting issues were discussed in detail. In addition, such discussions also included the potential impacts of the project activities on environmental and social parameters, identification of sensitive issues, risks, potential threats, public concerns and expectations from the project.

5.4 Findings from Focus Group Discussion

The salient features of the opinions expressed by the participants of different profession have divulged in general that they are concerned with due compensation and rehabilitation wherever any damage is done and with request for providing safe water in their localities on priority basis.


Though they have, in general, appreciated the project as a development work of the country and in their opinion, it will help setting up economic development, generate employment but note of caution was there from them that the work should be done carefully to avoid any accident in future and reinstatement along the project site has to be done properly and promptly after completing the all project works.

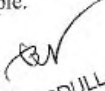
Participants in these consultation meetings were the land owners and available the local people along the intake and impounding reservoir site. **Table-5.2** through **5.4** reveals the number and composition of the participants in these meetings.

The participants in general welcomed for some extent and at some instant their approach is very much negative for this project site especially at the impounding reservoir and surface water treatment plant site. As reported, the following major issues among others were raised in the public consultation meetings for three sites.

(1) Impounding Reservoir Site

- Shrimp cultivation is the main business of this locality. This will affected a lot due to this project. So proper reimbursement like fish development cost to land compensation cost like double or triple or sometimes five times payment to the affected people.


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- Agricultural products including vegetation were affected. Due compensation of which should be paid on the spot to the affected people before the construction starts. Trees and vegetation compensation should be included for the affected people.
- Assembly of worker (labour) during project activities may damage crops and other trees.
- Noise pollution from vehicles and equipment at the project sites may cause disturbance to human being and wild life.
- Air pollution due to dust and gaseous emission should be controlled.
- Compensation for land as per government rate would not be a fair compensation to the affected person as it is far below prevailing market rate and should be minimized this issue as per market prices.
- There will be enhanced soil quality degradation particularly for the after project construction activities, which should be addressed properly.
- Water pollution of the natural water bodies may be aggravated and should be taken care of as this water is used for agriculture and domestic purposes.
- Movement of vehicles may affect movement of people, especially women, children and disabled persons from one place to another due to the project activities.
- Environmental pollution through sanitation and waste materials as well as other social nuisance should be controlled.
- They also raise issues that what will be benefit of the land owners for this project implementation.
- Moreover this land is their life and without these pieces of land they will lose everything, so if possible or not do not take this land instead of this land use government (khas) land.

(2) Water Intake Site

- Agricultural products like rice, jute and including vegetation were affected. Due compensation of which should be paid on the spot to the affected people before the construction starts. Trees and vegetation compensation should be included for the affected people.
- There will be enhanced soil erosion particularly on the river banks, which should be addressed properly.
- Traffic management should be controlled at day time may affect movement of people, especially women, children and disabled persons from one place to another.
- Environmental pollution like air pollution (due to dust and gaseous emission), water pollution (Madhumoti river) as natural water bodies may be aggravated and should be taken care of as this water is used for agriculture and domestic purposes and through sanitation and waste materials as well as other social nuisance should be controlled.

(3) Distribution Reservoir and Overhead Tank Site

- Most of the land inside the city is valuable and costly, so if possible then take government land.

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- Proper compensation should be paid for the land inside the city sites.

Summary of three sides opinion are presented in the **Table-5.6**.

Table-5.6: Summary of Opinion

Sl. No.	Opinion
1	Compensations of Shrimp Gher
2	Compensations of lands
3	Noise and air pollution
4	Soil quality degradation
5	River and natural water pollution
6	Movement of vehicles and Traffic Management
7	Government (khass) land

Source: Field Survey

This opinion is basically the general opinion that is found the similar situation in any development project work in any parts of the country of Bangladesh. Actually no resettlement work will be of this project accept the land acquisition.

5.5 Expectation: of the People

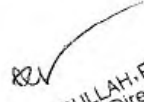
The following expectations of the local people were evidenced during the consultations:

- Local personnel should be employed in different activities of the project on a priority basis.
- Preference should be given to engage local businessmen/ contractors in different phases of the project for construction and development depending in their suitability for such engagements.
- Compensation payment, it should be in the rate of market prices and also with the negotiation of the affected people, should be properly and promptly distributed so that the actual affected person gets his full share and in right time.
- Supply of produced water would help improving their social life as drinking safe water conditions and therefore water should be made available in the areas through which water line would be passing through.

5.6 Public Consultation Results

The findings as recorded from public consultations have been presented in the **Table-5.7** indicating the critical issues. The names of some of the participants present in the meetings are listed at the **Table-5.2** through **5.4** on FGD records.


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Table-5.7: Public Consultations

Project Name	Issues Discussed	Issue Raised	Suggestions
Khulna Water Supply Improvement Project	Impact of construction of Water Intake, Impounding Reservoir and Surface water Treatment Plant	- Development	- Area will be developed by new access road, land scaping
		- Reduce Unemployment	- Labour should be taken from that locality.
		- Social & Economic development	- Living status will be high.
		- Land & property damage	- Due compensation to be paid according to the latest approval price list.
		- Crop damage	- Due compensation to be paid on the spot.
		- Fruit trees damage	- Due compensation to be paid on the spot.
		- Saline free water	- Discuss with superior person of the locality for providing water.
		- Compensation assessment	- Compensation assessment by DC and local leader.
		- Shrimp Cultivation	- Proper compensation will be paid as land development to shrimp Cultivation.
		- Fish breeding	- Must avoid breeding time
		- Pollution of air and surface water	- Due Compensation to be given, Monitoring shall be adopted.
		- Sanitary problem	- Sanitary system should be developed during construction.

Source: Field Survey

5.6.1 Consultation with Project Affected Person

This time a structured questionnaire was devised to collect all relevant socio-economic condition of the PAP along the dag number of the project activities area.

The suggestions on the losses, mitigation options and implementation strategies were taken from the people and the information and comments provided by each individual owner or his relative present in the Households was duly recorded in the questionnaire well structured to cover all relevant points respective to his socio-economic condition, attitude towards implementation and his claim / expectation of compensation for the losses he is going to incur for the project.

This time, members of the local government, local elites and people of different profession, representatives of JICA Study Team, KWASA, data collector were present to understand the views and suggestions of the PAP and the local people when the background, nature and components of project, summary findings of the EIA and LAP/RAP studies in respect of its positive and negative impacts etc including market value of their assets being affected, payment of compensation and grievance redress mechanism were discussed in details.

A summary of such meetings has been placed where in a total of 21 persons were present including local people, chairman, member, teachers, business man, services and etc. covering the plots as much as possible during the field survey and public consultation. The response of each and every PAP to the questionnaire has been duly recorded and then compiled in the master database prepared for the study.

5.6.2 Discussion Relating to Public Property

According to the present projects site, 84 nos. public lands and highway, LGED

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corporation roads are to be affected by the project. This affected land, infrastructures and facilities will create problems in turn for the local community to live smooth life. For example, at the construction stage, access road being used during water pipeline crossings, movement of human and transports, alternative access roads will have to be arranged for mitigating the inconvenience.

Thread bear discussion was held with KWASA on this issue and it has been revealed that due permission will be sought from respective authorities following finalization of design of the water pipeline sections with exact location of the crossing points, dimensions of crossings and tentative schedules etc and such permissions will be obtained on due payment of fees and other charges as asked for by these authorities are summarized in the following Table-5.8.

Table-5.8: List of Authorities

Sl. No.	Name of the Authorities
1	Bangladesh Inland Transport Authorities (BIWTA)
2	Bangladesh Water Development Board (BWDB)
3	Roads and Highway Department (R&H)
4	Local Government Engineering Department (LGED)
5	Khulna City Corporation (KCC)
6	Khulna Development Authority (KDA)
7	District Commissioner (Khulna and Bagerhat)
8	Department Public Health Engineering (DPHE)
9	Bangladesh Railway
10	Bangladesh Telecommunication Company Limited

Further, it has been disclosed that all works related to reinstatement, erosion protection, alternate thoroughfare provision etc. required thereof to mitigate the public inconveniences and restoration of damages will be included in the tender doc of the EPC contractors.

5.6 Response to Project

Summary of PAP response to this projects is placed in Table-5.9, where from it can be seen that among of the 30 PAP, 10 has disagreed to the execution of the project, 6 has given straight support while 5 have communicated certain conditions like providing job during construction, direct payment of compensation, payment should made without any hassle, payment should be made before starting the work etc for considerations.

Table-5.9: Summary of PAP Response to the Project

Comments	H/H No.	%
Positive without any condition	6	20
Positive on conditions of proper compensation, providing job etc	5	16.67
Alternate suggestion	9	30
Negative	10	33.33
Total	30	100

Source: Field Survey

5.7 Feedback and Conclusions

5.7.1 Conclusion

The Khulna Water Supply Improvement Project of KWASA is considered to be a feasible project examined from both social and environmental points of view. Acquisition of land being on both intake and impounding reservoir and surface water treatment plant site, the general

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
conclusion of the study and preparing Environmental Impact Assessment (EIA) Report is that no significant negative environmental and social impact will be produced by the project interventions so long as due mitigation measures and land acquisition or social impact actions **are taken as per Environmental Management Plan (EMP) and the Land Acquisition Plan (LAP)/Resettlement Action Plan (RAP) report** respectively. The study has also revealed the important areas, which need special emphasis during design and implementation phase. The following are the important considerations:

- a) Ensure institutional capacity of KWASA for implementing and monitoring EMP and LAP/RAP including formation of Grievance Redress Committee (GRC) with due representation from PAP and the authority and ensure budget provision in KWASA for implementing the LAP/RAP and the EMP with due importance to social management plan as placed in the EIA Report and the recommendations made at the LAP/RAP report. Provide them with due adequate manpower, logistic supports and the fund as required.
- b) Arrange all preparatory works so that compensations are paid to all of the eligible PAP well before carrying out of any works at site with interventions in their properties and ensure adequacy of the grievance redress mechanism during post project evaluation and take care of the residual impact, if any, under the GOB regulations & the JICA and ADB policy frame work. But as per GOB regulation KWASA cannot pay any excess money to the PAP for land acquisition. KWASA is under considering the point that the PAP raise during the stakeholders meeting and FGD period and KWASA will discuss this issue with the LGD to mitigate.
- c) Ensure incorporation of the provision of all mitigation measures including but not limited for due reinstatement of all public roads and protection of river banks etc from erosion. Ensure identification and inclusion of all items relating to EMP to be carried out by the EPC contractor in their scope of work.
- d) Monitor progress of implementation of both EMP and LAP/RAP through Owner's Engineer including deployment of Environmental Specialist of the independent Consulting Group with their placement in the organization chart recommended at of this report and ensure progress reporting to the management of KWASA and other concerned authorities e.g. DOE, JICA and ADB etc as applicable.

Acquisition under this project is a bulk nature. However, if any found during execution of works he/ they will have to be duly compensated. All these issues will be taken special care of by the GRC about their due compensation and grant as applicable.

In fine, feedbacks from the consultation process played an important role in understanding the apprehensions and expectations of the members of the public in general and stakeholders in particular. Such inputs from them helped development of a clear picture of the socio-economic and environmental base line of the project area too. This because, the public roads, streams/canals and banks of the rivers as affected by the project have been well identified and due mitigation measures have also been proposed for the same for example, loss of access to common property resources like roads, irrigation canals as identified have to be provided with alternative arrangements by the EPC contractor during the project implementation stage. It may be mentioned that the opinion expressed by them may also be considered indicative during preparation of LAP/RAP. Such steps of information dissemination and consultation shall have to continue throughout the implementation period in the interest of smooth execution of the project.


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CHAPTER-06

**IDENTIFICATION, PREDICTION AND MITIGATION
OF POTENTIAL IMPACTS**

EIA Report on Khulna Water Supply
Improvement Project, KWASA, Khulna Chapter 6

CHAPTER 6 IDENTIFICATION, PREDICTION AND MITIGATION OF POTENTIAL IMPACTS

6.1 The Aim of Environmental Assessment

The aim of the environmental assessment is to identify, analyze and assess the potential impacts of the project on the environment and then to ensure:

- Firstly, that the design of the project incorporates practical and cost-effective measures to avoid or minimize potential environmental impacts; and
- Secondly, that the predicted environmental impacts are suitably mitigated or compensated for and detailed in an Environmental Management Plan.

6.2 Methodology for Assessment of Impacts

The activities associated with Construction of Khulna Water Supply Improvement project, which may potentially give rise to environmental impacts, are generally well known. In this EIA Report, accumulated knowledge from numerous generic sources as well as those from field experience has been applied to identify potential impacts associated with the proposed project Activities in **Section 6.3** in this chapter.

A traditional EIA approach has been followed which entails the generation of a checklist for identifying potential sources of impact. The checklist is based on a combination of project activities and the existing environmental conditions. Each potential source of impact is analyzed and where possible, quantified. The significance of the impact is predicted and mitigation measures are proposed. The EIA Report is then submitted to regulatory authorities for proper authorization / clearance for the project to proceed. The authorities balance the project's economic benefits against its potential residual impacts and then make an informed decision.

6.3 Identifying Potential Impacts

Besides the generic sources referenced in **Section 6.1** above and based on experience learned from other similar projects, the following measures have been employed to ensure that a comprehensive identification, analysis and evaluation of likely impacts have been conducted.

- Overlaying project components on maps of existing conditions from the outset to identify the potential impact areas and issues;
- Reviewing secondary data sources covering relevant aspects to the project including the physical, biological and socio-cultural environment (**See Chapter-4**).
- Consulting with local environmental experts;
- Considering the concerns and issues rose during community meetings and with primary stakeholders (i.e., Communities directly affected by the project's proposed activities) (**See Chapter-5**).

Impact identification and risk ranking requires an examination of interactions between Important Environmental Components (IEC) and project activities. A number of IEC have been identified based on DOE guidelines with additional literature review including review of national & international reference documents and prior professional experience.

Table-6.1 to Table-6.6 shows (see below Table) the various project activities, potential impacts and risk ranking (severity versus duration) of potential impacts of each proposed project

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components, which have been evaluated based on the environmental and social characteristics reviewed in **Chapter-4**.

Table	Project Component	Location
Table 6.1	Water Intake Facility	Mollarhat
Table 6.2	Raw water Transmission Pipeline	From Mollarhat to Samonto Sena
Table 6.3	Impounding reservoir at Samonto Sena	Samonto Sena
Table 6.4	Surface water Treatment Plant	Samonto Sena
Table 6.5	Clear water Transmission Pipeline	From Samonto Sena to Different Reservoir & Overhead tank at KCC area.
Table 6.6	Distribution reservoir and Overhead tank	KCC area

In reviewing impacts, this Section addresses the following issues:

- Air Quality;
- Noise and Vibration;
- Surface Water and Groundwater Quality;
- Water Canal Management
- Land and Soil;
- Biodiversity;
- Interference with Navigation /Fisheries
- Health and Safety
- Road Sign/Marking
- River, Cannel, Box Culvert, Bridge crossing
- Abstraction of water
- Solid waste and waste water
- Water Sludge from Surface Water Treatment Plant
- Pipe leakage:
- Construction Norms
- Time Regulation at working
- Transportation / Traffic Management; and
- Truck Use
- Narrow Roads
- Market places
- Right of way of Pipeline
- Vector diseases (e.g. Mosquitoes)
- Other Social Aspects.
 - A. Vegetation growth
 - B. Local Community Level


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Table-6.1: Project Activities and Potential Impacts at Surface water Intake Facilities

Activity	Potential Impacts	Severity	Duration
Surface Water Intake Facilities (Capacity 110,000 m³/day)			
Pre-Construction Phase			
-Soil Testing for soil quality analysis will number of spot hole drilling will generate drill cutting waste			
-Movement of vehicles and working staffs and running of engines for about a year in an area of 2.52 acre.			
-Already two bore holes have been drills and rest of the instigation will be done at detailed study period			
-Temporary camp for land survey and soil investigation			
-vegetation disruption			
Local Community Level	<u>Socio-Economic</u> Loss of land and crop	N	T
Vegetation Growth	Loss of vegetation	N	T
Construction Phase			
-Land acquisition of 2.52 acre			
-Compensation of land owners of around 30 nos.			
-Construction of office, electrical & generator room, pump house, grid chamber, access road.			
-Site camps and labour shades for the construction workers			
-Movement of heavy and small vehicles			
-Construction materials			
-20 meter long river embankments			
-Abution control			
Dust emission from excavated soil	<u>Air Quality</u> Public nuisance	M	T
Dust emission from movement of vehicles	Air pollution	N	T
Emission of smoke from vehicles	Air pollution	N	T
Noise from vehicles and equipment	<u>Noise and Vibration</u> Nuisance to local people, livestock etc.	M	T
Disposal of waste and solid waste	<u>Domestic Waste water and solid waste</u> Air contamination	M	T
Erosion from disturbed soil	<u>Surface Water Quality</u> Turbidity and sedimentation	M	T
Blockage of natural existing creeks	Water logging	M	T
Discharge of domestic wastes	<u>Ground Water Quality</u> Contamination of aquifer	N	T
Excavation of soil and land levelling	<u>Soil Resources</u> Erosion	M	T
Mixing fertile top soil with unfertile subsoil	Loss of fertility	N to M	T
Movement of heavy vehicles	Soil degradation due to pollution	N to M	T
Vegetation	Soil compaction	M	T
Disruption of Earth Surface	Surface up gradation	M	T
Congestion of natural drainage system	Water logging	M	T
Congestion in the traffic	<u>Transportation and Traffic Management</u> Public nuisance	M	T
Disposal of Lube oil	Soil Contamination	M	T
Narrow road	Public nuisance	M	T
Market Place	Public nuisance	M	T
Excavation of soil	<u>Biodiversity</u> Loss of natural vegetation	M	T*
Clearance of vegetation	Loss of plants	M	T*
Movement of vehicle	Obstruction to traffic / animal movement	N	T
Noise from construction equipment	Nuisance to people and animals	M	T
Ecosystem (Flora and Fauna)	Displaced from the habited	M	T*
Excavation of land	<u>Other Social Aspects</u> Loss of crop	M	T
Movement of heavy vehicles	Public nuisance	N	T
Solid waste disposal	Public nuisance	M	T
Interference with navigation/fisheries	Commercial loss	N	T
Protection of workers' health and safety	Loss in workers health	M	T
Culture Activities	Public nuisance	N	T
Diseases	Loss in workers health	M	T
Post Construction Phase			
-24 hr operation			
-5% Water collection from the Modhamoti river			
-Movement of vehicles for Supervision and monitoring			
Generation of Sludge	<u>Loss Water Quality</u>	N	T
Disturbance to Aquatic Life	Loss to ecology	M	T
Noise and vibration	Public nuisance	N	T
Domestics sewerage and solid waste	Public nuisance	N	T
Inadequate periodic monitoring	Inadequate water supply	M	T

Note: N = Negligible, M = Moderate, S = Severe, T = Temporary, P = Permanent. To be covered = T, * = None.

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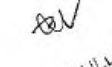
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Table-6.2: Project Activities and Potential Impacts at Raw Water Transmission Pipe (Mollarhat - Samonto Sena)

Activity	Potential Impacts	Severity	Duration
Raw Water Transmission Pipe (1350 mm Dia and 33 km long)			
Pre-Construction Phase			
-Survey and land mark -Land acquisitions -Geo-technical investigation	-Route selection -Vehicles movement -Staff and workers of survey investigation		
Local Community Level	<u>Socio-Economic</u> Public nuisance	N	T
Vegetation Growth	Loss of vegetation	N	T
Construction Phase			
-33 km pipe construction with materials of PVC -Earth moving, trenching, dumped truck, bulldozgers, lifts, mud pump, generator, sprinklers, water sprayers, pipe trolleys/trailers, human hoilers and construction testing and commission materials and equipments. -Top soil excavated and reclaim of up	-Waste generation at the site -Site camp and its equipments -Waste generation and excess surplus earth -Day time traffic congestion, -road signs -disposal of waste -Box culvert (18), bridge (17)		
Dust emission from excavated soil	<u>Air Quality</u> Public nuisance	M	T
Dust emission from movement of vehicles	Air pollution	N	T
Emission of smoke from vehicles	Air pollution	N	T
Noise from vehicles and equipment	<u>Noise and Vibration</u> Nuisance to local people, livestock etc.	M	T
Traffic Control	<u>Surface Water Quality (Box culvert and bridge)</u> Public nuisance	M	T
Navigation disruption	Loss of economy	M	T
Discharge of site camp wastes	Contamination of water	N	T
Excavation of soil and land levelling	<u>Soil Resources</u> Erosion	M	T
Mixing fertile top soil with unfertile subsoil	Loss of fertility	N to M	T
Movement of heavy vehicle	Soil degradation due to pollution	N to M	T
Congestion in the traffic	<u>Transportation and Traffic Management</u> Public nuisance	M	T
Disposal of Lube oil	Soil Contamination	M	T
Narrow road	Public nuisance	M	T
Market Place	Public nuisance	M	T
Excavation of soil	<u>Biodiversity</u> Loss of natural vegetation	M	T*
Clearance of vegetation	Loss of plants	M	T*
Movement of vehicle	Obstruction to traffic / animal movement	N	T
Noise from construction equipment	Nuisance to people and animals	M	T
Excavation of land	<u>Other Social Aspects</u> Loss of crop	M	T
Movement of heavy vehicles	Public nuisance	N	T
Solid waste disposal	Public nuisance	M	T
Interference with navigation/fisheries	Commercial loss	N	T
Protection of workers' health and safety	Loss in workers' health	M	T
Post Construction Phase			
-pile line patrolling and surveillance -leak detection and maintenance -right of ways encroachment			
Security checking of pipeline route	Public nuisance	N	T
Inadequate periodic monitoring	Water supply disruption	M	T
Leakages & Line breaks	Saline water contamination	M to S	T

Note: N = Negligible, M = Moderate, S = Severe, T = Temporary, P = Permanent, To be covered = T, * = None.


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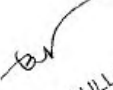
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Table-6.3: Project Activities and Potential Impacts at Impounding Reservoir at Samonto Sena

Activity	Potential Impacts	Severity	Duration
Impounding reservoir at Samonto Sena (1 nos. of Capacity 775,200 m³)			
Pre-Construction Phase -Survey and land mark -Land acquisitions -Geo-technical investigation	-Route selection -Vehicles movement -Staff and workers of survey investigation		
Local Community Level Vegetation Growth	Socio-Economic Loss of land and crop Loss of vegetation	M M	T T
Construction Phase -400x400 m ² -16 ha land acquisition -Earth moving, trenching, dumped truck, bulldozers, lifts, mud pump, generator, sprinklers, water sprayers, human hollers, bottom compactors, foundations structures -Top soil excavated and degradation of soil erosion -Waste generation at the site -Site camp and its equipments -Waste generation and excess surplus earth -Day time traffic congestion,	-construction norms and signs -disposal of waste -land disruption and landscaping -Earth work shoring -ground water evacuation pump -congestion of natural drainage and water logging -Site camps and labour shades for the construction workers -Health and occupational safety -Surplus soil disposal -Transportation and traffic management -Biodiversity -Surface and ground water quality		
Dust emission from excavated soil Dust emission from movement of vehicles Emission of smoke from vehicles	Air Quality Public nuisance Air pollution Air pollution	M N N	T T T
Noise from vehicles and equipment	Noise and Vibration Nuisance to local people, livestock etc.	M	T
Erosion from disturbed soil Blockage of natural existing creeks	Surface Water Quality Turbidity and sedimentation Water logging	M M	T T
Discharge of domestic wastes	Ground Water Quality Contamination of aquifer	N	T
Excavation of soil and land levelling Mixing fertile top soil with unfertile subsoil Movement of heavy vehicles	Soil Resources Erosion Loss of fertility Soil degradation due to pollution	M N to M N to M	T T T
Excavation of soil Clearance of vegetation Movement of vehicle Noise from construction equipment	Biodiversity Loss of natural vegetation Loss of plants Obstruction to traffic / animal movement Nuisance to people and animals	M M N M	T* T* T T
Excavation of land Movement of heavy vehicles Solid waste disposal Interference with navigation/fisheries Protection of workers' health and safety Diseases	Other Social Aspects Loss of crop Public nuisance Public nuisance Commercial loss Loss in workers health Loss in workers health	M N M N M	T T T T T
Post Construction Phase -24 hr operation -Vector diseases (e.g. Mosquitoes)			
Diseases (Mosquitoes)	Fresh water for breeding insects	N	T

Note: N = Negligible, M = Moderate, S = Severe, T = Temporary, P = Permanent. To be covered- T, * = None.


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Table-6.4: Project Activities and Potential Impacts at SWTP at Samonto Sena

Activity	Potential Impacts	Severity	Duration
SWTP at Samonto Sena (1 nos. of Capacity 110,000 m³/day)			
Pre-Construction Phase -Survey and land mark -Land acquisitions -Geo-technical investigation	-Route selection -Vehicles movement -Staff and workers of survey investigation		
Local Community Level	Socio-Economic	M	T
Vegetation Growth	Loss of land and crop Loss of vegetation	M	T
Construction Phase -250x400 m ² -10 ha land acquisition -Earth moving, trenching, dumped truck, bulldozgers, lifts, mud pump, generator, sprinklers, water sprayers, human hollers, bottom compactors, foundations structures -Top soil excavated and degradation of soil erosion -Waste generation at the site -Site camp and its equipments -Waste generation and excess surplus earth -Day time traffic congestion.	-construction norms and signs -disposal of waste -land disruption and landscaping -Earth work shoring -Ground water evacuation pump -Congestion of natural drainage and water logging -Site camps and labour shades for the construction workers -Health and occupational safety -Surplus soil disposal -Transportation and traffic management -Biodiversity -Surface and ground water quality		
Dust emission from excavated soil	Air Quality	M	T
Dust emission from movement of vehicles	Public nuisance	N	T
Emission of smoke from vehicles	Air pollution	N	T
Noise from vehicles and equipment	Noise and Vibration Nuisance to local people, livestock etc.	M	T
Erosion from disturbed soil	Surface Water Quality	M	T
Blockage of natural existing creeks	Turbidity and sedimentation Water logging	M	T
Discharge of domestic wastes	Ground Water Quality Contamination of aquifer	N	T
Excavation of soil and land levelling	Soil Resources	M	T
Mixing fertile top soil with unfertile subsoil	Erosion	N to M	T
Movement of heavy vehicles	Loss of fertility Soil degradation due to pollution	N to M	T
Excavation of soil	Biodiversity	M	T
Clearance of vegetation	Loss of natural vegetation	M	T*
Movement of vehicle	Loss of plants	N	T
Noise from construction equipment	Obstruction to traffic / animal movement Nuisance to people and animals	M	T
Excavation of land	Other Social Aspects	M	T
Movement of heavy vehicles	Loss of crop	N	T
Solid waste disposal	Public nuisance	M	T
Interference with navigation/fisheries	Public nuisance	N	T
Protection of workers' health and safety	Commercial loss	N	T
Diseases	Loss in workers' health	M	T
	Loss in workers' health	M	T
Post Construction Phase			
-24 hr operation			
-Vector diseases (e.g. Mosquitoes)			
Waste hazardous	Public nuisance	N	T
Diseases	Loss in health	N	T

Note: N = Negligible, M = Moderate, S = Severe, T = Temporary, P = Permanent, To be covered= T,* = None.


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Table-6.5: Project Activities and Potential Impacts at Clear Water Transmission Pipe (Samonto Sena – KCC area)

Activity	Potential Impacts	Severity	Duration
Clear Water Transmission Pipe (300 mm-1100 mm Dia and 25 km long)			
Pre-Construction Phase			
-Survey and land mark -Land acquisitions -Geo-technical investigation	-Route selection -Vehicles movement -Staff and workers of survey investigation		
Local Community Level Vegetation Growth	<u>Socio-Economic</u> Loss of land and crop Loss of vegetation	M M	T T
Construction Phase			
-33 km pipe construction with materials of Ductile Iron Pipe -Earth moving, trenching, dumped truck, bulldozers, lifts, mud pump, generator, sprinklers, water sprayers, pipe trolleys/trailers, human hollers and construction testing and commission materials and equipments.	-Top soil excavated and reclaim of up -Waste generation at the site -Site camp and its equipments -Waste generation and excess surplus earth -Day time traffic congestion, -road signs -disposal of waste -Box culvert (8 nos.), River Crossing (1no.)		
Dust emission from excavated soil Dust emission from movement of vehicles Emission of smoke from vehicles	<u>Air Quality</u> Public nuisance Air pollution Air pollution	M N N	T T T
Noise from vehicles and equipment	<u>Noise and Vibration</u> Nuisance to local people, livestock etc.	M	T
Cutting mud Heavy equipment and machinery Navigation interruption	<u>River Crossing</u> Water quality degradation Nuisance to local people, livestock etc Public nuisance	M N N	T T T
Erosion from disturbed soil Blockage of natural existing creeks	<u>Surface Water Quality</u> Turbidity and sedimentation Water logging	M M	T T
Discharge of domestic wastes	<u>Ground Water Quality</u> Contamination of aquifer	N	T
Congestion in the traffic Disposal of Lube oil Narrow road Market Place	<u>Transportation and Traffic Management</u> Public nuisance Soil Contamination Public nuisance Public nuisance	M M M M	T T T T
Excavation of soil and land levelling Mixing fertile top soil with unfertile subsoil Movement of heavy vehicles	<u>Soil Resources</u> Erosion Loss of fertility Soil degradation due to pollution Soil compaction	M N to M N to M M	T T T T
Excavation of soil Clearance of vegetation Movement of vehicle Noise from construction equipment	<u>Biodiversity</u> Loss of natural vegetation Loss of plants Obstruction to traffic / animal movement Nuisance to people and animals	M M N M	T* T* T T
Excavation of land Movement of heavy vehicles Solid waste disposal Interference with navigation/fisheries Protection of workers' health and safety	<u>Other Social Aspects</u> Loss of crop Public nuisance Public nuisance Commercial loss Loss in workers health	M N M N M	T T T T T
Post Construction Phase			
-pile line patrolling and surveillance -leak detection and maintenance -right of ways encroachment			
Security checking of pipeline route Inadequate periodic monitoring Leakages & Line breaks	Public nuisance Water supply disruption Saline water contamination	N M M	T T T

Note: N = Negligible, M = Moderate, S = Severe, T = Temporary, P = Permanent. To be covered= T*, * = None.

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
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Table-6.6: Project Activities and Potential Impacts at Distribution Reservoir & Overhead Tanks

Activity	Potential Impacts	Severity	Duration
Distribution Reservoir & Overhead Tanks Reservoir (5,000m ³ - 18,000m ³), OHT (300m ³ - 500m ³)			
Pre-Construction Phase			
-Survey and land mark -Land acquisitions -Geo-technical investigation	-Route selection -Vehicles movement -Staff and workers of survey investigation		
Local Community Level	Socio-Economic Loss of land and crop	M	T
Vegetation Growth	Loss of vegetation	M	T
Construction Phase			
Dust emission from excavated soil Dust emission from movement of vehicles Emission of smoke from vehicles	Air Quality Public nuisance Air pollution Air pollution	M N N	T T T
Noise from vehicles and equipment	Noise and Vibration Nuisance to local people, livestock etc.	M	T
Erosion from disturbed soil Blockage of natural existing creeks	Surface Water Quality Turbidity and sedimentation Water logging	M M	T T
Discharge of domestic wastes	Ground Water Quality Contamination of aquifer	N	T
Congestion in the traffic Disposal of Lube oil Narrow road Road Crossing Market Place	Transportation and Traffic Management Public nuisance Soil Contamination Public nuisance Public nuisance Public nuisance	M M M M M	T T T T T
Excavation of soil and land levelling Mixing fertile top soil with unfertile subsoil Movement of heavy vehicles	Soil Resources Erosion Loss of fertility Soil degradation due to pollution	M N to M N to M	T T T
Excavation of soil Clearance of vegetation Movement of vehicle Noise from construction equipment	Biodiversity Loss of natural vegetation Loss of plants Obstruction to traffic / animal movement Nuisance to people and animals	M M N M	T* T* T T
Excavation of land Movement of heavy vehicles Solid waste disposal Interference with navigation/fisheries Protection of workers' health and safety Diseases	Other Social Aspects Loss of crop Public nuisance Public nuisance Commercial loss Loss in workers health Loss in workers health	M N M N M	T T T T T
Post Construction Phase			
Leakages & Line breaks	Inadequate supply of water	M	T

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6.4 Analysis of Impacts and Suggested Mitigation Measures (common for all components of the project)

6.4.1 Air Quality

(1) Impact

During construction, the principal air quality impacts will arise from dust generation from excavation of soil, pipe laying and vehicle movement. Heavy vehicles may cause exhaust gas emissions, but these impacts are temporary and for short duration in the construction stage.

(2) Mitigation

- Excavated materials, stockpiles and haul roads shall be dampened with water spraying during dry ambient conditions;
- Vehicle speed restrictions shall be imposed to reduce dust generation and dispersion;
- Transport vehicles shall not be overloaded,
- Transport vehicles shall be covered by triple/plastic
- Periodical maintenance of the vehicle should be ensured.
- Visual inspections of equipment and vehicles shall be conducted on a periodical basis to ensure no excessive emissions of black smoke (**see Chapter-2**).
- Education to the driver to keep traffic regulation and manner.

6.4.2 Social Aspects

(1) Impact


Some social aspects will find during the construction stage. Such as:

1. Local Commonality unrest
2. Vegetation growth
3. Acquisition of land
4. Traffic Congestion/Living Standard
5. Solid and waste disposal
6. interference with navigation
7. Health and safety issue
8. Diseases
9. Cultural activities

(2) Mitigation

- Procedures for liaison with local people to be established before commencement of the construction work. KWASA must clearly explain to local people about the need for the project for both the country and regional contexts. KWASA should do public consultation for mitigate the social impact.
- Staff to be recruited locally where feasible. KWASA shall encourage contractor to employ local people during construction work.


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- Public relations programs with local communities should be continually maintained to advise on risks and safety;
- Establish good relationships with local communities and help support their community activities;
- To educate labour, driver and community people about the STD, especially HIV/AIDS infections.
- The positive potential impact on the socio-economic condition at the local level will be the opportunity generated primarily from the employment of labour during construction activities.
- The construction companies will engage several local people, thus creating employment opportunities as well as business opportunities for their goods and services.
- After finishing the construction work, vegetation and tree plantation as much as possible at the project boundary and pipeline route.
- Transmission pipeline construction activities will be during dry season to avoid any impact on agriculture or fish farming and fish breeding in the river and canals.
- Underground crossing will be done for the pipe line crossing so that water flow through the irrigation canal at this site is not obstructed.
- To avoid traffic accident by vehicles for construction, setting of sign board, public consultation explaining drivers education, shall be ensured.

6.4.3 Land Acquisition /Public Consultation

(1) Impact

During the construction stage land acquisition is the main possible impact of the project.

(2) Mitigation

- KWASA shall provide the proper compensation to the land owners.
- Socio-Economic development at the project sites.
- Job opportunity to the local people.
- Stake holds meeting for the smooth running of the project and also welfare of the community.


6.4.4 Noise and Vibration


(1) Impact

The movement of vehicles, Lorries, and construction equipment will produce noise and vibration during the construction stage. This impact will be minor and of short duration at any particular location along the route.

(2) Mitigation

- To avoid local traffic impact, time restriction for construction and diversion routes (if necessary) shall be considered.


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- Selecting 'quiet' working methods and use of low noise equipment must be specified in construction contract tender documents (see chapter-2);
- Construction activities should not take place at night times due to noise (see chapter-2). If this is absolutely unavoidable, the contractor shall advise/ consult with local community leaders.
- Local community should be consulted beforehand and reach an agreement over appropriate timing for noisy activities.
- Working hour's duration is mention in the Chapter-2; special cases can be done with consult with KWASA and local authorities.

6.4.5 Land and Soil

(1) Impact

Construction of the water transmission and distribution pipeline requires trench digging along ROW, impounding reservoir and other components of the project grading of roads & land and digging, displacement and disposal of substantial volume of earth. The impact of such changes, if not appropriately mitigated, could result in erosion, silting and impairment of water quality in nearby drainage channels and waterways, fragmenting of habitat and loss of existing ecological resources. But this only in very short duration.

(2) Mitigation


- For mitigation measures to be effective, technical specifications as well as management procedures for their design, implementation, supervision and checking must be in place prior to commencement of onsite works;
- Few small trucks will require for disposal of surplus soil to the land filling site or access road or embankment site as construction use.
- Strict supervision shall be maintained to ensure that a minimum area required for construction activities are cleared;
- Avoid earth work during rainy season, as appropriate;
- Clearing operations shall not interfere or obstruct natural watercourses and man-made drainage systems;
- During construction, excavated soil should be stored in designated areas. Topsoil shall be stored separately, and
- Access roads are planed to be constructed during the construction stage for the welfare of the local community.


6.4.6 River, Canal, Box Culvert, Bridge Crossing

(1) Impact

The pipeline is planned to cross Rupsha river, some canals and wetlands. It will also cross 27 box culverts and 17 bridges. This will cause disturb the normal thorough fare of the traffic and the members of the public through traffic congestion and as where bypass road has to be used.

(2) Mitigation


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- By the pipe jacking method the clear water transmission line will cross the Rupsha River. Pipeline will low down around 20 ft from the river ground level.
- Special care has to be taken for appropriate reinstatements at both the banks of the river crossing sites so far as protection of both banks of the river is concerned. Further, adequate measures are also essential in disposal of wastes, if any during such crossing operation
- Trenching and backfilling operations at the canal crossings shall be conducted during the dry season when canal elevations and flow are at their lowest.
- In small bridge and culvert, the transmission pipeline will go underground or by the side of the bridge/culvert. It will be duly considered during design stage, the bridges and culverts will not be disturbed due to crossing of same by the water pipelines.
- Day time, the traffic is high and so that KWASA should consider the traffic management with consults with the local authorities (RHD, LGED, KCC and etc).
- Road marker or sign shall use during the construction.
- Work shall be scheduled so that trenching and backfilling is completed in the shortest possible time. Spoil shall be placed on a level surface high enough to prevent washout in the event the canal and river level rises.
- The contractor shall provide drains protected with silt fences, jute mats or sand bags if necessary to trap sediment and shall drain excess water from the spoil area to minimize erosion.

6.4.7 Surface and Groundwater


(1) Impact

The potential impacts on local hydrology are principally those of altered drainage patterns as a result of onsite construction and earthwork activities. The proposed route will cross one river, 27 culverts and 17 bridges and natural canals which may be affected if proper mitigation measures are not taken.

(2) Mitigation

- Surface drainage shall be controlled to divert surface runoff away from the construction area;
- Completed areas should be restored/ re-vegetated as soon as practicable, using local plant and vegetation;
- Strict supervision should be maintained to avoid blockage of natural creeks during the construction period, and
- Containment of sanitary waste should be adequately disposed off to avoid surface and ground water contamination, to do so temporary toilet facilities at each project sites shall be constructed during construction stage (see Chapter-2).


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6.4.8 Biodiversity

(1) Impact

Roadside vegetation will be destroyed for clearing the proposed project area. Soil covering plants will be destroyed after such type of activities. These types of activities will create soil erosion in the project area. This will be of short term and vegetation will recover within a season.

(2) Mitigations

- Should clear the ROW as minimum as possible;
- Green buffer zone shall be established at operation stage.
- Big tree cutting should be kept at a minimum stage, and
- Re-vegetation with local plant and vegetation of the exposed part has to be done as early as possible just after completion of the project.

6.4.9 Market Place

(1) Impact

A numbers of hats and bazaars (market places) falling on the way will have potential impact on the buyers and sellers as well as others who will be using these places for several other reasons. Construction activities will also leave potential impact on the surrounding environment with dust, debris and obnoxious emissions from vehicles and equipment used thereof. But this is also very short duration.

(2) Mitigations


- Construction shall stop at weekly market time mainly at Friday as basically government holyday is Friday due to religious perspective.
- Public consultations will be effective at the construction stage.
- Diversion routes shall be construction if necessary.
- Safe guard personnel shall be deployed in such places.
- Safe sign board shall be set in such places.

6.4.10 Water Canal Management

(1) Impact

At Samonto Sena Impounding reservoir and SWTP site one canal is observed that will close due to the construction. Alternative route will construct to serve the water to the other side of the land owners for the agriculture and drainage purpose.

(2) Mitigations


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- By pass the canal water through closed conduit by the side of the project boundary or by underground pipe laying. This will study during the construction stage.

6.4.11 Road Sign/Marking

(1) Impact

At the construction stage different local, national highway, narrow road and institutes will interfere. Nuisance will create at the local people and livestock.

(2) Mitigations

- Road sign and road markers can be used during the construction stage.
- Public consultation shall be done before and during the construction stage

Some traffic signs and warning shall be used during the construction:



6.4.12 Interference with Navigation /Fisheries

(1) Impact

Construction and operation stage some time interference of navigation like boat, fisher men, cargo, and etc will stop operation. In the mean time fish cultivation will stop for construction work. But this is very short duration.

(2) Mitigations

- Public consultation with the river users can reduce the impact.

6.4.13 Health and Safety

(1) Impact

During the construction stage, KWASA should follow the Bangladesh Labor Law 2006, where the working environment, work place conditions and sanitary facilities for the workers are stated.

(2) Mitigations

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- Protective clothing, earplug, hamlets, shoes and accessories (PPE) should be provided to the workers, who would be subjected to adverse safety situation.
- Adverse impact on worker's safety would be minimized by implementing an occupational health and safety training program (see Chapter-2).
- Periodically medical checkup would be done to ensure the soundness of health of employees and workers (see Chapter-2).
- Periodically health education to labours, drivers shall be done especially HIV/AIDS issues.

6.4.14 Solid waste and waste water

(1) Impact

Valuable and recyclable items of solid wastes would be separated at the point of generation and remaining portion would be disposed at a convenient point and transported safely to the designated disposal site. There are low lying areas surrounding the project site and the general solid wastes could be safely disposed of by transporting the wastes to the nearby designated site in an environmentally sound manner.

(2) Mitigation

- Recycling system has to be introduced to reduce the volume of solid wastes.
- Remaining portion of solid waste has to be disposed into the designated landfill site for soil covering use.
- Septic tanks with soak-pit will have to be used to manage sewage and domestic wastewater

sludge drying bed is planned to be used by for dry solid matter and be disposed to the sanitary land fill for soil covering use which is not included chemical substances like heavy metels.

6.4.15 Time Regulation at working

(1) Impact

The movement of vehicles, Lorries, and construction equipment will produce noise and vibration during the construction stage. This impact will be minor and of short duration at any particular location along the route.

(2) Mitigation

- Construction activities should not take place at nighttimes. If this is absolutely unavoidable, the contractor shall advise/ consult with local community leaders.
- Local community should be consulted beforehand and reach an agreement over appropriate timing for noisy activities.
- Working hour's duration has to be set and subject seasonal adjustment. Special cases can be done with consult with KWASA and local authorities (like Deputy Commissioner, Upazila union chairman, and etc.

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6.4.16 Pipe leakage

(1) Impact

Regular testing of distribution pipeline for pathogenic and other harmful organisms present in the pipe and take necessary precaution.

(2) Mitigation

Replacement of old broken pipe with the new one immediately would minimize the impact. safe clearance between sewerage line and drinking water pipe lines has to be maintained so that drinking water is not contaminated by ground water which would have been otherwise will harmful for human consumption.

6.4.17 Transportation / Traffic Management and Truck Use

(1) Impact

Huge movement of Dump Trucks is expected during excavation in the impounding reservoir site. These will move to and fro from the land filling site(s) to dispose of the surplus earth.

(2) Mitigation

Pre- planned traffic management system has to be enforced so that there is least inconvenience to the other road users. Appropriate control of the traffic with due road signs and frequent inspection of the vehicles has to be undertaken to allow only roadworthy Trucks are engaged by the contractor for carrying the construction materials and refuses.

6.4.18 Narrow Roads


(1) Impact

In the area some narrow is identified (see Chapter-6). In this road both side have some shop and market. During the construction there is have some minor impact due to the dust, exhaust gas and etc.

(2) Mitigation

- Vehicle speed restrictions shall be imposed to reduce dust generation and dispersion;
- Transport vehicles shall not be overloaded,
- Transport vehicles shall be covered by triple/plastic
- Periodical maintenance of the vehicle should be ensured and visual inspections of equipment and vehicles shall be conducted on a periodical basis to ensure no excessive emissions of black smoke and to prevent break down on the way causing road blocks.


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6.4.19 Right of way of Pipeline

(1) Impact

Pipe line Right of way (ROW) will pass through large tracts of wet land, a natural canal and the river Rupsha. This will obstruct movement of the people leaving nearby and the will prevent flow of water of the irrigation channels and the natural canal. This ROW will involve crossing of 27 culverts & 17 bridges (see Annex-4).

(2) Mitigation

All possible steps has to be taken to provide for alternative arrangements to reduce inconveniences in movements of the public, unhindered flow of irrigation water during lying of pipelines and road congestions while activities will be there in crossing the culverts & bridges.

6.3.20 Vector diseases (e.g. Mosquitoes)

(1) Impact

Further, it is suggested that arrangement for good quality of drinking water, hygienic sanitation and accommodation facilities for the staff and the workers are to be made. In construction phase, all of the impacts are reversible including spreading of diseases among the workers and the people working and living nearby particularly vector and rodent involved diseases. For example, Mosquito, rats etc are to blame for spreading Malaria, Dengue, and Cholera etc. So adequate preventive care has to be ensured in site camps and labor sheds. However, the impacts are of short duration.

(2) Mitigation


- Frequent medical check-up would also be helpful in controlling the spreading of diseases. Emergency medical services and adequate first aid facilities should always be available at the site during construction period
- In the Impounding Reservoir and SWTP, fresh water will reserve, so water wave can reduce the breeding of mosquitoes.
- Periodically sweeping of impounding reservoir and SWTP.
- Making wave at up and down process, so that some undulations at the edge of the boundary of impounding reservoir and SWTP.


6.5 Analysis of Impacts and Suggested Mitigation Measures of Khulna City Corporation Area (Eleven overhead tank and Five Distribution reservoir sites)

6.5.1 Air Quality

(1) Impact

During construction, the principal air quality impacts will arise from dust generation from excavation of soil, pipe laying and vehicle movement. Heavy vehicles may cause exhaust gas emissions, but these impacts are temporary and for short duration in the construction stage.


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(2) Mitigation

- Excavated materials, stockpiles and haul roads shall be dampened with water spraying *during dry ambient conditions*;
- Vehicle speed restrictions shall be imposed to reduce dust generation and dispersion;
- Transport vehicles shall not be overloaded,
- Transport vehicles shall be covered by triple/plastic.
- Periodical maintenance of the vehicle should be ensured.
- Visual inspections of equipment and vehicles shall be conducted on a periodical basis to ensure no excessive emissions of black smoke (**see Chapter-2**).
- Education to the driver to keep traffic regulation and manner.

6.5.2 Noise and Vibration

(1) Impact

The movement of vehicles, Lorries, and construction equipment will produce noise and vibration during the construction stage. This impact will be minor and of short duration at any particular location along the route.

(2) Mitigation

- To avoid local traffic impact, time restriction for construction and diversion routes (if necessary) shall be considered.
- Selecting 'quiet' working methods and use of low noise equipment must be specified in construction contract tender documents (**see chapter-2**);
- Construction activities should not take place at night times due to noise (**see chapter-2**). If this is absolutely unavoidable, the contractor shall advise/ consult with local community leaders.
- Local community should be consulted beforehand and reach an agreement over appropriate timing for noisy activities.
- Working hour's duration is mention in the **Chapter-2**; special cases can be done with consult with KWASA and local authorities and public consultation.


6.5.3 Railway crossing


(1) Impact

The distribution pipeline in the city sometimes will cross the railway line. So at the construction stage the project proponent should take the permission from the Bangladesh Railway authority.

(2) Mitigation

- By the underground by tunnel system the pipeline will cross the railway line.
- Special care has to be taken for appropriate reinstatements at both the crossing sites so


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far as protection of the line. Further, adequate measures are also essential in disposal of wastes, if any during such crossing operation.

- Day time, the traffic is high and so that KWASA should consider the traffic management *with consults with the local authorities (RHD, LGED, KCC and etc).*
- Road marker or sign shall use during the construction.
- Work shall be scheduled so that trenching and backfilling is completed in the shortest possible time.
- The contractor shall provide drains protected with silt fences, jute mats or sand bags if necessary to trap sediment and shall drain excess water from the spoil area to minimize erosion.

6.5.4 Narrow road

(1) Impact

In the city area some narrow is identified (see Chapter-6). In this road both side have some shop and market. During the construction there is have some minor impact due to the dust, exhaust gas and etc.

(2) Mitigation

- Vehicle speed restrictions shall be imposed to reduce dust generation and dispersion;
- Transport vehicles shall not be overloaded,
- Transport vehicles shall be covered by triple/plastic
- Periodical maintenance of the vehicle should be ensured and visual inspections of equipment and vehicles shall be conducted on a periodical basis to ensure no excessive emissions of black smoke and to prevent break down on the way causing road blocks.
- Education to the driver to keep traffic regulation and manner.
- Safety sign board and public consultation shall be ensured.

6.5.5 Transportation and Traffic Congestion


(1) Impact

The movement of Dump Trucks is expected during excavation in the city distribution and reservoir sites. These will move to and fro from the land filling site(s) to dispose of the surplus earth.

(2) Mitigation

- Pre- planned traffic management system has to be enforced so that there is least inconvenience to the other road users.
- Appropriate control of the traffic with due road signs
- Frequent inspection of the vehicles has to be undertaken to allow only roadworthy.
- Trucks are engaged shall be covered during carrying the construction materials and refuses.


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6.5.6 Health and Safety


(1) Impact

During the construction stage, KWASA should follow the Bangladesh Labor Law 2006, where the working environment, work place conditions and sanitary facilities for the workers are stated.

(2) Mitigations

- Protective clothing, earplug, hamlets, shoes and accessories (PPE) should be provided to the workers, who would be subjected to adverse safety situation.
- Adverse impact on worker's safety would be minimized by implementing an occupational health and safety training program (see Chapter-2).
- Periodically medical checkup would be done to ensure the soundness of health of employees and workers (see Chapter-2).
- Periodically health education to labours, drivers shall be done especially HIV/AIDS issues.


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CHAPTER-07

ENVIRONMENTAL MANAGEMENT PLAN

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CHAPTER 7 ENVIRONMENTAL MANAGEMENT PLAN

7.1 INTRODUCTION

Water Supply projects, in general, have not so much potentials for adverse environmental impacts during both the construction and operational phases. Rather, these projects have substantial positive impacts particularly, in terms of socio-economic benefits. Environmental Management Plan (EMP) is related to the implementation of the measures prescribed in the EIA to reduce the adverse impacts at the acceptable levels as well as to enhance the beneficial impacts. The objective of EIA cannot be achieved unless the mitigation and benefit enhancement measures, identified in the EIA are observed properly.

For the proposed Khulna Water Supply Improvement project, all the measures will be said to be successful if they comply with the Environmental Quality Standards (EQS) as specified in the Environmental Conservation Rules (ECR), 1997. Thus the general objectives of EMP for this project are:

- (i) Implementation of the mitigation measures to reduce or eliminate negative impacts
- (ii) Implementation of enhancement activities in order to maximize positive impacts, and
- (iii) Identifying monitoring requirements and monitoring indicators.

The environmental management plan prepared for the project will include an examination of the following:

- Work plans and schedules
- Resources necessary for implementation
- Emergency response plan procedures
- Training requirements

These aspects are discussed in the subsequent paragraphs hereinafter.

7.2 MAJOR ASPECTS

7.2.1 Air quality management

During construction phase, dusts will be generated from the construction activities and movement of heavy transport vehicles producing exhaust gases. Attempt will be made to complete the construction works during wet periods and daytime only. Water will be sprayed on exposed surfaces regularly during dry season in order to keep the soil wet so that dust generation is reduced. In the site if water sprinkler or water sprays system provide than the dust generation can be reduce. Vehicle speed restriction, covered protection, vehicle inspection and education of the drivers can reduce the air pollution.

7.2.2 Water Quality Management

Raw water will be abstracted (110,000 m³/day) during the entire period of project life except during the dry season of the years. Water will be withdrawn from the River Madhumati at Mollarhat and supply to the consumers following due treatment.

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The small amount of waste-water discharge from the treatment facilities will comprise effluent from the sedimentation tank, backwash of filter bed and other occasional releases and it will be passed to a treatment facility for treatment to maintain standard effluent quality as per EQS of DOE.

7.2.3 Solid Waste Management

There will a facility waste management system in place to handle sludge, wastewater, and solid waste. Solid wastes, oily rag and used fuel and lube oil filters, will be collected in leak proof and fire proof containers that will be taken off the site for proper disposal. The waste will be collected in a designated place and handled in a sanitary manner either in land development purpose or incinerated as appropriate.

7.2.4 Plantation of tree

Under the corporate social responsibilities of KWASA, the authority should plant trees at the boundary area of impounding reservoir, SWTP, water intake, raw and clear water transmission line, during the construction some vegetation & tree shall be cut off due to project implementation. Generally, rainy season is the best time for tree-plantation. Most of the tree-plants thrive well in rainy season. Still then, we should seek advice from the Government agricultural experts about the appropriate time for the plantation of a particular kind of tree. Only planting the trees is not enough. Because, planted trees may be destroyed by animals or otherwise, or may die for regular service of water. So KWASA should be particular about the after-care of the planted trees.

7.2.5 Traffic management

Traffic congestion will be created during the construction stage at different project component. At day time construction work shall be minimum volume at the narrow road, market area, different institutions area (most of school, madrasa (Islamic institute) and college). Utilizing the traffic sign (See at chapter-7) the traffic congestion can be control at different public gathering places. At the certain day of every week market place is open from early morning to evening, lot of gather at that time, than minimize the time and work with the public consultation and approval of local authority (District Commissioner, LGED, Upazila, union chairman and local elite persons etc.). Especially in Bangladesh, Friday is the market time and in special cases like government holidays, public procession, meetings are there.

7.2.6 Lubricating and Chemicals Management

The dirty oil from the system will be collected in drums and sold to other secondary / re-users.

7.2.7 Health and Safety Management

Construction and operational activities will be carried out in accordance with relevant health and safety procedures. The procedures of standard Health and Safety Guidelines of international best practice will be followed in this regard. These are briefly described below:

(I) Workplace Air Quality

Protective respiratory equipment (PPE) will be used in areas where employees are exposed to dust, welding fumes, solvents and other material present.

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(2) Workplace Noise

To limit noise level within allowable limit, sound-insulated equipment and control rooms will be employed in normal work areas. Equipment for facilities will be well maintained to minimize noise levels. Hearing protection must be worn

(3) Electrocutation

In order to reduce the risk of electrocution a formal "permit-to-work system" will be operated. Strict procedures will be followed for de-energizing and checking electrical equipment before maintenance work. Strict safety procedures must be implemented in the case of energized equipment including constant supervision. Full training will be provided on the revival techniques for electrocution.

(4) Work in Confined Spaces

Confined spaces such as tanks, sumps sewers and excavations will be tested for the presence of toxic, flammable and explosive gases or vapors and for the lack of oxygen before entry. Employees will use air-supplied respirators in areas, which may be contaminated or deficient in oxygen during any period of time in a confined area. Additionally, adequate ventilation will be provided before entry and during occupancy of these spaces.

(5) General Health

In order to maintain sound occupational health and safety for the plant personnel on a routine basis, the following general procedures will be undertaken.

- Ensure use of personal protective equipment (PPE) at each project site. Personnel will use special footwear, masks and clothing for work in areas with high dust levels or contaminated with hazardous materials. Safety equipment will be supplied where applicable, particularly in areas where exposure to high temperature or chemicals is likely.
- Shield guards and guard railings will be installed at all belts, pulleys, gears and other moving parts.
- Elevated platforms and walkways, stairways and ramps will be equipped with handrails and non-slip surfaces.
- All electrical equipment will be grounded, well insulated and will conform to all applicable codes.
- Provision of first aid kit with required items shall be kept and maintained at the plant site.

(6) Record keeping and Reporting

Records will be maintained of significant environmental matters, including monitoring data, accidents and occupational illnesses, spills, fires and other emergencies. The information should be reviewed and evaluated to improve the effectiveness of the environmental, health and safety program.

(7) Complaint Reporting

Complaint regarding any project oriented activities should be recorded with proper format and reported to KWASA in the construction and operation stage.

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(8) Training

To ensure employees and Labour, driver' health and safety, training is essential. Both theoretical and practical training will be imparted to the employees on the hazards, precautions and procedures for the safe storage, handling and use of all potentially harmful materials. Training procedures will incorporate information from the Material Safety Data Sheets (MSDSs) (ANNEX-7) for potentially harmful materials. Training will include:

- use of personal protective equipment
- prevention of accident
- safe handling practices
- location and proper use of emergency equipment
- procedures for raising the alarm and notifying emergency response teams
- proper response actions for each foreseeable emergency situation.

(9) Maintenance

Maintenance of the facilities and vehicles will be undertaken to ensure that releases to the environment are kept to a minimum. Equipment specific maintenance will be carried out in accordance with the manufacturer's guide lines.

7.2 ACTION MEASURES

7.3.1 Resources, Implementation and Training

(1) Resources

In order to ensure proper operation, maintenance and environmental safety, the water supply system operational workforce shall include a designated officer of KWASA who will be a senior officer with executive responsibility for environmental matters.

(2) Implementation


The Environmental Engineer will be responsible for ensuring that the environmental management plan is effective. He will be responsible for initiating any necessary improvements, via direct reporting to the Plant Manager.


(3) Training

The Environment Engineer will be responsible for conducting following environmental training:

- Environmental protection procedure;
- Promotion of environmental awareness;
- Specific training for staff working in sensitive areas;
- Updating staff on changes to environmental standards;
- Reporting to staff on plant environmental performance
- Training and orientation program for visitor and contractors.

(4) Education of the worker/labor


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Work place education is very important, education of work procedure and safety, hazardous material disposal, sanitary waste disposal, occupational health and safety, especially communicable diseases (e.g. HIV/AIDS) and other diseases etc is required. Before starting the construction work the project proponent shall teach this education to the worker and give the positive and negative side of each component. KWASA can appoint one/more training specialist to teach such activities to the worker.

(5) Compensatory Measures

If any specific problem arise are identified in relation to the project's environmental performance, mitigation measures will be adopted if deemed to be appropriate and included in the improvement plans for the project. This deviation in the environmental performance of the project may arise through the deterioration of performance of components of the project or changes in legislation.

7.4 EMERGENCIES ACTION PLAN

To ameliorate any environmental risk, there shall be an "Emergency Action Plan" in place so that in case of an emergency, all project staff are aware of their responsibilities. Fire protection equipment and facilities will be available at suitable locations within the projects sites and these will include:

- Fixed fire protection systems
- Fire hydrants
- Alarm enunciators
- Portable fire fighting equipment
- Automatic fire vents
- Fire compartments
- Fire exit sigas.

In the event of an emergency, the Environmental Engineer will be available to provide specialist advice as to the environmental aspects of the situation and potential for pollution incidences.

Advice will also be provided on the use of fire equipment on site. Fire emergency drills will be conducted on regular intervals to update emergency response awareness of the plant operational personnel.

In order to provide 24 hour coverage, either a member of staff will be appointed for those times not covered by the full-time Engineer, or provision will be made for the Engineer to be accessible 24 hours a day.

7.4.1 Emergency Response Systems & Procedures

It is required in any pre-set emergency response procedure that Emergency Response Plan (ERP) includes at least implementation of and training in the following procedures:

- All construction, fabrication, welding, testing and commissioning and operation are done utilizing good practice in responding to requirement of emergency re-work and as such all tools, equipment, machinery and materials to be properly stored for using immediately on call.

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- Emergency escape procedures and escape route assignments
- Presence of employees and members of public if involved must be taken into account for evacuation
- Emergency shut-down procedures and qualified personnel assignment
- Accounting for all employees after emergency evacuation
- Rescue and medical duties for employees who will perform them
- Preferred means of reporting fires and other emergencies
- Names and job titles of persons to contact for more information about the plan.

7.4.2 Alarm Systems

The KWASA shall establish a system to alert all employees of an emergency within the operation facility. If the alarm system is meant to serve more than one purpose, it should emit a different sound for each purpose. As a result, no one should mistake an evacuation alarm for the one that signals the emergency response team.

7.4.3 Training

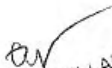
KWASA shall train all concerned employees regarding use and purpose of Emergency Response Plan:

- When the plan is developed
- Whenever emergency action plan responsibilities change
- Whenever the plan changes.

7.4.4 Approach to Emergency Response

Figure 7.1: Illustrates an example system approach to Surface Water Treatment Plant & Other Components Construction & Operation of Water Supply Improvement Project of KWASA


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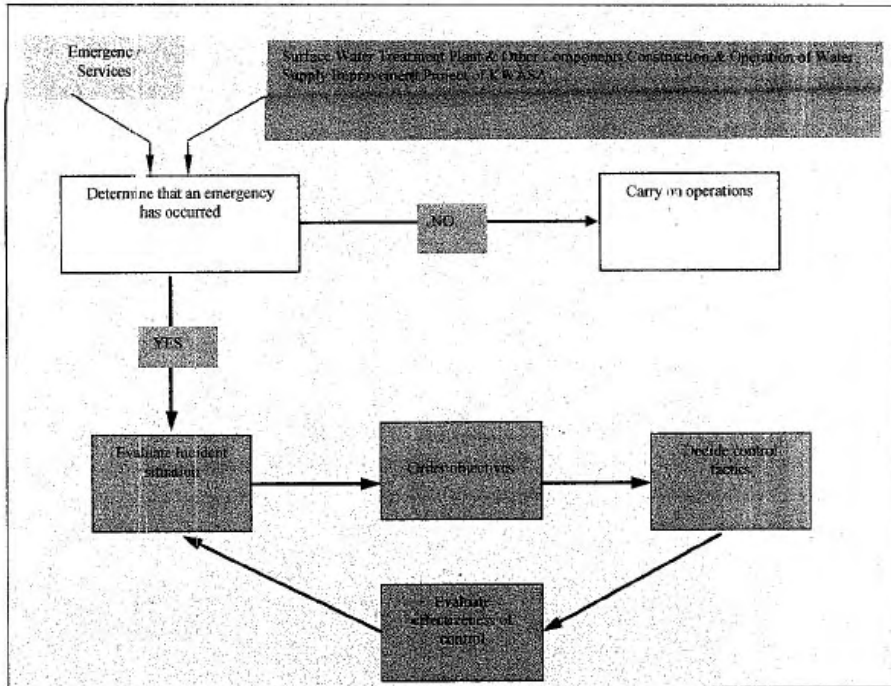


Figure: 7.1 Emergency Response System (as example)

For this project emergency response systems should be in place to deal with dangerous goods if any, uncontrolled releases spills, natural calamities fires burns and injuries There are to be trained emergency response teams specific contingency plans and incidence specific equipment packages in place to cope with these types of an emergency Should an incident occur immediate action must be taken to mitigate the impacts

In order to minimize the possibility of injury to the responders and others it is important that emergency responders follow a specific sequence of actions to be stepped out in the SOP (Standard Operating Practices) of KWASA

7.4.6 Standard Work Operating Practices (Sops)

Carefully written practices (procedures) will form the basis for implementing and recommendations as well as Environmental and Safety (ES) Action Plans: Practices will specify who is to carry out tasks, give step-by-step instructions for how tasks are to be accomplished, and include directions for dealing with departures from the practices. Setting and maintaining effective practices involves five stages:

1. hazard identification,
2. risk assessment,
3. identifying risk control measures,
4. preparing and implementing procedures to maintain control; and
5. ongoing audit and review of those procedures.

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7.5 Environmental impacts resulting from the project

In doing so, the results of the studies on Environmental baseline condition, Socio-economic surveys and Biological resource were carefully reviewed. Environmental components and sub-components were identified and their magnitude and duration of impacts were examined.

7.5.1 Water

From the review at **Chapter-4**, basically the water qualities of Rupsha and Modhumoti River, some parameter like BOD, COD, DO, TDS and SS which are exceed the allowable limit of Department of Environment of Bangladesh.

Now the water demand is high and in the city area most of the houses have the deep tube wells and KWASA has tube wells, hand pumps and others private pumps of production capacity is 119,100 m³/day to serve the KCC area habitants. After finishing the construction of the water supply project using the surface water, then the KWASA will get 110,000 m³/day water to his line. In the mean time if the KWASA will not develop any tube wells using the ground water, the water demand will be increased due to population growth. More water demand means more consumption and produces more waste water.

Now in the Khulna area there is no sewerage system. Most of the houses have the septic tanks but due to increase the water demand the waste water may flow to the environment (i.e. the surface water river and evaporated and leaching to the underground soil). Therefore "with" or "without" project, the waste water will be increased in Khulna by the population growth. Thus an immediate impact of the waste water by the projects is not predicted. In addition, in future there is a comprehensive Master Plan in Khulna is as follow:

- 1) Preliminary study and definition of Tor for consulting services: 2012-2013
- 2) Definition of TOR and selection of Consultants: 2014
- 3) Development of the comprehensive Master Plan: 2015-2016
- 4) Feasibility Study on priority projects: 2017-2018

If this project implement in the near future then the water quality will be improve. So these projects should be implemented for the sustainable of the Khulna Water Supply Improvement project.

7.5.2 Air

At the **Chapter 4**, Air quality (SPM, SOx, NOx) at the Rupsha Bridge observed that at one point it exceed the limit of DOE allowable standard. As the project location at Samonto Sena and Water Intake point at Mollarhat is located in the rural-area where the air quality is not like the Rupsha Bridge site. In this projects location the traffic volume is very less and also the environmental conditions like plantation, vegetation are there. Only at the construction stage there may be some air pollution and which is very minor due to the heavy vehicles and equipment /operation which produce exhaust gases which however disappeared to the air. Proper mitigation measures shall take by the KWASA and Contractors.

However, in this pre-construction, construction and post construction stage, initial assessment of possible impacts caused by the projects has been discussed in the **Chapter 6**. Only main impact shall the land acquisition impact. This discussed at the **Land Acquisition Plan/ Resettlement Action Plan** report.

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7.6 ENVIRONMENTAL MONITORING PLAN

7.6.1 Environmental Monitoring System

In the EIA report, it is identified several environmental impacts caused by the project among which the "Land Acquisition" is the main possible impact, in which the compensation and mitigations is discussed in the Land Acquisition Plan and resettlement Action Plan.

Therefore, KWASA shall have an environmental monitoring system for the project to deal with such impacts as follows:

- Grievance function: to take complaints and take necessary action.
- Emergency function: rapidly increases the BOD, COD, DO and etc, identify and remedial action in corporation with DOE (for emergency only).
- Leakage: Identify and corrective action.
- Periodic Inspection of the facilities including the water stolen by the farmer.

After getting the Environmental Clearance Certificate (ECC), there may be certain terms and condition to full fill by the KWASA of drinking and river water quality monitoring at the intake site in Mollarhat.

In addition, the following shows the periodically monitoring other than the monitoring to be required by EIA. Therefore, a reasonable condition between the Environmental monitoring in the Environmental monitoring system in the EIA and Operational monitoring required by DOE.

On this account, KWASA shall take the initiative to coordinate with the DOE to avoid overlap of similar monitoring (required by DOE, by ECC and the EIA follow), double assignment of the personnel and so on.

➤ Drinking water, Ground and Surface Water Quality Monitoring by KWASA

In the Feasibility Study Report, it is recommended that at the construction stage DOE will monitor the river water quality at the intake point. DOE is monitoring the Modhumati river water quality but not at the actual point where the water will collect for supply. So, proper coordination with DOE by KWASA, to change the sampling point to the intake facility site.


After the commencement of the SWTP, KWASA should monitor the Modhumati River and the SWTP water quality every day. There is around 23 parameters shown in the Feasibility Study Report that have to check by that time.

However in the Chapter-6, the initial assessment of possible impact caused by the impacts has been discussed. Therefore, the following are the possible items to be monitored:


- Complaints from the water users.
- Social awareness of the water uses.
- Monitoring the Modhumoti river at intake site and the water quality of SWTP
- Checking the ground water and drinking water quality

➤ River Water Quality Monitoring by DOE

According to the Environmental Conservation Rule 1997, DOE has the authority to monitor the different environmental aspects as stated in **Chapter-2**. DOE have their own laboratory for environmental parameter checking. Under the organizational responsibilities the DOE check the river water quality monthly at different parameters (i.e. BOD, COD, p^H , SS, TDS and DO etc.).


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So, proper coordination with KWASA is required for monitoring of river water at the intake point in Mollarhat.

For reference, the following shows important work responsibility of DOE with regard to Environmental Monitoring generally.

1. Issuance Site and Environmental clearance certificate
2. Renew of Environmental clearance certificate
3. Identification and Solving of Environmental pollution
4. Industrial site visit
5. Sample collection and analysis of water, air, sound and waste water
6. Organize and maintaining the travel court
7. Industrial pollution
8. Environmental protection, development and prevention books and publication
9. Sample collection and analysis (in request) according to the government fee for the air, water, sound, waste water
10. Enforcement activities
11. As per citizen charter Daily
12. Problem solving solution subject meet the people programme
13. Public awareness built up meeting
14. Environmental protection and development inter official relation
15. Ministry / Department instruction environmental protection/development and departmental activities

7.6.2 Environmental Monitoring Function for the Project

The JICA Feasibility Study Report has proposed a new KWASA Organization as follows.

- Technical Services Division: headed by Deputy Managing Director.
- Planning and Development department: Under the Technical services division, there is a headed by Chief Engineer.
- Section of Project Management and Monitoring: Planning and Development department, there is the section headed by executive engineer. This section is responsible for the Environmental and Social monitoring.

If any observation or complaint find in the field level during the construction and operation stage, the Executive Engineer shall coordinate to the respective department or authorities (like DOE, KCC and etc.). The **Table-7.2** shows the proposed Environmental Monitoring Organization.

Table 7.2 Proposed Environmental Monitoring Organization

Stages	Construction	Post-Construction
Responsible Organization	PIU of KWASA	KWASA (selection of Project management and Monitoring)
Monitoring	PIU of Planning and Development Department Coordinate between the DOE	KWASA Reporting to the DOE as per ECC requirement
Responsibilities	Handling the environmental monitoring items discussed in the EIA report, ECC, JICA, ADB (If any), coordination is necessary	Handling the periodic monitoring items done by the DOE (ECC), JICA, ADB (If any), coordination is necessary
Personal	One person	One person

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7.6.3 Reporting

In the terms and conditions to be written in the ECC, there generally may suggest reporting system for the environmental monitoring activities.

In addition, such reporting shall be followed based on relevant guidelines of external funding donors like JICA and ADB. For the monitoring items, frequency and period of the reporting, KWASA shall discuss with those funding agencies during the appraisal mission study and other opportunities.

As for the JICA, JICA has prepared a "Monitoring Form" in the JBIC Environmental & social Consideration Guidelines as attached in the next page. In the form, the principal environmental impact predicted by the EIA is social impacts caused by the land acquisitions and the compensations. Therefore, the monitoring items to be monitored shall focus on No.4 Social Environmental in the form which shall be discussed between KWASA and JICA carefully.

Based on results of discussion(s) to be done with JICA, KWASA and/or the PIU (Project Implementation Unit) for the projects shall refer the monitoring form for the periodic submissions of the environmental monitoring reports to JICA during construction stage and/or after implementation stage of the projects.


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Attachment 21: Monitoring Form (format)
(JICA Environmental Monitoring Form attached in the Guidelines)

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase or development, operation and mine closure) should be considered.

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
ex.) Responses/Actions to Comments and Guidance from Government Authorities	

2. Mitigation Measures

- Air Quality (Emission Gas / Ambient Air Quality)

Item	Unit	Measured Value(Mean)	Measured Value(Max.)	Country's Standards	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
SO ₂							
NO _x							
CO							
O ₃							
Soot and dust							
SPM							
Dust							

- Water Quality (Effluent/Wastewater/Ambient Water Quality)

Item	Unit	Measured Value(Mean)	Measured Value (Max.)	Country's Standards	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
pH							
SS (Suspended Solid)							
BOD/COD							
DO							
Total Nitrogen							
Total Phosphorus							
Heavy Metals							
Hydrocarbons / Mineral Oils							
Phenols							
Cyanide							
Temperature							

- Waste

Monitoring Item	Monitoring Results during Report Period

- Noise / Vibration

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level							
Vibration level							

- Odor

Monitoring Item	Monitoring Results during Report Period

3. Natural Environment

- Ecosystem

Monitoring Item	Monitoring Results during Report Period
ex.) Negative effects/Actions to Valuable species	

4. Social Environment

- Resettlement


Monitoring Item	Monitoring Results during Report Period

- Living / Livelihood

Monitoring Item	Monitoring Results during Report Period


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CHAPTER-08

CONCLUSION AND RECOMMENDATIONS

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CHAPTER 8 CONCLUSION AND RECOMMENDATIONS

8.1 General

The EIA of the proposed Khulna Water Supply Improvement Project with water intake, impounding reservoir, SWTP & distribution reservoir and overhead tank has been carried out at generic level in terms of both project design and environmental definition. This is believed to be the appropriate level of assessment for the present stage of project development.

Most of all the Water Supply Projects is, in general, environmental friendly projects and as such no negative impacts are observed except in their construction stages. The key areas of environmental sensitivity have been identified in this process of EIA and mitigation measures have been proposed respective to potential impacts so identified. A management plan has also been delineated for the project which should ensure that, among other issues, environmental sensitivity is adequately addressed at all stages of its development, operation and maintenance

It may be pointed out that this EIA is the requirement of the DOE for issuing the Environmental Clearance and accordingly it has been prepared as per the TOR of KWASA and the guidelines of the ECA '95 and ECR '97 with all amendments until 2010 of DOE. Simultaneously, the project being financed by JICA, all efforts have been directed to follow the policies and principles as laid down in the guidelines of both JICA in preparing the EIA.


Further, since land acquisition is involved in executing this project and the project is also being funded by ADB, its guidelines have also been closely taken in to consideration in addition to above. As such, this EIA report is intended for submission to the DOE as well as to the JICA and includes a broad coverage of the environmental, socio-economic, health and safety impacts etc and its mitigation, management and monitoring plans.

Further, it may be mentioned here that, substantial acquisition, restoration and mitigation measures had to be delineated in the Land Acquisition Plan / Resettlement Action Plan has also been prepared as per requirement of the ADB. This document has been separately submitted to JICA & KWASA. In doing so, rigorous efforts have been made to follow the Acquisition and Requisition of Immovable Properties Ordinance (ARIPO) 1982, its subsequent amendments in 1993 & 1994 and the Acquisition of Immovable Properties Manual 1997 of GOB and the TOR of KWASA.


Effort has also been made to present these 2 reports to have independent character. Thus the LAP/RAP report so done separately has captured most of the social issues such as plot to plot details of the PAP, their loss of assets; land acquisition procedures, compensation payment, employment opportunity, loss or impact on public and community facilities etc and has certain issues in common in the perspective of environmental and social (ES) aspects. Therefore, it might be felt convenient to the readers to go through both the reports for an integrated view of the overall potential impact of the project so far as the environmental and social aspects are concerned and the suggested mitigation, management and monitoring plans presented thereof.

8.2 Conclusions

The benefits of the project will be realized primarily at the level of the national economy. The implementation of the proposed project will provide supply of saline free water and necessary


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feed stock for the domestic, commercial and industrial consumers in particular in the Khulna and its surrounding city dwellers.

It is expected that the proposed project activities have hardly any significant adverse environmental impact so far as a time bound execution program with application of advanced environment friendly construction technology is ensured. The mitigation measures are well within such codes and practices of pre-construction, construction and operation & maintenance of the water supply system.

On the basis of the project summary and other relevant reports provided to the JICA study Team by KWASA and detailed survey conducted by the JICA Study Team along the project affected area, it may be concluded that in receiving the foregoing enhanced benefits, the project would minimize and mitigate most of its environmental and socio-economic impacts.

It is believed that KWASA will take due note of the concerns expressed during public consultations and would attend to the mitigation measures suggested against each of them. At the same time, KWASA will avail itself of the opportunities in discharging its corporate social responsibilities in providing different facilities to the host communities and their neighborhood as far as practicable.


In other words, it transpires that the execution of the project would stand environmentally sound and socio-economically sustainable with due adoption of the recommended mitigation measures and adherence to the environmental management plan and ensuring effective monitoring processes during different stages of its implementation.

8.3 Recommendations

In the interest of smooth, scheduled and environment friendly execution of the project, a set of recommendations are placed below for due attention of all concerned

1. It is recommended that the relevant legislations, rules, regulations and recommendations of concerned agencies, including but not limited to, the DOE, Departments of Agriculture, fisheries and Forests and the JICA and ADB etc, are strictly complied with
2. It is also recommended that pre-execution consultation with the projected persons, communities and the concerned government agencies be made by KWASA and the EPC contractor to inform them of projected activities and schedules
3. All necessary permissions be obtained by KWASA well in advance from the concerned authorities i.e. Khulna City Corporation, District Commissioners (Khulna and Bagerhat) etc particularly for the land use of eleven distribution reservoirs and overhead tank sites, Impounding reservoir & SWTP site at Samonto Sena and Mollarhat water intake point. The conditions set forth in the permissions there of, if any, should be duly complied with.
4. All recommendations within the Environmental Management Plan (EMP) should be implemented without reduction in intent, scope or duration. The EMP being a live document those recommendations should be augmented with further specific information regarding potential impact mitigation if and when it becomes available.
5. In the **Chapter-7**, Environmental management Plan, KWASA shall follow the procedure of the environmental monitoring system.


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6. Even though the probability of any unacceptable risk and hazard etc arising from the proposed operations is unlikely, it is recommended that, the emergency response cell as proposed in the organizational set-up is duly operative and a team of environmental and safety professionals are full-time present on site under supervision and coordination of a qualified environmental and safety specialist when any works are conducted and during the progress of clean up and reinstatement activities at sites
7. KWASA should continue to discharge its corporate social responsibilities and foster good community relations with local people through effective implementation of the community consultation strategy. This will tremendously contribute to the long term success of this project.

Apart from the fore going recommendations, the following pertinent points may also be revisited in the interest of safe, unhindered and environmentally sound execution of the project:

1. Severe weather conditions would have an impact on the construction activities and may even cause stoppage of works during the cyclonic storms and rainy days. So it is, recommended that commencing construction in early winter season may help to reap the benefit of full dry spell of the season. Further
2. In order to enhance the occupational health and worker safety during the construction period, construction equipment would have to be kept in good order. Adequate safety measures should be taken and safety related equipment including PPE, firefighting equipment etc. must be provided in order to reduce the potential for accidents.
3. KWASA will organize specific pre-project training / refreshers program on physical & biological hazards, health, safety and environmental issues for its Engineering & Management professionals to be involved in on-site execution and operation of the project. Such facilities of tailor-made training may be obtained from local professional institutions, Industrial Safety Board of Bangladesh (ISBB) of IEB, Engineering Staff College etc. These will further prepare the personnel designated for overseas training under the project at a later date.
4. A well developed camp site management plan has to be adhered to as per recommendation made in the EMP (see Chapter-7) in all aspects of its safe, hygienic, secured and environment friendly occupation and appropriate restoration after completion of the project.
5. A good community relationship may be developed to meet any exigency situation together with them. Strategic alliance should also be firmed up with local administration, and health centers etc nearest to the project sites for ensuring prompt support in the hour of need, if any.
6. Solid waste will be generated during the construction period from soil excavation and refuse from construction camps. The solid refuse from the construction camps should be stored in the designated containers and disposed of in a sanitary manner.
7. Felling of trees should be kept to a minimum. It is very important for the preservation and protection of natural ecosystem and avoiding undesirable erosion/ deposition. Any unavoidable loss of those belonging to the State including road side vegetation should be

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
replenished by undertaking appropriate plantation programme to be implemented before completing the project and continue throughout its operation.

8. *In addition to the one as recommended above, a compensatory forestation program should be included in the project component. This belonging to PAP but also those belonging to the State including road side vegetation and the neighborhood community. As a corporate social responsibility, KWASA has to arrange for implementation of same before completion of the project*
9. Due importance has to be put in to recommended environmental enhancement / restoration and bank side slope erosion protection plans for the natural streams, rivers, roads and other physical community features impacted by the project.
10. The major issue is the need to minimize disturbance to the local population in the areas of project component construction. Effort should be put in to arrive at a fair and equitable level of compensation for the PAP.
11. In the post construction phase, the environmental impact of the project will be some loss of land utility along the water pipeline alignments and the leakage of water due to improper maintenance or accident, if any. The former can be mitigated by adoption of a fair compensation policy and the latter by adequate maintenance and monitoring.
12. Though the anticipated impacts are mostly of short duration and relatively minor in nature, all efforts have to be maintained to keep monitoring such impacts and taking prompt mitigation measures as far as practicable.

In fine, it has to be appreciated that, so far as enhancement of the benefits of the project and minimization of its negative impacts are concerned, appropriate management and monitoring of impact mitigation measures in respect of both environmental and social aspects are to be simultaneously taken care of by the project proponent KWASA, Accordingly, following specific recommendations made in the relevant chapters of this EIA document, KWASA being in the overall management of the project, has to decide as to how it organizes itself in getting the mitigation measures are implemented and monitored efficiently, on time and within budget.

Recapitulating the recommendations made in the EMP, it is presumed that KWASA will have an organizational structure of as placed in the **Chapter-7** on EMP, KWASA will be assisted in supervision by an Owner's Engineer, who in turn will be supported by the Environmental Specialist, a member of the Consulting Group being appointed by KWASA They will oversee and ensure that the parts of the jobs of KWASA & its contractor are done in the way it should be. As such it is recommended that KWASA should consider these jobs so identified in the EMP as given with estimated budget in their cost estimation and include the items in the scope of works of the contractor so that they make provision for it and reflect in their financial bid.

It is believed that all these recommendations are conforming to the policies and principles of the JICA and ADB, the funding agencies of the project and as such they would support KWASA to get these specific aspects of the EMP done by the contractor under close monitoring and supervision of KWASA and its consulting functionaries. In doing so, it will help also help them attracting encouragement from concerned agencies like DOE, and will have strategic alliances with related GOB agencies i.e. Local administration, police, fire brigades and health services for successful execution of the project.


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

MD. ABDULL AH. PENG
Managing Director
Khulna WASA

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Since in terms of its environment and safety policies, KWASA is committed to taking necessary and appropriate mitigation measures as delineated in their own plan and as discussed in the present report, it has also appeared that, KWASA holds a very positive approach towards *sustainable environmental management*. So, it is firmly believed that it would apply and maintain the best practice for standard quality of implementation of the program with due consideration to all standing rules, regulations, protocols and conventions thereof. As such, the project may be recommended for implementation.

In consideration of the foregoing findings and commitments placed in this EIA Report, the JICA may accord approval for financing the project and DOE may approve and issue the Environmental Clearance in favor of KWASA for implementing construction and operation of the proposed Water Supply Project with its associated facilities as per their schedule of execution.


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