Dhaka Environmentally Sustainable Water Supply Project

ঢাকা পরিবেশবান্ধব পানিসরবরাহ প্রকল্প

Package 1: Raw Water Intake, Pipeline & Water Treatment Plant

Environmental Impact Assessment

পরিবেশগত প্রতিক্রিয়া সমীক্ষা

August 2014

অগাস্ট ২০১৪

Dhaka Water Supply and Sewerage Authority

WASA BHABAN, Kawran Bazar, Dhaka

Abbreviations

ADB	Asian Development Bank
AAQ	Ambient Air Quality
BFRI	Bangladesh Fisheries Research Institute
BIWTA	Bangladesh Inland Waterways Transport Authority
BWDB	Bangladesh Water Development Board
BNBC	Bangladesh National Building Code
BOD	Biochemical Oxygen Demand
DBC	Design Build Contractor
DESWSP	Dhaka Environmentally Sustainable Water Supply Project
DMC	Design Management Consultants
DoE	Department of Environment
DoF	Department of Fisheries
DTW	Deep Tube Well
DWASA	Dhaka Water and Sewerage Authority
ECA	Environment Conservation Act
ECR	Environment Conservation Rules
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EM&MP	Environmental Management & Monitoring Plan
GW	Ground Water
IEE	Initial Environmental Examination
IWM	Institute of Water Modeling
LAP	Land Acquisition Plan
MoEF	Ministry of Environment and Forest
NGO	Non-governmental Organization
PMU	Peoject Management Unit
RAP	Resettlement Action Plan
RoW	Right of Way
SC	Supervision Consultant
STW	Shallow Tube Well
SW	Surface Wate
SWTP	Surface Water Treatment Plant
WSF	Water Safety Framework
WSP	Water Safety Plan
WTP	Water Treatment Plant

...

Units

°C	degree Celsius
CFU	Colony-Forming Unit
dB	decibels
ha	hactare
km	kilometer
km/h	kilometer per hour
m	meter
mg/l	milligram per liter
MLD	million liters per day
mm	millimeter
µg/m^3	micro-gram per cubic meter
NTU	Nephelometric Turbidity Unit
ppm	parts per million

Table of Contents

List of Figures

List of Tables

Executive summary

The Dhaka Water Supply and Sewerage Authority (DWASA), acting as the executing agency (EA) and assisted by the Asian Development Bank (ADB) and other development banks and bilateral agencies, has embarked on an ambitious expansion and refurbishment of Dhaka's water and sewerage systems. One of the components of DWASA's plan to augment the overall water supply and to reduce the amount of groundwater abstraction is the 500 million liters per day (MLD) Gandharbpur Water Treatment Plant Project. DWASA published a comprehensive feasibility study and IEE in 2011 and 2013 respectively.

The project intends to withdraw, in two phases, up to 1,050 MLD from Meghna River for transmission to Dhaka city and for distribution after treatment. The project consists of the following components: (i) construction of an intake at the village of Bishnondi from the Meghna River, with pumping and other facilities to deliver uninterrupted supply of water to the transmission mains; (ii) construction of raw water transmission pipelines connecting the raw water intake with the Gandharbpur water treatment plant (WTP); (iii) construction of a 500-MLD surface WTP at Gandharbpur; and (iv) construction of treated water mains from the Gandharbpur treatment plant to the injection point, connecting with the distribution system inside Dhaka.

In accordance with ADB's Safeguard Policy Statement (SPS, 2009) the project is classified as category B, means no significant impacts are envisioned. However, as per the Government of Bangladesh's (GoB) Environmental Conservation Act (ECA, 1995) (Amendment 2000) and the Environmental Conservation Rules (ECR, 1997), the project is classified as a red category, requiring environmental impact assessment (EIA) for necessary environmental clearance requirements for any new industrial set up. In accordance with this, an EIA has been carried out for the mentioned project. The EIA report has been prepared through identifying the potential impacts, assessing them and recommending possible mitigating and enhancing measures for negative and positive impacts respectively.

There are no significant or irreversible environmental impacts envisaged due to the project interventions. The impacts are largely construction related, and can be addressed through adoption of good engineering practices during project implementation. While the project components are rather simple, the scale and magnitude of facilities proposed trigger the need for an effective integration of environmental measures at all stages of the project.

There are no protected areas, forests, wetlands, or environmentally sensitive areas within or in the vicinity of the project sites. The proposed locations for intake at the Meghna River and the WTP at Gandharbpur are agricultural lands. The raw water transmission lines from the intake to the Gandharbpur WTP and a portion (4.5 km) of the treated water mains from the WTP are proposed to be laid through agricultural and low-lying areas. The other transmission mains for raw and treated water are routed along existing roads within the road reserves. The proposed abstraction for the 1,050-MLD intake (two phases) accounts for 0.3% of the lean flow, and would have negligible impacts on ecological flow and downstream uses.

Potential negative impacts were identified in relation to design, construction, and operation of the improved infrastructure. Mitigation measures have been developed to reduce all negative impacts to acceptable levels.

Key construction stage impacts identified includes: loss of productive agricultural lands and destruction of topsoil; impacts on low-lying areas and water bodies; air, noise, and vibration impacts due to construction vehicles, equipment, and machinery in addition to

dust generation during construction activities; impacts on the river courses and the water quality during the construction of the transmission mains across the rivers and streams; soil disposal due to the excavation for the transmission mains; accident hazards; impacts on community health and safety hazards posed to the public, specifically in inhabited areas. Field visits and consultations with the stake holders and affected population were taken into considerations in the evaluation and mitigation proposals in this assessment report.

The impacts from construction and operation will be manageable, and no insurmountable impacts are predicted, provided that the EMP is included in the contract and its provisions implemented and monitored to their full extent.

On the basis of the EIA, it is observed that there are no major adverse impacts due to the project located in the mentioned area. So the selected location for the construction of intake, WTP and transmission line for raw water and treated water is considered acceptable. In construction phase there would be some normal construction hazard which will require precautions. But all the impacts at construction phase are of short term and reversible. It is understood that DWASA will take necessary steps to control, and minimize any adverse impact to an acceptable level through institutional measures and incorporating standard engineering practices.

Water abstraction from river Meghna is one of the major activities to be associated during operation phase of the proposed project. But the study reveals that a negligible amount, as already mentioned, would be abstracted during lean flow which would have negligible impacts on ecological flow and downstream uses. On the other hand, the project will have a positive impact in terms of production of pure drinking water supply from surface water conserving scarce ground water. The other positive impact of the project will be the employment during construction and operation phases. Field visits and consultations with the stake holders and affected population were taken into considerations in the evaluation and mitigation proposals in this assessment report.

An outline of EMP has been given in the present report to mitigate/enhance the impacts, which are expected to be occurred during operation phase of the project. However, adequate and effective pollution prevention, abatement and control measures, proper and careful operation and maintenance, regular and effective environmental monitoring with adequate staff and budgetary provision, creation of an environmental Cell, ensuring preventive management practices, adoption of the Disaster Risk Management Plan and reporting to DOE should be ensured.

It is expected that DWASA will follow all environmental compatible steps during operation and maintenance by which it sets a positive example as an environment friendly water supply project. It is also expected that DOE will do surveillance monitoring of the project performance. DOE should also continue its encouragement for water supply project of DWASA for initiatives to save scarce underground water resource and to ensure a better environment.

The potential benefits, which are expected due to this project, considered substantial, and will offset the anticipated negative impacts. Hence, DOE should consider positively issuing the necessary clearance for implementation of such project in the above mentioned location.

1 INTRODUCTION

1.1 Background

The Dhaka Water Supply and Sewerage Authority (DWASA), acting as the executing agency (EA) and assisted by the Asian Development Bank (ADB) and other development banks and bilateral agencies, has embarked on an ambitious expansion and refurbishment of Dhaka's water and sewerage systems. The water sector is addressed by the Dhaka Water Supply Sector Development Project (DWSSDP), funded by ADB[1]. It aims to increase surface raw water sources and thereby decrease reliance on groundwater abstraction, which is mining the aquifers at a current rate of 2-3 meters per year. Future plan for water sources by DWASA is shown in Figure 1.1 and Table 1.1. The project further aims to strengthen the distribution system, thereby adding to the service areas and significantly reducing non-revenue water (NRW).

One of the components of DWASA's plan to augment the overall water supply and to reduce the amount of groundwater abstraction is the 500 million liters per day[2] (MLD) Gandharbpur Water Treatment Plant Project. DWASA published a comprehensive feasibility study[3] (FS) in 2011; the review of this study and the endorsement or identification of gaps are the central objectives of this project preparatory technical assistance (PPTA).

The project intends to withdraw up to 1,050 MLD from Meghna River in two phases for transmission to Dhaka city and for distribution after treatment. The project consists of the following components:

- construction of an intake at the village of Bishnondi from the Meghna River, with pumping and other facilities to deliver uninterrupted supply of water into the transmission mains;
- construction of raw water transmission pipelines connecting the raw water intake with the Gandharbpur water treatment plant (WTP);
- construction of a 500-MLD surface water treatment plant at Gandharbpur; and (iv) construction of treated water transmission mains from the Gandharbpur treatment plant to the injection point connecting with the distribution system inside Dhaka. Chapter 3 of this report provides a more detailed description of the project components.

The socio-cultural roots of our present environmental crisis lie in the paradigms of scientific materialism and economic determinism, which fail to recognize the physical limits, imposed by ecological systems on economic activity. The economic activities must expand within ecosystems, which have limited regenerative capacities. Contrary to the neoclassical theory of continuous material growth, economic activities directly undermine the potential for development through over-exploitation of natural resources, and indirectly compromise future production through the

1 ADB. 2007. Report and Recommendation of the President to the Board of Directors: Proposed Loans and Technical Assistance Grant to the People's Republic of Bangladesh for the Dhaka Water Supply Sector Development Program. Manila. The scope of the program included preparation of a feasibility study of the project.

2 This is Phase 1, with an expansion of 500-MLD Phase 2 planned to go into production in 2020. The intake is to be designed for 1050 MLD (with 5% extra capacity).

3 DWASA, 2011. Feasibility Study for Augmentation of Water Supply to Dhaka, Design and Management Consultancy Services. Dhaka, August 2011.

discharge of residuals. The entrenchment with quantitative growth as a major instrument of social policy is thus quite paradoxical.

The emergence of the concept of sustainable development in recent years has brought in the general realization that societal perceptions must shift towards ecological determinism so as to achieve qualitative growth within the limits of ecosystem carrying capacity. The carrying capacity based planning process, innovative technologies for enhanced material and energy efficiency of production and consumption, structural economic change towards less resource-intensive sectors, and preventive environmental management through increasingly

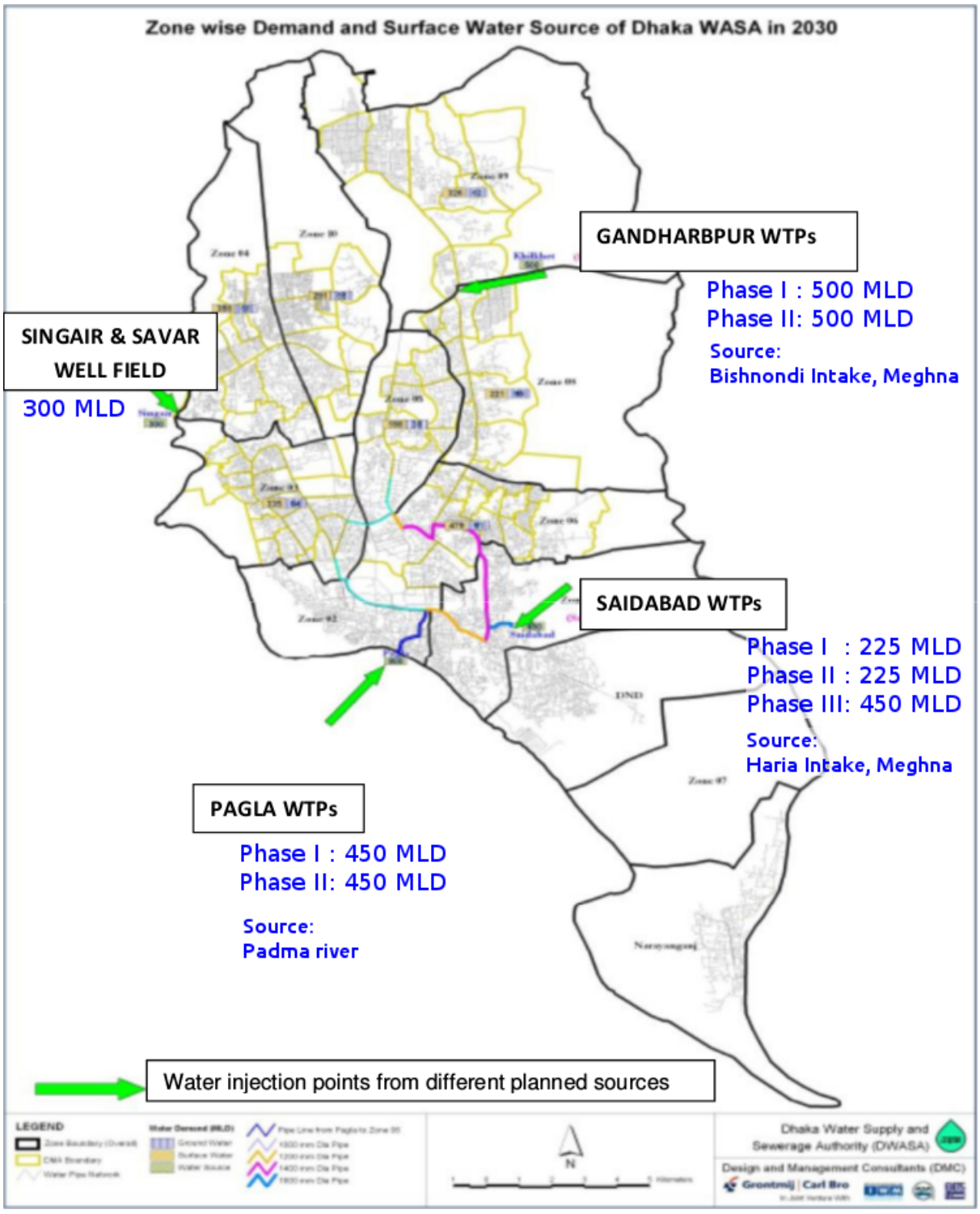


Figure 1.1: Future plan for water sources by DWASA

interventionist policies are some of the strategies for reconciling developmental goals with ecological capabilities.

Proper location / siting, its process and waste abatement and control are very important for a water treatment plant to be environmentally sound. To ensure this, an Environmental Impact Assessment (EIA) is a very effective tool, which delineates what needs to be done to make a plant unit suitably located and operate in an environment friendly way.

The EIA was carried out as a follow up study of the initial environmental examination (IEE) prepared as part of the PPTA to address environmental impacts resulting from the project. It is based on review and updating of the IEE carried out by the FS. An environmental management plan (EMP) outlining the specific environmental measures to be adhered to during implementation of the project has been prepared. During the detailed design, the EMP shall be further updated as a stand-alone EMP for each of the procurement packages, and appended to the contract document. This will allow integration of environmental provisions and management measures in the document.

Table 1.1: Water Supply master plan for DWASA

Year	**2011**	**2015**	**2020**	**2025**	**2030**	**2035**
Demand:						
Required Production	2,179	2500	3,112	3,685	4,573	5,453
Supply:						
From GW sources	1,900	1950	1,360	1,260	1,260	1,260
From SW sources:						
Godnail, Sonakanda & Chandnighat (rehab ongoing)	10	96	96	96	96	96
Saidabad I (in operation)	225	225	225	225	225	225
Saidabad II (in operation)		225	225	225	225	225
Saidabad III (FS completed)			450	450	450	450
Gandharbpur I (FS completed)			500	500	500	500
Gandharbpur II (FS completed)					500	500
Padma I (FS completed)			450	450	450	450
Padma II (FS required)					450	450
Meghna I (Rupganj) (FS required)						500
Meghna II (N.ganj) (FS required)						200
From SW sources	235	546	1,946	1,946	2,896	3,596
Total Production (SW + GW)	**2,135**	**2,496**	**3,306**	**3,206**	**4,156**	**4,856**
Surplus or Deficit	-44	-4	194	-479	-417	-597

Source: DESWSP

1.2 Objective

The objective of the assignment is to carry out an Environmental Impact Assessment (EIA) in accordance with the Environment Conservation Act 1995 (ECA'95) and the Environment Conservation Rules 1997 (ECR'97) and In accordance with ADB's Safeguard Policy Statement (SPS, 2009). For the approval of feasibility study (FS) by the Government of Bangladesh (GoB), the environmental and social studies, Environmental Impact Assessment (EIA) studies, and Environmental Management Plan (EMP) is required as per ECR'97. The specific objectives of the environmental study to be carried out for the proposed project are:

- to assess the existing environmental conditions (physical, biological and socio-economic) of the proposed project sites (intake structure and WTP sites) and routes of water transmission lines and their surrounding areas in order to establish a baseline framework, against which potential environmental impacts due to the implementation of the project would be compared;
- to identify and evaluate environmental impacts resulting from the project activities during both construction and operational phases of the project, and to suggest appropriate mitigation measures;
- to carry out public consultations in order to get views and concerns of local people and peoples' representatives regarding different aspects of the proposed project, and to address those in the EIA.

1.3 Literature Review

During the preparation of this report, pertinent references were consulted and reviewed. Many environmental legislatives were reviewed that have implication to the project.

Bangladesh has consented to be bound by the terms of some 21 of the 44 principal international conventions, treaties and protocols relating to the environment. Those with partial and indirect relevance to projects are the Paris convention of 1972 concerning the protection of the world cultural and natural heritage, convention concerning safety in the use of chemicals at work, Geneva 1990, Biodiversity convention, Rio-De-Janeiro 1992, convention concerning occupational health services, Geneva 1985 etc.

A wide range of laws and regulations related to social and environmental issues are effective in Bangladesh. Many of these are cross-sectoral and only partially related to environmental and social issues. The laws and regulations such as National Water Policy, 1999; Forest Act 1927 (modified up to 30th April 2000); National Forest Policy, 1994; National Conservation Strategy; National Environmental Management Action Plan (NEMAP); Environment Conservation Act 1995 (ECA 1995); Environmental Conservation Rules 1997; Environment Conservation (Amendment) Act (2002) and Draft Environment Conservation (Amendment) Act 2009; Coastal Zone Policy, 2005; Coastal Development Strategy, 2006; National Agricultural Policy, 1999; National Fisheries Policy, 1996; National Livestock Development Policy, 2007; Standing Orders on Disaster, 1999; Climate Change Strategy and Action Plan, 2009; National Plan for Disaster Management, 2008-2015; and Other Legislation are considered here.

Some of the most important legislations that have implication with the project activities:

- Bangladesh Environmental Conservation Act (ECA), 1995
- Environment Conservation Rules (ECR), 1997

- National Water policy, 1999
- National Safe Drinking Water Supply and Sanitation Policy 1998
- National Fisheries Policy, 1996
- National Agricultural Policy, 1999
- National Livestock Development Policy, 2007
- Others

The most important of these are the Environment Conservation Act, 1995 (ECA, 1995), and the Environment Conservation Rules (ECR, 1997). The ECA 1995 is primarily an instrument for establishing the Department of Environment (DoE), and for controlling industrial pollution. The Act also defines in general terms that if any particular activity is causing damage to the ecosystem, the person responsible will have to apply corrective measures. Until the appearance of ECR, 1997, enforcement of the Act was not possible, as many of the clauses refer to specifications spelled out in the Rules.

A list of this review has been presented in Chapter- 2.

1.4 Scope of the Present Study

The major activities were carried out for the Environmental Assessment of the proposed project are summarized below.

Review of Policy, legal, and administrative framework: The relevant local, regional, and national regulations and standards governing environmental quality (such as air and water discharge standards), health and safety aspects, protection of sensitive areas and endangered species, project site, and land use controls were reviewed.

Description of the Project: This covered the following information:

i. Nature and Scope of the project
ii. Need for the project (in the context of Dhaka metropolitan city's water supply scenario)
iii. Location and site description (using maps to show the project and site location, and any specific environmental attributes in and around the location)
iv. Description of the construction and operation activities

Description of Environmental Baseline: Environmental baseline surveys were performed covering areas in and around the proposed locations of the intake structure and treatment plant and along the proposed alignment of the raw and treated water transmission lines.

Physical Environment: This included information on topography, geology / seismology, soil type , climate and meteorology , natural gradient and drainage pattern, and ambient noise levels and air quality.

Assessment of Water Quality: Baseline data covered the assessment of water quality of the area including intake water quality.

Fisheries: Assessment of the baseline fisheries in the river stretch adjacent to the intake structure was undertaken.

Flora and Fauna: Baseline information on flora and fauna of importance, especially any endangered species, sensitive habitats, and species of commercial importance that may be affected due to project activities was collected and presented.

Socio-economic: The socioeconomic baseline was established through secondary data and questionnaire survey at the site.

Description of potential environmental impacts and mitigation measures: All potential impacts the project during construction and operational phases of the

project were identified. This will include the following issues:

1) Loss of property/land/income
2) Dislocation and displacement,
3) Public health,
4) Air and noise pollution,
5) Raw and treated water quality
6) Sanitation and solid waste, disposal of treatment waste
7) Stability of riverbank and erosion
8) Aquatic and terrestrial flora and fauna
9) Traffic congestion and safety,
10) Employment and commercial activities,
11) Public health and safety

Using an impact matrix the scale of impacts by the project related activities on the baseline environment were screened initially. Impact assessment was carried out and characterized in terms of nature (e.g., reversible, irreversible, positive or negative), scale (e.g., local, regional), and duration (e.g., short-, medium-,long-term).

After detailed assessment of environmental impacts, mitigation measures were designed and suggested for reducing and eliminating adverse impacts and for enhancing the positive and beneficial impacts, both for construction and operational phases of the project.

Recommendations were proposed for the most appropriate mitigation and mechanism for water shed protection of Meghna River.

Analysis of Alternatives: Feasible alternatives to the intake location, route of water transmission pipeline and water treatment process were studied – including the zero alternative – in terms of potential environmental impacts and the feasibility of mitigating the impacts.

Environmental Management Plan: An EMP was developed that consists of a set of mitigation, monitoring, and institutional measures to be taken during different stages of the project (construction, and operation) to mitigate the adverse environmental impacts, offset them, or reduce them to acceptable levels. The EMP identified and summarized all anticipated significant adverse impacts, and describe – with technical details – each mitigation measures. Furthermore, the EMP contained clear and agreed allocation of responsibility amongst project proponents and government agencies for implementation of the mitigation measures as well as their oversight and monitoring. The EMP proposed cost-effective mitigation measures, the cost of which should be a part of the project cost.

Public Consultations: In order to ensure that all relevant issues have been covered by the EA, potentially affected people and other relevant individuals/ organizations early in the EA process were consulted, so that their views and concerns about environmental issues can be addressed to the extent possible. Consultant organized Focus Group Discussions (FGDs) with the potentially affected persons (PAPs) and other stakeholders by taking help of the local people living in the zone of influence. FGD participants were mainly better informed people, educated and to some extent were aware of different development activities taking place in the locality.

1.5 Methodology

The present environmental study called EIA has been carried out as a follow up study of IEE, which is the requirement of DOE for such type of treatment plant. This report is based on the primary data generated during the study period, secondary data from various sources and information from field visits and the project proponent. Several field visits were undertaken to the project location with a view to

reconnaissance and detailed physical survey of the surrounding areas. These were followed by evaluation of the information to delineate the major environmental issues relating to the treatment plant. During this process, the following steps have been followed:

- compilation of survey/monitoring data. Field survey using a prepared questionnaire covering a wide cross- section of people in the study area to acquire field-level data on the existing environment and socio-economics and apprehended impacts due to the project. Monitoring of water quality (both ground and surface water) of adjoining areas was done.
- understanding the process involved in the plant.
- identification of potential impacts and evaluation of their consequences, to the possible extent. Identification of impacts was done using **Checklist method**.
- review of the adequacy and efficiency of proposed mitigation measures for the plant.
- development of an **Environmental Management Plan (EMP)** for possible mitigation / enhancing measures for negative and beneficial impacts .
- suggestion of mitigation measures for residual impacts.

This report is prepared following the EIA methodology as described in the Asian Development Bank (ADB, 1988) manual of EIA guidelines, and also EIA guidelines for Industries (DOE, 1997) to a certain extent, but not limited to those.

1.6 Limitation

An EIA is generally carried out as an integral part of the Feasibility study (FS) or together with it and before going into the final design phase and into the construction phase of a particular development project. If so than the findings of the EIA could be incorporated in the project design, overall planning and budget and that the project could be implemented accordingly. When an EIA is conducted separately as just an add-on, often it does not get due importance in the overall implementation of the project, which undermines the role of the EIAs and can contribute to environmental damages.

1.7 EIA Team

This report has been prepared under the guidance and supervision of Dr. M. S. Osman, the Individual Consultant, assigned for this project. The other members of the team and their responsibilities are as follows

Prof. Dr. S. M. Atiqul Islam – Identification impacts, Analysis of impacts and Compilation, etc.

Engr. Md. Quaisarul Islam – Providing necessary data and guidelines.

Dr. Miah M. Hussainuzzaman – Compilation, FGD and impact identification and analysis etc.

Mr. Asaduzzaman Rumel - Organization of FGD.

CRTS, DUET- DUET – for measurements of Air and Noise quality.

2 LEGISLATIVE, REGULATORY AND POLICY CONSIDERATION

2.1 ADB Safeguard Policy (ADB Safeguards Policy Statement, 2009)

The ADB SPS stipulates addressing environmental concerns, if any, of a proposed activity in the initial stages of project preparation. For this, the SPS categorizes the proposed components into categories (A, B or C) to determine the level of environmental assessment required to address the potential impacts. All three safeguard policies involve a structured process of impact assessment, planning, and mitigation to address the adverse effects of projects throughout the project cycle. The safeguard policies require that

- impacts are identified and assessed early in the project cycle;
- plans to avoid, minimize, mitigate, or compensate for the potential adverse impacts are developed and implemented; and
- affected people are informed and consulted during project preparation and implementation.

The policies apply to all ADB-financed projects, including private sector operations, and to all project components. The internal procedural requirements are detailed in the *Operations Manual* sections and involve similar implementation processes as follows:

- screening and scoping of the main issues start as soon as potential projects for ADB financing are identified and continue throughout the project cycle;
- impacts are assessed, safeguard plans summarizing mitigation measures, monitoring program, and institutional arrangements are prepared, and arrangements are made to integrate safeguards into project design and implementation;
- affected people are consulted during project preparation and implementation and information is disclosed in a form, manner, and language accessible to them; and
- safeguard plans are disclosed to the general public and the information is updated at various stages in the project cycle. ADB's safeguard policies require that both ADB's and DMCs' safeguard requirements are complied with.

A screening process for all ADB projects classified them into four environmental assessment categories as described in Table 2.1.

Table 2.1: ADB Projects Environmental Classification

Category	Category A	Category B	Category C	Category FI
Description	The project is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an	The project has potential adverse environmental impacts on human populations or environmentally important areas—including wetlands, forests, grasslands, and other natural habitats—are less adverse than those of Category A projects. These impacts are site-specific;	The project is likely to have minimal or no adverse environmental impacts	The project involves investment of IFC funds through a financial intermediary, in subprojects that may result in adverse

Category	Category A	Category B	Category C	Category FI
	area broader than the sites or facilities subject to physical works	few if any of them are irreversible; and in most cases mitigatory measures can be designed more readily than for Category A projects.		environmental impacts.
EA Requirements	For a Category A project, the project sponsor is responsible for preparing a report, normally an EIA	EA is narrower than that of Category A EA. Like Category A EA, it examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance.	Beyond screening, no further EA action is required for a Category C project	For FI category subproject sponsors requires to carry out appropriate EA for each subproject

2.2 Government Policies, Laws, Regulations

The severe floods of 1987 and 1988, and the resurgence of concern about environmental issues, have heightened in improving environmental conditions of the country through promulgation of numbers of policies and legislation in the country. All of the policies or legislation aimed at the conservation and protection of the environment. The existing policies and legislation, which are relevant to the environment, are described in the following sections.

2.2.1 Industrial Policy 1991

The Industrial policy of 1991 contains the following clauses in respect of environmental protection:

- To conserve ecological balance and prevent pollution during industrialization.
- To take effective steps for pollution control and conservation of environment during industrialization.

To ensure embodying of necessary pollution control and preventive measures by industrial investment project endangering environment

2.2.2 National Environmental Policy 1992

Bangladesh National Environmental Policy (GoB, 1992) was approved in May 1992, and sets out the basic framework for environmental action, together with a set of broad sectoral action guidelines. Key elements of the policy are:

- Maintenance of the ecological balance and overall progress and development of the country through protection and improvement of the environment.
- Protection of the country against natural disasters.
- Identification and regulation of all types of activities which pollute and degrade the environment.
- Ensuring sustainable utilization of all natural resources.
- Active association with all environmentally related international initiatives.

Environmental policy contains the following specific objectives with respect to the industrial sector:

- To adopt corrective measures in phases in industries that causes pollution.

- To conduct Environmental Impact Assessments (EIAs) for all new public and private industries.
- To ban the establishment of any industry that produces goods that cause environmental pollution, closure of such existing industries in phases and discouragement of the use of such goods through the development and/or introduction of environmentally sound substitutes.
- To ensure sustainable use of raw materials in industries and to prevent their wastage.

2.2.3 National Safe Drinking Water Supply and Sanitation Policy 1998

National Safe Drinking Water Supply and Sanitation Policy (NSDWSSP, 1998) was drafted in 1998, and sets out the basic framework for the improvement of public health quality and to ensure improved environment, together with a set of broad sectoral action guidelines. The draft policy offered various objectives to achieve the goal and these are:

- To manage water supply and sanitation related basic needs for all.
- To bring the positive change of peoples attitude, regarding water and sanitation.
- To reduce the outbreak of water borne diseases.
- To increase the efficiency of the Local Government and associated community for handling more effectively the problems related to water supply and sanitation.
- To improve sustainable water supply and sanitation system.
- To ascertain proper conservation, management and use of surface water, and to control water pollution due to the scarcity of underground water.
- To take necessary steps to use and conserve rain water.
- To ascertain the rain water disposal in the urban areas.

2.2.4 National Conservation Strategy 1992

National Conservation Strategy (GoB/IUCN, 1992) was drafted in late 1991 and submitted to the Government in early 1992. This was approved in principle, however the final approval of the document is yet to be made by the cabinet. Meanwhile it underwent a number of modifications over the last five years and awaiting for approval. For sustainable development in industrial sector, the report offered various recommendations; some of those are as follows:

- Industries based on nonrenewable resources should be made to adopt technology which conserves raw materials, and existing industries should be given incentives to install technical fixes to reduce wastage rate.
- All industries, specially those based on imported raw materials, should be subjected to EIA and adoption of pollution prevention/control technologies should be enforced.
- No hazardous or toxic materials/wastes should be imported for use as raw material.
- Import of appropriate and environmentally sound technology should be ensured.
- Complete dependence on imported technology and machinery for industrial development should gradually be reduced, so that industrial development is sustainable with local skills and resources.

2.2.5 National Environmental Management Plan

National Environmental Management Action Plan, also referred to as NEMAP (GoB, 1995) is a wide-ranging and multi-faceted plan, which builds on and extends the statements set out in the National Environmental Policy. NEMAP was developed to address issues and management requirements during the period 1995 to 2005, and sets out the framework within which the recommendations of the National Conservation Strategy are to be implemented.

NEMAP has the broad objectives of:

- identification of key environmental issues affecting Bangladesh.
- identification of actions necessary to halt or reduce the rate of environmental degradation.
- improvement of the natural and built environment.
- conservation of habitats and biodiversity.
- promotion of sustainable development.
- improvement in the quality of life of the people.

One of the key elements of NEMAP is that sectoral environmental concerns are identified. In outline, the environmental issues of the industrial sector include the following:

- Pollution arising from various industrial processes and plants throughout the country causing varying degrees of degradation of the receiving environment (Air, Water, and Land).
- There is a general absence of pollution abatement in terms of waste minimization and treatment.
- Low level of environmental awareness amongst industrialists and entrepreneurs.
- Lack of technology, appropriate to efficient use of resources and waste minimization leading to unnecessary pollution loading in the environment.
- Economic constraints on pollution abatement and waste minimization such as the cost of new technology, the competitiveness of labor, and intensive production methods as compared to more modern methods.
- Concentration of industry and hence pollution in specific areas which exacerbate localized environmental degradation and exceed the carrying capacity of the receiving bodies.
- Unplanned industrial development has resulted in several industries located within or close to residential areas which adversely affects human health and quality of human environment.
- Establishment of industries at the cost of good agricultural lands and in the residential areas.
- Lack of incentives to industrialists to incorporate emission/discharge treatment plant in their industries.

2.3 Conventions, Treaties and Protocols

Bangladesh has consented to be bound by the terms of some 21 of the 44 principal international conventions, treaties and protocols relating to the environment (Islam, 1996). Those with partial and indirect relevance to industrial projects are the Paris convention of 1972 concerning the protection of the World cultural and natural Heritage, Convention concerning safety in the use of chemicals at work, Geneva 1990, Biodiversity convention, Rio-de-Janeiro, 1992, Convention concerning occupational health services, Geneva 1985 etc.

2.3.1 Environment Conservation Act 1995

Provides for the conservation of environment, improvement of environmental standards, and control and mitigation of environmental pollution. In line with these provisions of the act, the Environment Conservation Rules, 1997 have been framed. This act provides for (i) remedial measures for injury to the ecosystem; (ii) any person affected by environmental pollution to apply to DoE for remediation of the damage; (iii) discharge of excessive environmental pollutants; (iv) inspection of any activity or testing any equipment or plant for compliance to the environment act, including power to take samples for compliance; (v) power to make rules and standards with reference to the environment; and (vi) penalty for non-conformance to the Environment Act under the various sections.

The provisions of the act apply to all of the project interventions in the construction and operation stages.

2.3.2 Environment Conservation Rules 1997

The rules outline the processes and requirements of environmental clearances for specific types of projects indicated therein, and stipulates that “no industrial unit or project shall be established or undertaken without obtaining, in the manner prescribed by rules, an Environmental Clearance Certificate (ECC) from the Director General” of the Department of the Environment. Schedule 1 of the rules classifies industrial units and projects into four categories according to their site and impact on the environment, namely (i) green, (ii) orange-A, (iii) orange-B, and (iv) red. The rules specify the procedures for issuing ECC for the various categories of projects.

The Project is categorized as red and requires two stages of clearance, location clearance and environmental clearance. All requisite clearances (LCC and ECC) from the DoE shall prior to be obtained commencement of civil works.

2.3.3 Environment Court Act 2000

Enacted to establish environment courts and make rules for protection against environmental pollution. Environment courts are situated at the district level, but government may, by notification in the official gazette, establish such courts outside the districts. Environment courts were given power to directly take into cognizance any offense relating to environmental pollution. Proceedings of this court will be similar to that of criminal courts. One important feature of this act is that it has been given retrospective effect on any crime committed against environment laws; thus, any crime previously committed but not taken before any court can be taken before the environment court or any special magistrate.

Table 2.2 summarizes the applicable national and local laws, regulations, and standards for environmental assessment and management.

Table 2.2: Government Policies, Laws, Regulations, and Environmental Standards

Laws, Regulations, and Standards	Details	Relevance
Environment Conservation Act, 1995	Provides for the conservation of environment, improvement of environmental standards and control and mitigation of environmental pollution. In line with these provisions of the Act, the Environment Conservation Rules, 1997 have been framed. This Act provides for (i) remedial measures for injury to ecosystem; (ii) provides for any affected person due to	The provisions of the act apply to the entire Project interventions in the construction and operation stages.

Laws, Regulations, and Standards	Details	Relevance
	environmental pollution to apply to DOE for remediation of the damage; (iii) discharge of excessive environmental pollutants; (iv) inspection of any activity for testing any equipment or plant for compliance to the environment act, including power to take samples for compliance; (v) power to make rules and standards with reference to environment; and (vi) penalty for non-conformance to environment act under the various sections.	
Environment Conservation Rules (ECR), 1997	The Rules outline the processes and requirements of environmental clearances for specific type of projects indicated therein, and stipulates that “no industrial unit or project shall be established or undertaken without obtaining, in the manner prescribed by rules, an Environmental Clearance Certificate (ECC) from the Director General” of the Department of the Environment. Schedule 1 of the Rules classifies industrial units and projects into four categories according to their site and impact on the environment, namely (i) green, (ii) orange-A, (iii) orange–B, and (iv) red. The Rules specify the procedures for issuing ECC for the various categories of projects. For Red Category: (i) completed application for ECC, and the appropriate fee; (ii) report on the feasibility of the project; (iii) report on the IEE for the project, and Terms of Reference for the EIA; or EIA report prepared on the basis of TOR previously approved by DOE, plus (in the case of an industrial project): layout plan showing location of ETP, process flow diagram, design and time schedule of the ETP; (iv) report on the EMP; (v) no objection certificate from the local authority; (vi) emergency plan relating to adverse environmental impact and plan for mitigation of the effect of pollution; and (vii) outline of the relocation and rehabilitation plan (where applicable).	The project activities are categorized under this rule and as per categorization required environmental assessments were done
Environment Court Act, 2000	Enacted to establish Environment Courts and make rules for protection of environmental pollution. Environment Courts are situated at the District-level but Government may by notification in the official Gazette, establish such courts outside the districts. Environment Courts were given power to directly take into cognizance any offense relating to environmental pollution. Proceeding of Environmental Courts will be similar to Criminal Courts. One important feature of this Act is that	The Court has jurisdiction over, in accordance with the Act provisions, trial of an offense or for compensation under an environmental law, imposing penalties for violation etc.

Laws, Regulations, and Standards	Details	Relevance
	it has been given retrospective effect of any crime committed under environment laws and thus any crime previously committed but is not taken before any court can be taken before the Environment Court or any special Magistrate.	
National Policy for Arsenic Mitigation, 2004	Provides a framework for provision of water supply for areas/aquifers with high arsenic levels. Roles for agencies are specified for development of water supply systems, certification of arsenic removal technology, and disposal of treatment sludge. Arsenic-prone area also identified.	Considered in design and project preparation. Water supply is considered under this policy.
Pourashava Ordinance (Second Amendments) 1988; Municipal Administration Ordinance 1960	These ordinances have clearly assigned responsibilities to the LGIs to ensure urban health for their residents. It has given them the mandate to ensure and provide a wide range of primary and public health services including primary health care, sanitation, water supply, drainage, food and drink, birth and death registration, vector and infectious disease control, etc. As independent autonomous bodies, the LGIs, as necessary, may take all required actions to ensure good health for tourist and concerned population within its jurisdiction. They have the authority to address all related issues with their legal and administrative mandate.	The Project integrated community and workers health and hygiene at the construction stage, and this will be taken forward during the operation and maintenance of the infrastructure facilities for tourists, local community and other concerned peoples.
National Forestry Policy, 1994	Rules related to forest protection, often a domain of environmental management, are found in the Policy. Due to the dearth of forests, afforestation is actively pursued with targets to "implement programs of tree plantation and afforestation on fallow and hinterland, the bank of the pond and homestead land, which are under private ownership."	It is desirable to incorporate tree planting in the Project (where it is practical).
Bangladesh Labor Act, 2006	The Act provides the guidance on employer's extent of responsibility and workmen's extent of rights to compensation in case of injury by accident while working.	Provides for safety of work force during construction period.
National Water Policy, 1999	The Policy explicitly states 6 main objectives: (i) address the use and development of groundwater and surface water in an efficient and equitable way; (ii) ensure the availability of water to all parts of the society; (iii) accelerate the development of public and private water systems through legal and financial measures and incentives, including appropriate water rights and water pricing rules; (iv) formulate institutional changes, encouraging decentralization and enhancing the role of women in water management; and (v) provide a	Water supply should be under this consideration

Laws, Regulations, and Standards	Details	Relevance
	legal and regulatory framework that encourages decentralization, consideration of environmental impacts, and private sector investment.	
Bangladesh Standard Specification for Drinking Water, 1990	Formulation and revision of national standards. Now it is incorporated under the schedule of ECR 1997	Water supply should be under this consideration
Inspection and Enforcement Manual 2008	This manual has been written to provide national standard and uniformity environmental sampling for the inspections, investigations in the Department of Environment (DOE) in Bangladesh.	Will be considered at the time of environmental monitoring during the implementation of EMP
Acquisition and Requisition of Immovable Properties Ordinance 1982	The government made rules in the exercise of the powers conferred upon by section 46 of the acquisition and requisition of the immovable property ordinance, 1982 (Ordinance No. II of 1982). ARIPO sets the Government rules and regulations governing all cases of land acquisition.	If any acquisition is required, this will be considered

EIA = Environmental Impact Assessment, EMP =Environmental Management Plan, ETP = effluent treatment plant, IEE = Initial Environmental Examination, km = kilometer, LGI = Local Government Institution, TOR = terms of reference

2.4 International Conservations, Treaties and Protocols

The following are the International Environmental Conservations, Treaties and Protocols:

- Rio Declaration, Convention on Biological Diversity, Rio De Janeiro, 1992 (Ratified 1994)
- RAMSAR, 1971(Ratified 1992)
- International Plant Protection Conservation, Rome, 1951 (Ratified 1978)
- Basel Convention, Basel, 1989 (Ratified 1993)
- United Nations Framework Conservation on Climate Change, New York, 1992 (Ratified 1994)
- Montreal Protocol, 1987 (Ratified 1994)
- World Heritage Convention, 1972 (Ratified 1983)

Among them, Table 2.3 summarizes the relevant to this project activity.

Table 2.3: International Environmental Conventions relevant to the project activities

International	Details	Relevance
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	No sensitive species are located in the project area. There is no threat to the conservation of flora or fauna.

International	Details	Relevance
	signatory along with a total of 178 countries.	
Convention on Wetland of International Importance Especially as Waterfowl Habitats, Ramsar (1972)	The Ramsar Convention was adopted on 2 February 1971 and entered into force on 21 December 1975. Bangladesh ratified the Convention on 20 April 2002. Bangladesh has two Ramsar Sites (i) parts of Sundarban Reserved Forest (Southwest of Bangladesh); and (ii) Tanguar Haor Northeast of Bangladesh).	No impact

2.5 Relevant Occupational Health and Safety Laws and Rules

During construction, the Project will conform to the occupational and health related rules as outlined in the Table 2.4 below.

Table 2.4: Relevant Occupational Health and Safety Laws and Rules

Title of Laws and Rules	Descriptions
Social Security under the Act, 1923 and an amendment in 1980	According to the Act social impact assessment includes the processes of analyzing, monitoring and managing the intended and unintended social consequences, both positive and negative of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions.
The Employer's Liability Act, 1938	The Act declares that the doctrine of common employment and of assumed risk shall not be raised as a defense in suits for damages in respect of employment injuries. Under the Maternity Benefit Act, 1939, the Maternity Benefit Act, 1950, the Mines Maternity Benefit Act, 1941, and finally the rules framed thereunder, female employees are entitled to various benefits for maternity, but in practice they enjoy leave of 6 weeks before and 6 weeks after delivery.
Public Health (Emergency Provisions) Ordinance, 1994	The ordinance calls for special provisions with regard to public health. Whereas an emergency has arisen, it is necessary to make special provision for preventing the spread of human disease, safeguarding public health and providing them adequate medical service and other services essential to the health of respective community and workers in particular during the construction related work.
The Employees State Insurance Act, 1948	It has to be noted that health, injury and sickness benefit should be paid to people, particularly respective workers at work place under the Act.
Bangladesh Factory Act, 1979	The Act requires every workplace including small or large scale construction where women are employed to have an arrangement of childcare services. Based on this Act and Labor Laws - medical facilities, first aid and accident and emergency arrangements are to be provided by the authority to the workers at workplaces.
Water Supply and Sewerage Authority Act, 1996	The Act specify WASA's responsibility to develop and manage water supply and sewerage systems for the public health and environmental conservation.

2.6 Compliance with DoE EIA Guidelines

The most important of these are the Environmental Conservation Act, 1995 (ECA, 1995) and the Environment Conservation Rules (of this Act), 1997 (ECR, 1997). The ECA 1995 is primarily an instrument for establishing the Department of Environment (DOE) for implementing Environmental pollution legislation. As per Environmental Conservation Act (ECA, 1995) and ECR 1997, the industrial units and projects shall, in consideration of their site and impact on the environment, be classified into the following four categories:

1) Green; 2) Orange – A; 3) Orange – B; and 4) Red

Industries and projects included in the various categories as specified in sub-rule (1) have been described in Schedule – 1 of ECR 1997.

- Environmental Clearance Certificate shall be issued to all existing industrial units and projects and to all proposed industrial units and projects falling in the Green Category.
- For industrial units and projects falling in the Orange – A, Orange – B and Red categories, firstly a Location Clearance Certificate and thereafter an Environmental Clearance Certificate shall be issued:

  Provided that the Director General may, without issuing a Location Clearance Certificate at the first instance, directly issue Environmental Clearance Certificate if he, on the application of an industrial unit or project, considers it appropriate to issue such certificate to the industrial unit or project.
- The entrepreneur of the concerned industrial unit or project shall apply to the concerned Divisional Officer of the Department in Form-3 along with appropriate fees as specified in Schedule – 13 of ECR 1997.
- the following documents shall be attached with an application made under sub-rule above
  - Green category industries are to be granted environmental clearance within 15 days. The Green Category Schedule does not list specific projects.
  - For industries and projects in Category Orange A & B an application for environmental clearance is accomplished by a Feasibility Report, Initial Environmental Examination (IEE), and for industries also a Process Flow Diagram and Layout Plan.
  - For Red Category Industries and projects requires an Environmental Impact Assessment (EIA) for final approval and clearance. The ECR, 1997 list the Contents required for both IEE and EIA.

2.7 Obtaining Environmental Clearance

The environmental clearance procedure is pictorially presented in Figure 2.1.

2.8 Environmental Standard

Standards for different environmental parameters has been described in the Environmental Conservation Rules 1997 as described in the **Appendix-2**.

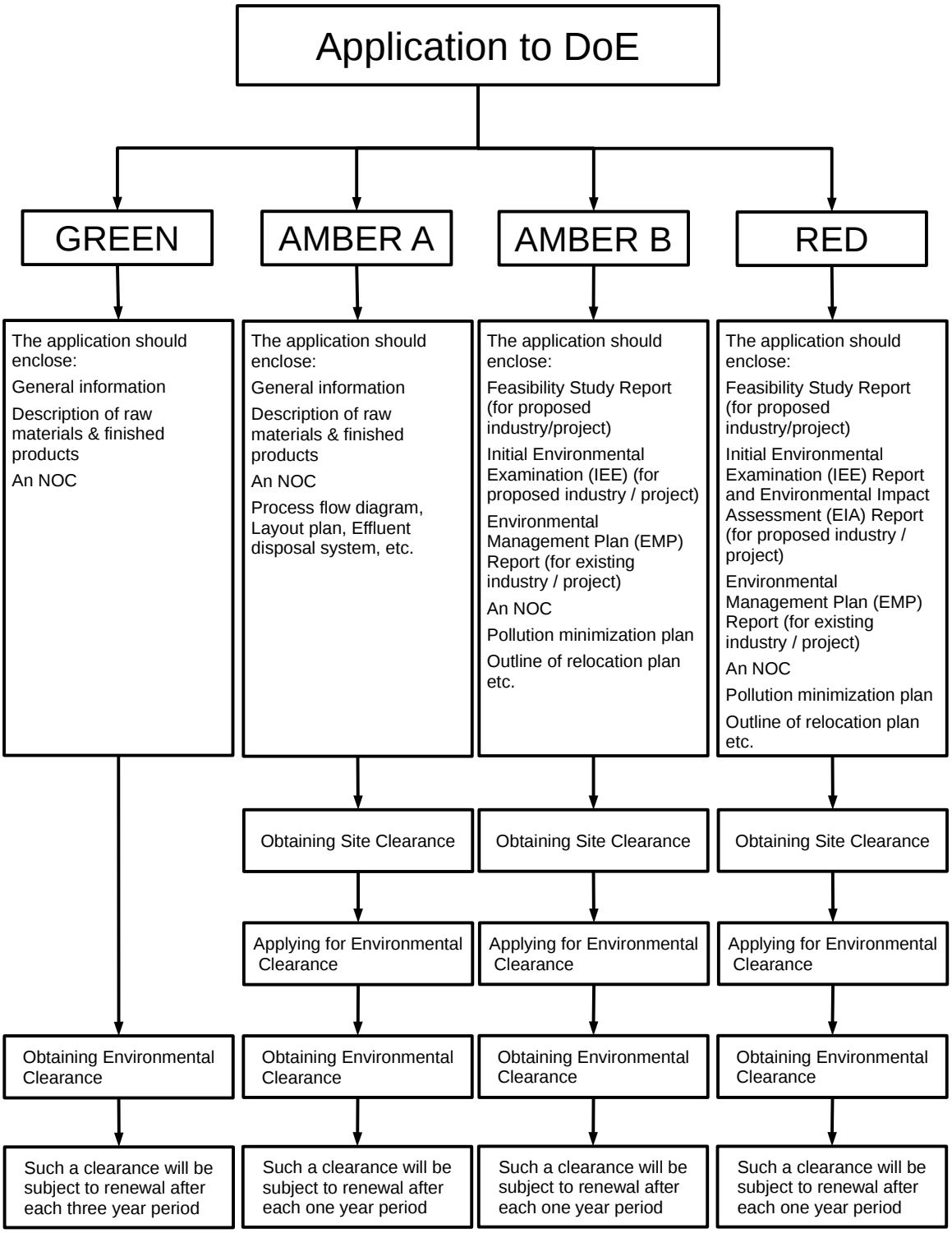


Figure 2.1: Government Environmental Clearance Process

3 THE PROJECT

This project under EIA is described under package-1 of “Dhaka Environmentally Sustainable Water Supply Project”. There are 4 packaged planned under this project, which are:

Package-1: Raw water intake at the Meghna river with structure with 1050 MLD capacity + 22 km Raw water pipe line + new WTP at Gandharbpur (WASA Land) having capacity 500 MLD.

Package-2: Treated water transmission pipeline from the Gandharbpur WTP to the injection point of the existing distribution network at Baridhara near US embassy Total 13km.

Package-3: Distribution reinforcement line in side Dhaka city (± 30 Km).

Package-4: Distribution Network improvement and Rehabilitation work at Zone-6 area under ICB Package-02.7.

This project (Package-1) consists of a river intake & pumping station to draw raw water from Meghna river, pipelines to carry that water to a water treatment plant, the treatment plant and the delivery mains to the Dhaka water supply network. Detail of the project is discussed in the following sections.

3.1 Project Location and area

Location: The project is spread east-west through Araihazar and Rupganj upazilla of Narayanganj district in Bangladesh. At the east end of the project, the intake is on the bank of Meghna river at Bishnanadi Union (adjacent GPS: N 23° 44' 45.821", E 90° 42' 45.186"), which is about 2km downstream (south) of Manikpur Ferry Ghat/crossing. The proposed pipelines and road are mostly through agricultural land. West end of the project, the Water Treatment Plant is located at Gandhrabpur village of Murapara Union of Rupganj Upazilla (GPS: N 23° 45' 32.422”, E 90° 30' 50.119”).

Area: A total of 197 acre land will be acquired for this part of the project. More detailed information is provided in Table 3.1. The land area required for the WTP site was acquired by DWASA long ago, and hence, no new land acquisition for WTP is required.

Table 3.1: Land acquisition requirements

Sl.	Location	Length (km)	Width (m)	Land Area (Acres)
1	Shomvupura & Chetia mouja of Bishnandi Union at Araihazar Upazilla on the bank of Meghna river	-	-	21
2	From Meghna Bishnandi to Dhaka-Sylhet roads Shezan Juice point (Vulta union, Golakanda Mouja)	17.50	31.0	148
3	Shejan Juice point to Gandharbpur WTP	4.50	25.0	28
			Total :	**197**

3.2 Project Concept

Water supply of Dhaka city is heavily depending on groundwater (GW), but the aquifer is not sufficient to support the growing demands and is now depleting due to over harvesting of water. Reducing recharge due to expansion of urbanization is also

contributing to this problem. Therefore, shifting the dependency of Dhaka water supply from depleting groundwater sources to more sustainable surface water is the central theme of this project. Besides, expanding the coverage of DWASA is another major concern behind this project.

3.3 Overview of the Project Components

The overall proposed project have six project components. Among those, components 1 to 4 falls under package-1, which is covered by this EIA study. The components are as follows:

Table 3.2: Project Components

Sl.	Component name	Infrastructure	Contract Package
1	Intake structures	Capacity: 1,050 MLD	Design-build contract
2	Pumping station	Total Capacity: 1,050 MLD Equipment Capacity: 500 MLD	Design-build contract
3	Raw water transmission lines	17.2 km: Intake to Shezan Juice Factory 4.5 km: Shezan Juice Factory to Gandharbpur WTP	Design-build contract
4	Water treatment plant	Capacity: 500 MLD at Gandharbpur	Design-build contract
5	Treated water mains	13 km: Gandharbpur WTP to US Embassy injection point	Construction contract
6	Distribution reinforcement	21 km: within the existing network	Construction contract

3.3.1 Intake

The intake structure will be designed for the full design capacity of 1,050 MLD in year 2030. The intake structure will receive raw water from the Meghna River, and the water will flow by gravity to the pump sump in the pumping station, located near the riverbank. The intake structure and the pump station shall be designed for the 100-year flood level and 50-year low levels in Meghna River. The intake structure serves as a pre-sedimentation chamber to settle larger particles. A pre-chlorination facility is also included in order to avoid organic growth in the transmission line. Coarse/Rough and fine screens will be included in the intake structure and at the inlet to the pump sump for removing coarse and fine suspended materials.

3.3.2 Pumping Station

The pumping station structure will be designed for full capacity in year 2030. The pumps will draw water from the pump sump, supplied by gravity through the intake channel from Meghna River. The pumping station includes power supply and necessary controls.

3.3.3 Transmission Mains

The proposed system will consist of one raw water transmission pipe (2,200 mm) to convey 500 MLD to Gandharbpur WTP. The raw water pipe include will include one pipe of 2,200 mm for a 17.2-km stretch from intake to Shezan juice factory on the Dhaka-Sylhet Highway. A 31 -m wide corridor is being acquired under the project, to accommodate a future total of four pipes and an access road (6.5 m-wide carriageway with 2 m-wide shoulders on either side) during construction and maintenance. Then it goes on for a length of 4.5 km from Shezan juice factory to the Gandharbpur WTP, to be accommodated within a 25 m-wide corridor through

agricultural lands and open areas.

a) Intake to Shezan juice factory on Dhaka-Sylhet Highway

This section of the transmission lines is a green field alignment for a length of 17.2 km through agricultural fields and open areas. One pipe with a diameter of 2,200 mm is proposed to be accommodated within the 31-m width of land[4] to be acquired for the length of this corridor, to accommodate pipes and access road. While one pipe of 2,200 mm is proposed to be laid as part of the present project, the remaining pipe(s) will be laid at a subsequent phase. The transmission mains would require a width of 16 m, while construction of an access road (to transport pipes during construction, as well as excavated soil and bedding materials) would require 15 m. To minimize land take, sheet piling on the edges of the corridor is proposed. The road will provide continued access to the transmission mains during the project and allow access to the site during the laying of the pipes at a later phase.

b) Shezan Juice factory to Gandharbpur WTP

The transmission lines along this 4.5-km stretch from Shezan to Gandharbpur WTP is proposed through agricultural fields and open areas. One pipe with a diameter of 2,200 mm is proposed to be accommodated within the 25-m width of land to be acquired. While one pipe of 2,200 mm is to be laid under the project, road reserve to accommodate an additional pipe is being secured for utilization at a later phase.

3.3.4 Gandharbpur Water Treatment Plant

The 30.35-hectare (ha) site at Gandharbpur will accommodate the phase 1, 500 MLD facility as well as Gandharbpur 2, doubling the total capacity to 1,000 MLD for Gandharbpur 1 and Gandharbpur 2. The plant will be designed for a continuous output of 500 MLD. The treatment plant will include pre-chlorination, coagulation, flocculation, sedimentation, filtration, PPTA, and the 20-m width was found inadequate for construction purposes. and post-chlorination facilities. Recirculation of backwash water and dewatering of sludge are included. The following main components are proposed:

(i) pre-chlorine, aluminium sulfate, lime, and polyelectrolyte dosing facilities for treatment;
(ii) three lines of two rapid mixing chambers in series, each equipped with a mechanical rapid mixer;
(iii) three lines of 2 x 2 flocculation chambers in series, each tank equipped with one mechanical flocculator;

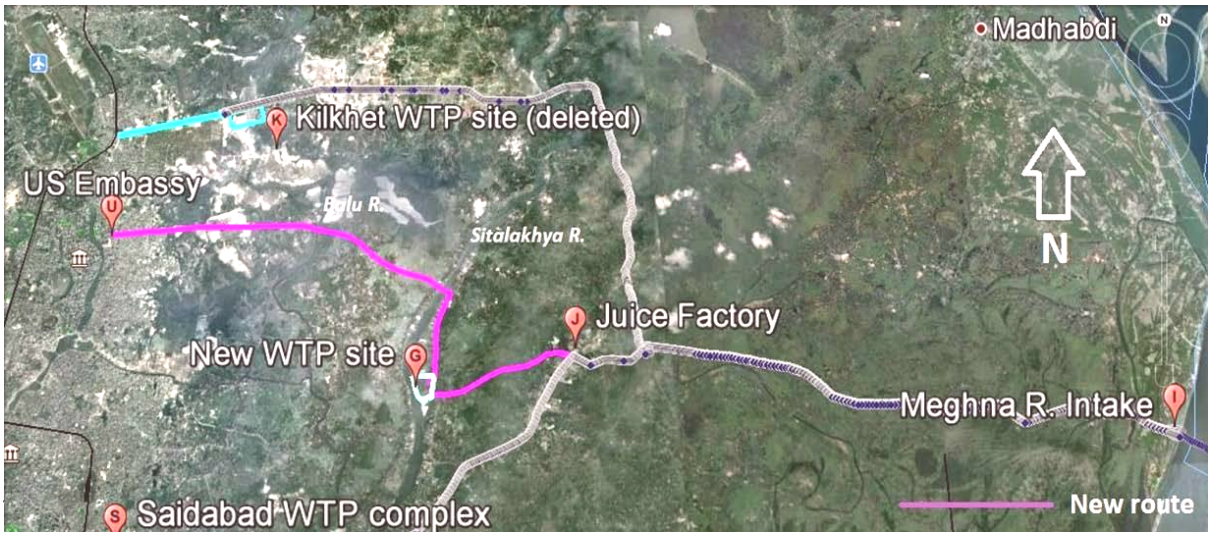


Figure 3.1: Project Lay-out Plan

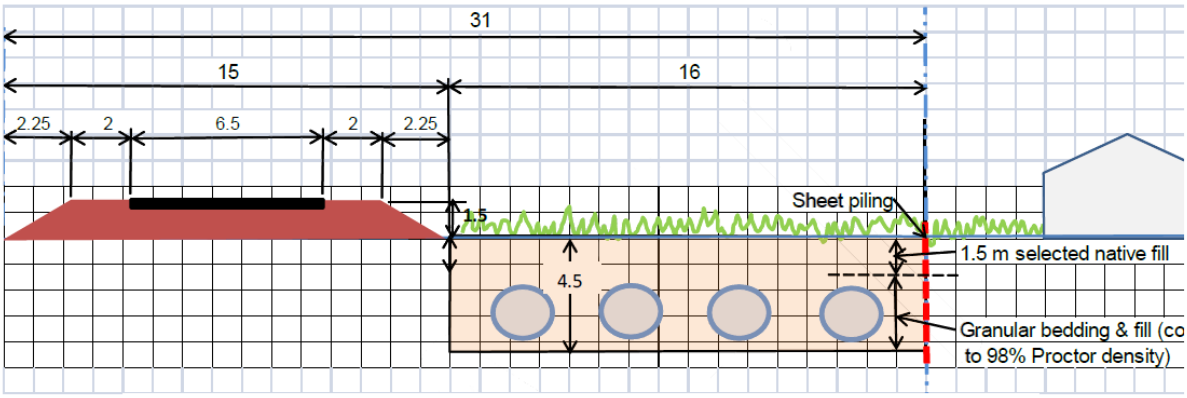


Figure 3.3 Transmission line – Intake to Dhaka-Sylhet Highway Junction

(iv) three lines of two plate settlers in parallel, each settler equipped with a scraper and desludging valves;
(v) three lines of eight rapid sand filtration units in parallel of the deep sand bed type, including air and water backwash facilities and a backwash water storage tank;
(vi) post-chlorination and lime solution dosing facilities;
(vii) three contact time reservoirs in parallel;
(viii) two common storage reservoirs in parallel; and
(ix) one treated water pumping station.

There will also be a storage tank and pumping facilities for backwash water before recycling. Backwash water will be pumped through the process after temporary storage for flow equalization. Sludge from the sedimentation, after preliminary thickening in the sedimentation tanks themselves, will be pumped to sludge-drying beds for final disposal.

3.3.5 Treated Water Mains

The water supply from the Gandharbpur WTP will serve the population, as listed in the following table:

Table 3.3: Water Supply from Gandharbpur WTP

Zone	Name	Population	%	Amount, MLD
04	Mirpur	537,300	36%	178
05	Gulshan	253,050	17%	84
08	Badda	536,621	36%	178
09	Uttara	179,907	12%	60
Total		1,506,878	100%	500

Treated water from Gandharbpur 1 WTP will be conveyed to the US Embassy injection point through one 2,000-mm pipe. This section will include (i) Gandharbpur WTP to Murapara Bridge (3 km), along the DWDB road; (ii) Sitalakhya River crossing by micro-tunneling method (0.5 km); (iii) the west bank of Sitalakhya River to Balu River through open paddy fields for a length of 4.5 km, wherein the pipes shall be accommodated within a 25 m-wide corridor through open paddy fields; (iv) Balu River crossing at Baraid by micro-tunneling for a length of 0.25 km; and (v) Balu River crossing to Vatara near US Embassy for a length of 6.5 km within the RoW of Raidhani Unnayan Kartripakhaya (RAJUK), a 100-ft road.

Further on, from the injection point, 1,000 mm-1,800 mm diameter feeder mains will be laid along major arterial roads, connecting at strategic points based on the Dhaka

water distribution model designed and operated for DWASA by Institute of Water Modeling (IWM) under the Design Management Consultants (DMC).

Detailed Topo-maps showing land plots and adjacent area along the project alignment and sites are reproduced in **Appendix-3**.

3.4 Project Activities and schedule

A detailed project schedule listing all the project activities or steps and schedule in the form of Gantt chart is presented in **Appendix-4.** The project activities related to package 1 that may produce environmental impacts or related to environmental issues can be listed below:

- Planning stage
  - Recruitment of DB Contractor
  - Survey Investigation for WTP at Gandharpur and pipe network
  - Preparation of EIA and obtaining Environmental Clearance
  - Preparation Resettlement Action Plan (RAP)
- Design Stage
  - Design Development for WTP at Gandharpur and pipe network
  - Incorporation of EIA recommendation to Design
  - Survey investigation including soil investigation
  - Implementation of land acquisition and RAP
- Construction Stage
  - Excavation and disposal of soil and debris
  - Relocation of utilities and allocation of utilities for construction
  - Transportation and storage of construction material at site
  - Land acquisition
  - River training at intake location for construction of intake (if any)
  - Construction of intake
  - Construction of water treatment plant
  - Construction of pump and layout of pipes
  - Construction of road along the pipe
  - Construction of bridge, culvert and other water regulating structures
  - Construction of other infrastructures
  - Supplies of utilities
  - Implementation of EIA recommended mitigation measures
  - Environmental monitoring
- Testing and commissioning of the treatment plant, pump station and pipe
- Operational stage
  - Uptake of water form Meghna River
- Environmental monitoring

3.5 Resources and Utilities demand

Existing power sources can be used in intake and WTP sites for power requirements for electro-mechanical work. The contractor may arrange for portable power

generator for works requiring power supply in the pipeline construction.

Pumping station shall be able to operate 24 hours without disruptions. All pumping stations shall have a primary power supply and a back-up power supply. In the feasibility study it is assumed that primary power supply comes from public grid with a back-up system of diesel generators ensuring a swift changeover with interruptions of minor durations (5-10 minutes).

Existing road network and the navigation facilities will be used to transport construction materials and equipment to Intake, WTP and pipe construction sites.

The contractor will arrange for water used in construction sites and labor-sheds from existing stream network and by installing STW for GW.

Construction of the road will require lot of earth filling. The contractor will arrange for the bulk material (earthwork) by sand-mining from existing streams or will get the earth by direct purchase from land owners.

Failure of components

There is always a risk of failure of individual components in pumping stations and treatment plants. The impact of such failure can be minimized through:

- Redundancy of components and systems (stand-by pumps, redundancy of power supply).
- Use of high quality components from manufacturers with known history for quality.
- Availability of spare parts
- Well-trained and efficient Operation and Maintenance organization.

4 BASE LINE/ EXISTING CONDITION

4.1 Introduction

As part of the Environmental Impact Assessment (EIA) of the project, an environmental baseline survey was carried out in areas surrounding the project site. The specific objectives of the baseline study were to gather information on the existing physical environment, biological-ecological environment and socio-economic environment of the areas in and around the project site; to gather and assess peoples' perception on different aspects of the proposed project in and around the project area. The baseline survey report provides a detailed description of the existing conditions of physical, biological as well as socio-economic environment in and around the project area.

This Chapter describes the existing physical environment of areas in and around the project site based on the baseline survey and other studies (e.g., water quality, air and noise level measurements) carried out as a part of the present study. Relevant information on climate, topography and drainage, geology and soils, hydrology and water resources, air quality, noise level, and water quality have been described in this Chapter.

4.2 Project Location

The package 1 of the project is Raw water intake at the Meghna river with structure with 2000 MLD capacity along with 22 km Raw water pipe line and new WTP at Gandharbpur having capacity 500 MLD. The project location is shown in Figure 4.1.

The intake structure will be designed for the full design capacity of 2,000 MLD in year 2030. The intake structure will receive raw water from the Meghna River, and the water will flow by gravity to the pump sump in the pumping station, located near the riverbank. The intake structure and the pump station shall be designed for the 100-year flood level and 50-year low levels in Meghna River. The intake structure

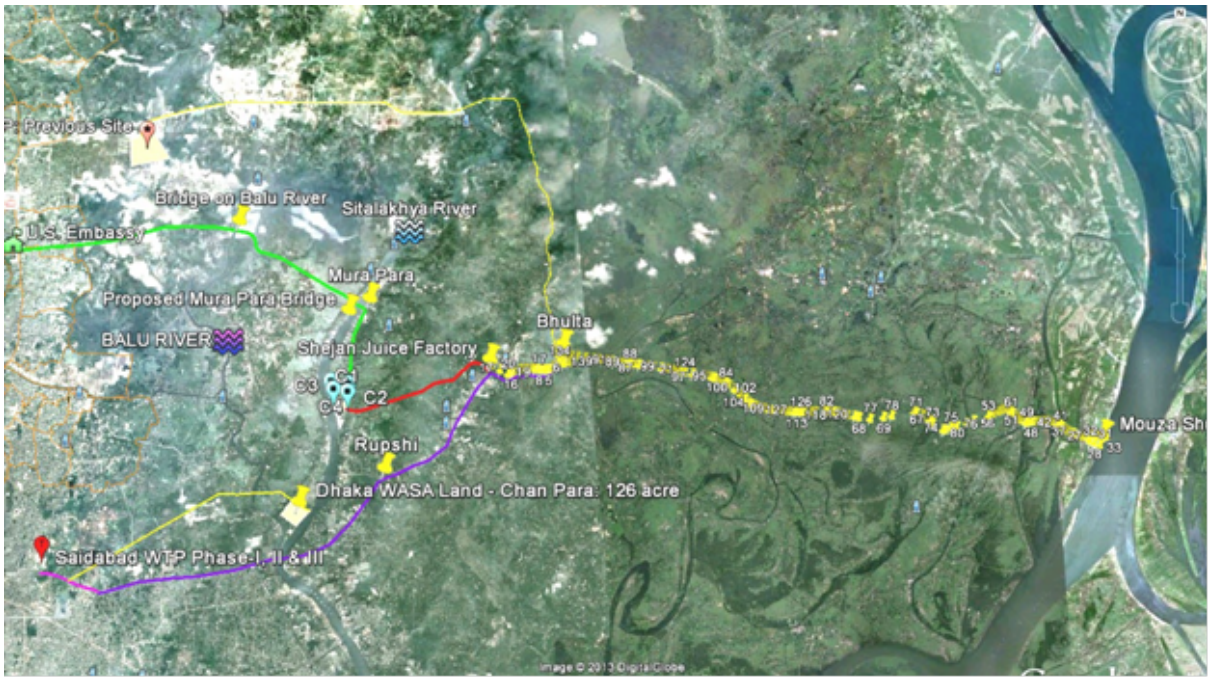


Figure 4.1: Project Location showing intake at Bishnondi, Meghna River to Gandharpur treatment plant (Source: Feasibility Study, 2011)

serves as a pre-sedimentation chamber to settle larger particles. A pre-chlorination facility is also included in order to avoid organic growth in the transmission line. Coarse/Rough and fine screens will be included in the intake structure and at the inlet to the pump sump for removing coarse and fine suspended materials.

In Feasibility Study, the proposed abstraction accounts from Meghna River for only 0.6% of the lean flow for 2035, and about 0.2% of the maximum flow for 2035. These levels of abstraction are within the safe levels of the river and will not adversely impact downstream uses or adversely impact the ecological flows of the Meghna River.

Baseline is prepared considering the project activities and their possible impact on the physio-chemical and biological environment as follows:

Table 4.1: Project activities and their possible impact

Activities	Possible impact
Design Stage	
Design Development for WTP at Gandharbpur and pipe network	Social impact
Incorporation of EIA recommendation to Design	Social impact
Survey investigation including soil investigation	Social impact
Implementation of land acquisition and RAP	Social impact
Construction Stage	
Excavation and disposal of soil and debris	Impact on soil and water
Relocation of utilities and allocation of utilities for construction	Impact on soil and water
Transportation and storage of construction material at site	Impact on air, water and soil
Land acquisition	Social impact
River training at intake location for construction of intake (if any)	Impact on river flow and ecological
Construction of intake	Impact on river flow and ecological
Construction of water treatment plant	Impact on noise, air, water and soil
Construction of pump and layout of pipes	Impact on noise, air, water and soil
Construction of road along the pipe	Impact on noise, air, water and soil
Construction of bridge, culvert and other water regulating structures	Impact on noise, air, water, soil and ecological
Construction of other infrastructures	Impact on noise, air, water, soil and ecological
Supplies of utilities	Impact on noise, air, water and soil
Testing and commissioning of the treatment plant, pump station and pipe	Impact on noise, air, water and soil
Operational stage	
Uptake of water form Meghna River	Impact on river flow and ecological

4.3 Baseline: Climate

Bangladesh is located at the central part within the Asiatic monsoon region where the climate is tropical. Relatively small size of the country and generally low-lying

area cause moderate variation in terms of temperature, precipitation, relative humidity and wind speeds.

The region has a tropical 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.

Different meteorological data like rainfall, temperature, relative humidity and wind speeds are described in the following sub-sections.

4.3.1 Precipitation

The general pattern of precipitation (which consists entirely of rain) follows the monsoon pattern with the cooler, drier months of November to March, increasing rains in April and May and highest rainfall in the summer months of June to September when the prevailing wind direction from the southwest brings moisture laden air from Bay of Bengal. Average monthly rainfall values for the study area are given in Table 4.2 and Figure 4.2.

Table 4.2: Rainfall characteristics of the study area, 1990-2004

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Average rainfall (mm)	7	23	54	129	273	402	440	361	279	163	38	7	2176
Average rainy day per month	2	2	5	9	14	18	23	21	17	9	3	0	123

Source: Bangladesh Meteorological Department; Bangladesh Water Development Board

4.3.2 Ambient Air Temperature

The temperature of the country has the relationship with the period of rainfall. In general, cool seasons coincide with the period of lowest rainfall. Table 4.3 And Figure 4.3 shows the monthly average mean, maximum and minimum temperature along with average monthly evaporation of the project area. Maximum average temperature of 28.7°C was observed in May and minimum average temperature was 18.7°C in January.

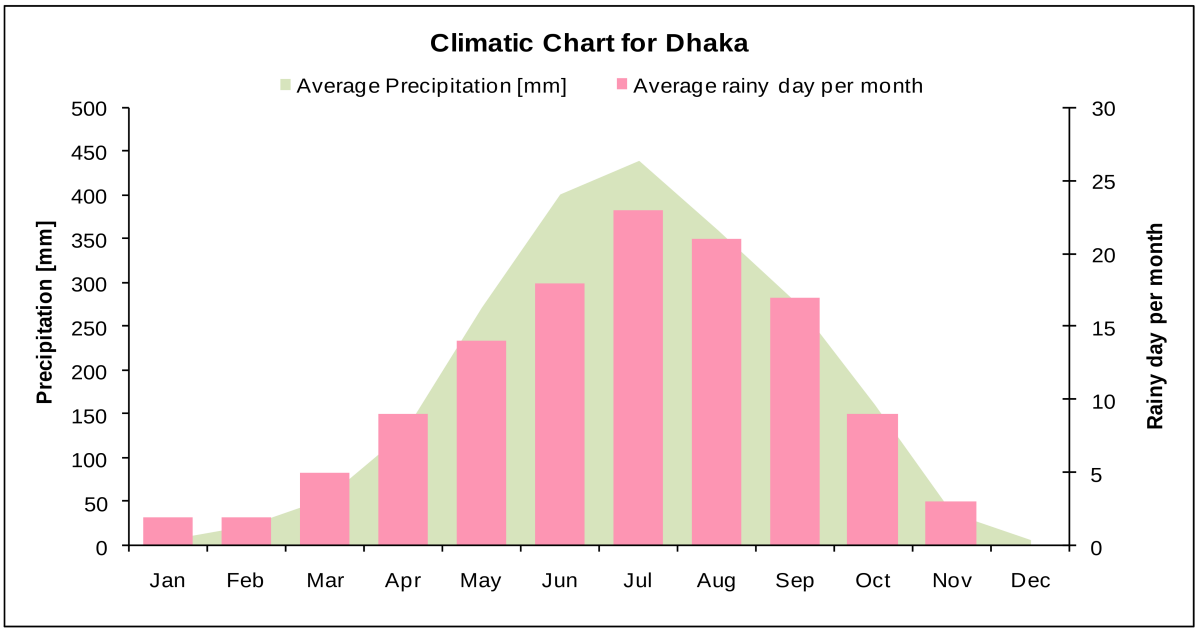


Figure 4.2: Monthly average rainfall and rainy days(Source: BCA, 2005)

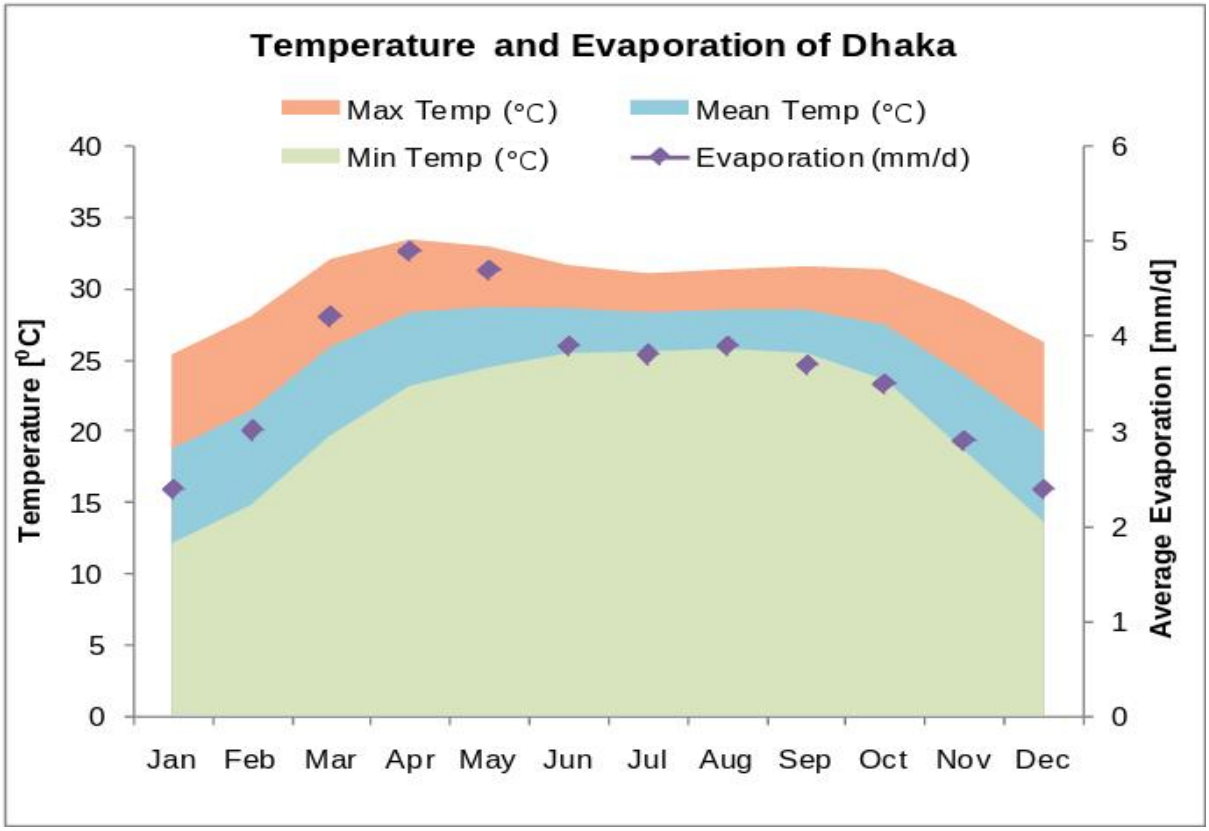


Figure 4.3: Monthly temperature profile and average evaporation

Table 4.3: Temperature and evaporation for project area, 1990-2004

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
Mean Temp (°C)	18.7	21.4	25.9	28.3	28.7	28.6	28.3	28.5	28.5	27.4	23.9	19.9	25.7
Max Temp (°C)	25.3	28.0	32.0	33.4	32.9	31.6	31.0	31.3	31.5	31.3	29.1	26.2	30.3
Min Temp (°C)	12.1	14.8	19.7	23.2	24.5	25.5	25.6	25.8	25.5	23.6	18.6	13.6	21.0
Evaporation (mm/d)	2.4	3.0	4.2	4.9	4.7	3.9	3.8	3.9	3.7	3.5	2.9	2.4	3.6

Altitude: 8 meter(s) above MSL; Source: BCA 2005

The project consists of a river intake & pumping station to draw raw water from Meghna river, pipelines to carry that water to a water treatment plant, the treatment plant and the delivery mains to the Dhaka water supply network.

4.4 Baseline: Soils

Land profile from Demra to Bishnondi at the intake point along the proposed pipe line alignment is shown in the figure. It shows that average elevation of the land is in between 3-4 m above Mean Sea Level (MSL).

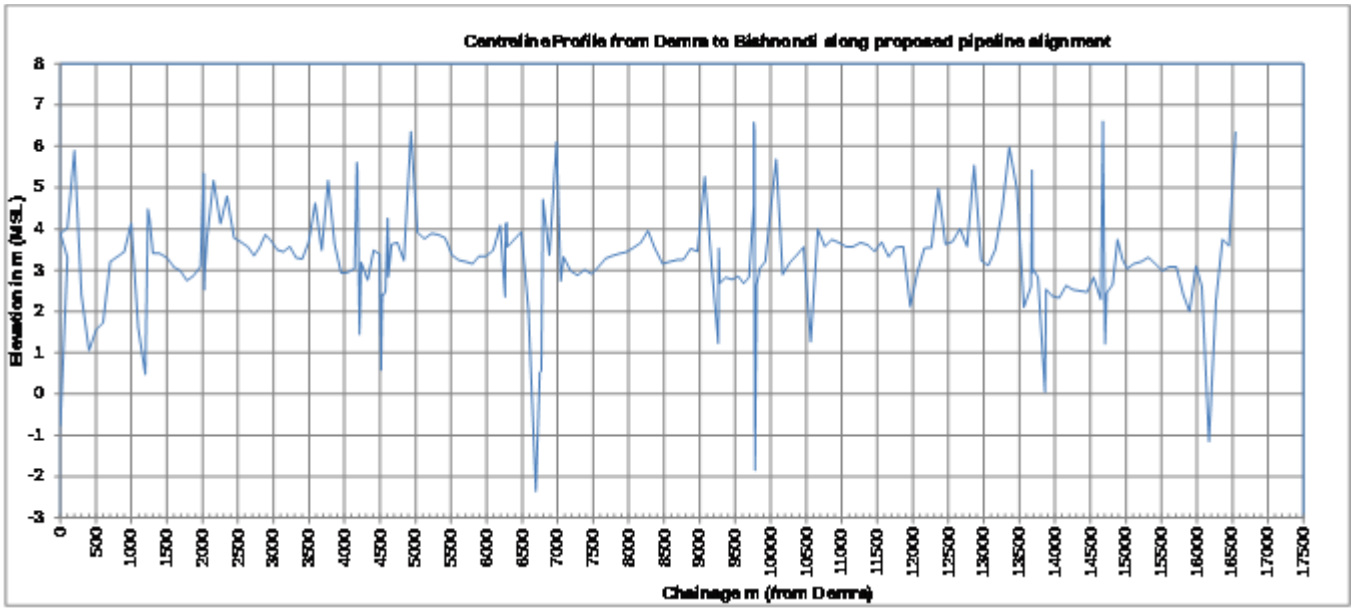


Figure 4.4: Land profile from Demra to Bishnondi along proposed alignment of pipeline
Source: GPS DATA WGS 84

The proposed site is a part of the mid-lower Ganges-Brahmaputra River floodplain as per the national classification. In this region, the soil is predominantly silty with silty loams on ridges and silty clay loams in depressions.

Since the treatment plant is proposed to be constructed on low land, earth filling will be required to raise the height of the plinth above the flood level.

A detailed geologic profile along the pipe-line is provided in **Appendix-5**.

Earthquakes

Dhaka is located in a seismic zone II[5], referred to as the medium risk zone for earthquake. In the medium risk zone, shocks of moderate intensity are possible, with a probable maximum magnitude of 6-7 on the Richter scale. Seismic events in Bangladesh are relatively infrequent, but historically, have been severe, such as the earthquakes of 1930 and 1950 that caused widespread damage throughout the country, and the earthquake of 2004 that damaged large parts of Dhaka City. To address any potential impacts due to seismic activities, provisions of the Bangladesh National Building Code (BNBC) 1993 and 2006 shall be strictly followed in the detailed designs of project components, apart from consideration of seismic vulnerability in the specifications for the design and construction of the works, including the choice of pipe materials and pipe-laying methods for the transmission

5 The National Seismic Zoning Map produced by the Geological Survey of Bangladesh (GSB) divides the country into three regions: i) a high-risk zone between Mymensingh and Sylhet in the north and northeast; ii) a medium-risk zone stretching diagonally from Rajshahi in the northwest through Dhaka and Comilla to Chittagong and Cox's Bazar in the southeast; and iii) a low-risk zone in the south and southwest, around Khulna and Barisal.

mains.

4.5 Baseline: Hydrology and Water Resources

4.5.1 Surface Water Resources

River Network

The main river related with the project is Meghna. The river system in the Dhaka watershed includes Dhaleswari, Turag, Tongi Khal, Buriganga, Balu, Bangshi, and Sitalakhya Rivers. Dhaka is primarily surrounded by three rivers: Buriganga on the southwest, Turag in the northwest, and Balu in the northeast. The Sitalakhya River flowing by the southeastern part of Greater Dhaka is also included in the surrounding river system. There are more than 40 canals within the city that were originally used for drainage.

Dhaka region is in the natural floodplain of the various rivers in the area, and functioned as an important breeding ground for many aquatic species in the past. This function is still evident in the seasonal flooding that affects large parts of the city. The floodplain function has been further degraded by the construction of embankments to protect the city from flooding, and particularly from infilling to reclaim land, which reduces the water retention capacity of these areas and increases flooding both upstream and downstream.

Due to encroachment and disposal of solid and liquid wastes into these canals, several areas of the city have become vulnerable to water logging. All the rivers receive untreated sewage and industrial liquid wastes and municipal waste through the major canal systems, as well as from direct disposal. The surface water quality in the two river systems and other surface.

Water bodies, e.g. khals and ponds, have very high biological oxygen demand (BOD), chemical oxygen demand (COD), and E-coli content, indicating discharge of untreated industrial effluents and domestic sewage. The organic pollution of the rivers is compounded by the poor state of sewerage and sanitation systems of the Dhaka urban area.

The most polluted water bodies are the Buriganga and Sitalakhya Rivers, Tongi Khal, and the canal system in Dhaka East, where very low dissolved oxygen levels of 1.5~4 mg/l reflect contamination caused by organic waste, domestic sewage, and chemical residues from factories. These water bodies are almost biologically dead during the dry season. The high BOD levels of 10~30 mg/l in the Buriganga and Sitalakhya Rivers (the standard BOD is 6 mg/l) reflect mainly the high density of untreated industrial wastewater discharged into the rivers. Some tidal backflow of relatively clean water from the Meghna and Dhaleswari Rivers results in dilution of contaminants in the southern reaches of both the Buriganga and Sitalakhya Rivers, to a limited extent. The high ammonia levels, particularly in the canal system in Dhaka East, the Balu River, and the southern reaches of the Buriganga River reflect the discharge of sewage into these waterways. Ammonia in Dhaka East area increases from 0.3 mg/l in October to more than 20 mg/l in March-April, almost 20 times higher than the national environmental quality standard (1.2 mg/l).

Given the high pollution levels in the Dhaka rivers, in line with the provisions of the ECA 1995 (Section 5)[6], through a gazette notification dated 1 September 2009, the

6 Section 5 of ECA, Declaration of Ecologically Critical Areas, specifies that (1) if the government is satisfied that, due to degradation of environment, the ecosystem of any area has reached or is threatened to reach a critical state, the government may, by notification in the official gazette, declare such area as ecologically critical. Further, (2) the government shall specify, in the notification provided, which operations or processes shall not be carried out or initiated in the ecologically critical area.

High Court declared the four rivers surrounding Dhaka, namely Buriganga, Turag, Balu, and Sitalakhya, as ecologically critical areas. Subsequently, pollution-creating activities detrimental to the water and aquatic life in those rivers have been declared forbidden.

The proposed treated water mains from the Gandharbpur WTP cross Sitalakhya at Murapara and the Balu River along the RAJUK road leading to the US Embassy. There is no management plan prepared for the four rivers of Dhaka, and specific protocols or management actions for taking up infrastructure activities around these rivers have not been laid down. While no specific clearance requirements exist for interventions/activities around these four rivers, it was explained that control of pollution, hunting, disposal of wastes, etc. were to be taken care of by project proponents. Accordingly, projects shall incorporate specific measures in addition to adoption of good engineering and construction practices so as to ensure that there is no significant impact on the watercourses.

Hydrological consideration

Based on data taken at Bairab Bazar (approximately 20 km upstream from Bisnondi) gauging station from year 2000 to 2009, it was possible to carry out an approximate statistical determination of the flows in Meghna as

Q95= 3815 m^3/s

Q05=11630 m^3/s

Q50= 4037 m^3/s

The highest recorded flow in Meghna was reported in 1988 as 19500 m^3/s at Baairab Bazar. It has been reported that low flows during dry season may reach 2500 m^3/s.

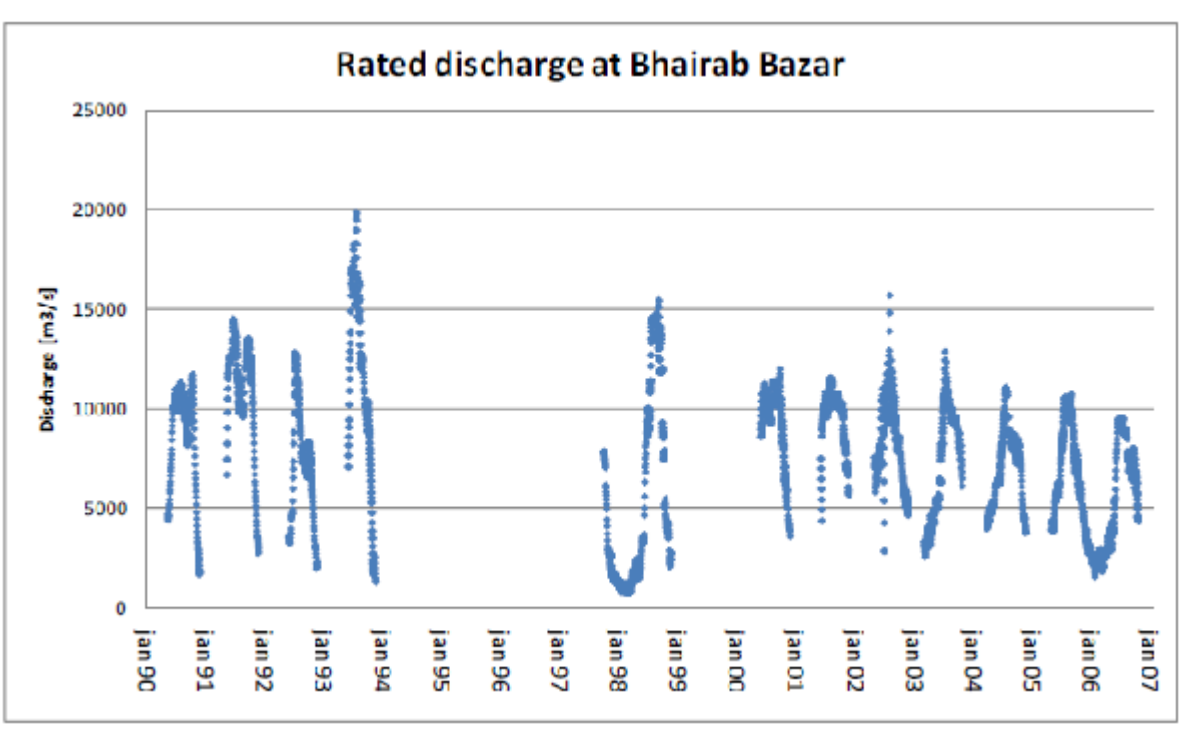


Figure 4.5: Rated discharge at Bhairab Bazar (approximately 20 km upstream from Bisnondi)

Source: BWDB

The analysis of the water level data (1999-2009) obtained from BWDB Gauge station at Meghna River Narsingdi (2 km upper than Bishnandi) is shown in the following figures (Figure 4.6 and Figure 4.7) for high tide and low tide.

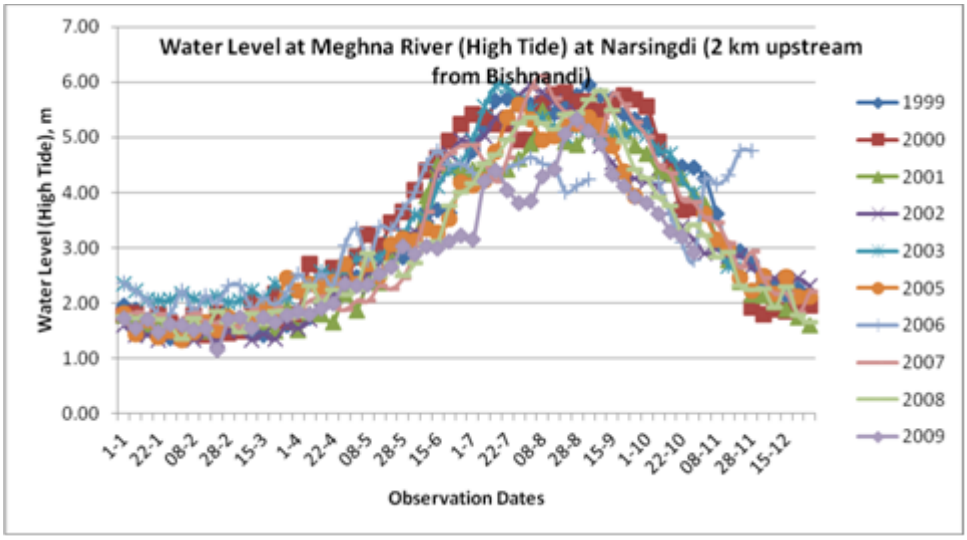


Figure 4.6: Temporal Water level data for high tide at Narsingdi (2 km u/s of Bisnandi)

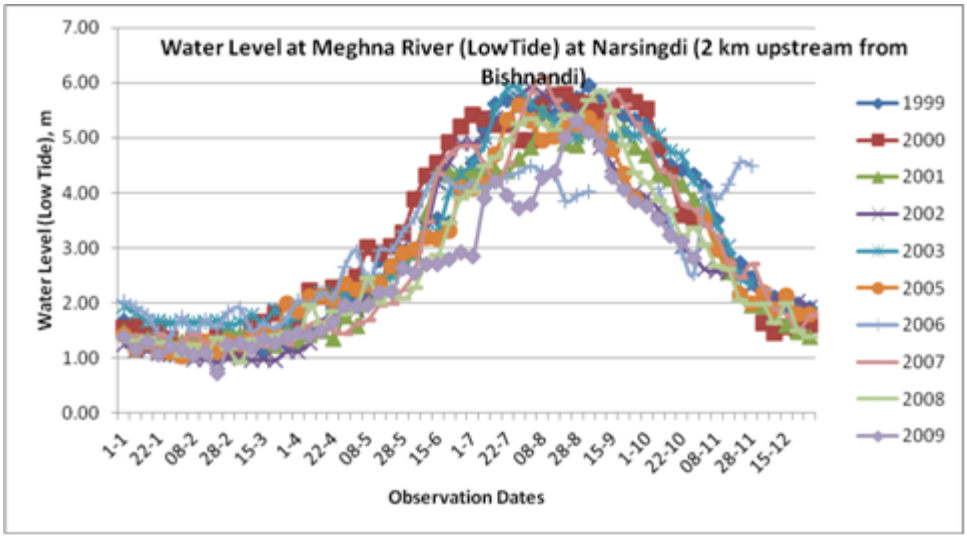


Figure 4.7: Temporal Water level data for low tide at Narsingdi (2 km u/s of Bisnondi)

Source: BWDB

Since there are no water level measurements at Bishnondi on the Meghna the water level variation has been obtained in the Feasibility Study from the General Model (MIKE11 model) of Bangladesh available at IWM. The model has been run for a period of 20 years, from 1987-2006 using topography and calibration data from 2000. The model is calibrated/validated from year to year. However, when running a long continuous period, a single set of model parameters is used. This means that the model results may be less accurate in some years than in others. Moreover, the model has results stored at daily intervals, wherefore the minimum water levels will not be accurate since these are tidally influenced.

Despite of these deficiencies it is necessary for design purposes to apply maximum and minimum water levels with 50-year and 100-year return period. Such values have been derived from the model results. The 50-year and 100 year maximum have been determined to be 7.75 m and 8.20 m respectively. The 50-year and 100-year minimum have been determined to be 1.18 m and 1.07 m respectively. The statistical

method applied is most promising for the maximum determination, and less good for the minimum prediction. The latter is due to the tidal influence on the water level during the dry season. It should be emphasized that the data behind the analysis stem from a mathematical model which is only partly calibrated, thus the actual values may in reality vary.

The water levels in the Meghna vary approximately 4-5 metres throughout the year. This has significant impact on the shape of the river channels and the stability hereof. The variation in water level in two distinct seasons, dry and wet season, means that a clear dry season and a wet season channel can be identified along the rivers. One effect of this is that the bed shear stress in the vicinity of the banks during the wet season is larger than if the channel was u-shaped. Another effect is that the wet season banks are not as high as if the rivers have u-shaped cross sections.

4.5.2 Groundwater Resources

Water aquifers are present beneath the vast majority of Bangladesh, which are being recharged by the major river systems and by infiltration of rainwater. Most ground water is available within 5 m of the surface. This level fluctuates seasonally, approaching the ground surface over most of the country during the months July to September.

Local ground water represents a stable source of water for various activities including irrigation (both shallow and deep tube wells), domestic purposes (hand pumps) and industrial applications (deep tube wells).

The local groundwater level is lowered to approximately 6 m below ground level during the dry seasons, with levels returning to their normal position before the end of the monsoon. This fall in ground levels is an entirely natural process that arises because of the hydrological link with the river.

There are three main aquifers in the central region of Bangladesh, where the Dhaka City region is located:

i) an upper (composite) aquifer, which can reach depths of 50 m and is covered with an upper silty clay layer of less than 20 m;
ii) a middle (main) aquifer of fine to heavy sands, which is generally 10-60 m deep, and in most areas is hydraulically connected with the composite aquifer above; and
iii) a deep aquifer of medium, medium-to-fine, or medium-to-coarse sand, which is generally found at depths below 100 m.

In Dhaka region, about 80% of the domestic water supply is obtained from the middle aquifer, extracted by tube wells throughout the city. Recent studies have shown that water levels have fallen dramatically, and suggest that the aquifer may be changing from a confined to an unconfined condition, which could make it vulnerable to contamination. The groundwater quality is slightly acidic, the high nitrate content exceeding the permissible limit of the prescribed environmental quality standards.

Extraction of groundwater is presently from the upper Duptilia aquifer and the lower Duptilia aquifer under Dhaka city. DWASA operates approximately 550 deep wells and in addition to this there are approximately 1300 private wells. As of June 2009, groundwater constituted about 87% of the total water supply by DWASA. There are today approximately 550 DTW, extracting approximately 1640 MLD (sometimes reported as high as 1918 MLD). The water is being distributed in local networks (with smaller dimensions). These local networks are interlinked; however there is no overall transmission between areas in Dhaka.

The upper aquifer is in stressed condition and recharge is less compared to the abstraction, causing severe drawdown of groundwater table. It has been evaluated that the groundwater table is falling with 2-3 m/year As a result, according to ADB (2007) around 50% of DTWs in the upper aquifer will become inoperative by 2015 and groundwater production will reduce substantially.

The present existing groundwater extraction from the upper aquifer is approximately 600 -700 Mm^3/y (1648 -1918 MLD) and 44 Mm^3/y (120 MLD) in the lower aquifer. IWM has prepared a groundwater model and estimated that the existing water table in the upper aquifer will stabilize after 16 month if extraction is stabilized on 600 m^3/year (1650MLD).

The lower Duptila aquifer is currently exploited at 44 Mm^3/day (120 MLD) from 28 wells. Available IWM numerical modeling indicates that abstraction could be increased to 139 Mm^3/day from 94 boreholes if 4 hours recovery are permitted every day. There is some uncertainty about the safe extraction and the actual safe extraction from the upper and lower groundwater and a conservative approach has been taken in that study.

4.6 Baseline: Air Quality

Air quality in the Dhaka city and its neighboring areas is deteriorating with rapid urbanization and industrialization. In the rural areas however the ambient air quality is relatively good. During IEE stage air quality was monitored in 6 locations. Results are presented below:

Table 4.4: Ambient Air Quality (AAQ) Monitoring Locations

Sl. No.	Project Component	Monitoring location	Parameters
1	Intake Tetia village	Tetia village (along the access road)	(24-hour monitoring for 2 days at 7 locations) SPM $PM_{2.5}$ PM_{10} SO_2 NO_x CO
2	Transmission main – intake to Bhulta through agricultural fields	Village within 100m of the transmission main alignment	
3	Khilkhet	Residential complex	
4	Construction site of 300-ft road	RP constructions along 300-ft road (about 100m before Balu River)	
5	Transmission main – Bhulta to DND Canal	Along the highway, approx. 1 km from the junction	
6	Transmission main – DND Canal	KM 2 along the DND Canal towards Jatrabari	

Source: IEE report

Table 4.5: Ambient Air Quality Analysis

Sl.no	Location of Monitoring Point	$PM_{2.5}$ µg/m^3	PM_{10} µg/m^3	SPM µg/m^3	SO_2 µg/m^3	NO_X µg/m^3	CO mg/m^3
1.	Location – 1	50.28	125.815	191.285	4.01	8.765	1.0
2.	Location – 2	46.87	143.36	173.3	2.33	12.43	1.5
3.	Location – 3	**82.49**	**182.125**	**253.56**	3.65	31.24	4.5
4.	Location – 4	**79.56**	**175.925**	**282.93**	4.28	23.30	0.0
5.	Location – 5	**105.01**	**182.86**	**338.675**	5.17	46.33	7.5
6.	Location – 6	**116.74**	**202.045**	**401.84**	3.00	54.87	6.5
DoE (Bangladesh) Air Quality		65	150	200	120	100	10

Base line/ existing condition

Sl.no	Location of Monitoring Point	$PM_{2.5}$ $\mu g/m^3$	PM_{10} $\mu g/m^3$	SPM $\mu g/m^3$	SO_2 $\mu g/m^3$	NO_X $\mu g/m^3$	CO mg/m^3
Standards							

Source: IEE report

The present concentration is measured during EIA stage. It is observed that NO_x and SO_2 were found exceeded the DOE standard due to rapid urbanization and industrialization in nearby area (Table 4.6).

Table 4.6: Concentrations of air pollutants measured in Aug-2014 at the project site

Sl No.	Air Quality Parameters	Unit	Measured Concentration		DOE Standard (Revised 2005)
			Harina Point, Rupganj	Dayakanda, Shambupura	
1	SPM (PM_{10})	$\mu g/m^3$	-	25	200
2	CO_2	ppm	390	410	NYS
3	CO	ppm	9.6	7.6	35
4	NO	ppm	7.5	6.3	NYS
5	NO_2	ppm	0	0	NYS
6	NOx	ppm	1	1.1	0.053
7	SO_2	ppm	1.2	1	0.14
8	Temperature	^oC	31.2	31.4	NYS

NYS-Not Yet Set

4.7 Baseline: Noise level

4.7.1 General

Sound is transmitted through air when an object moves, like water flowing over rocks, or air passing through vocal cords. This movement causes air waves, similar to ripples in water. When these waves reach human ears, they are transformed into sound. Sound is usually measured in decibels (dB). A decibel is a relative measure that is accompanied by a reference scale. Technically, sound pressure is 20 times the logarithm (base 10) of the ratio of the pressure level of any sound to the reference sound pressure in decibels. Sound (noise) levels can be measured and quantified in several ways. All of them use the logarithmic decibel (dB) scale. The dB scale is logarithmic to accommodate the wide range of sound intensities found in the environment. Table 4.10 shows typical sound levels generated by common indoor and outdoor activities, along with its effect on human.

Baseline Noise Conditions

Existing ambient noise levels can serve as a baseline from which to measure potential disturbance caused by project activities.

Ambient noise was analyzed at IEE stage. Monitored results are presented below:

Table 4.7: Ambient Noise Level Monitoring Locations

S.No	Project Component	Monitoring Location	Land Use
1	Intake	Tetia village (along the access road)	Residential/agricultural
2	Transmission main - intake to Bhulta through agricultural fields	Village within 100 m of the transmission main alignment	Agricultural

S.No	Project Component	Monitoring Location	Land Use
3	Khilkhet	Residential complex	Residential
4	Construction site of 300-foot road	RP constructions along 300-foot road (about 100 m before Bhalu River)	Residential
5	Transmission main – Bhulta to DND Canal	Along the highway, approximately 1 km from the junction	Industrial
6	Transmission main – DND Canal	KM 2 along the DND Canal towards Jatrabari	Industrial / Commercial

Source: IEE report

Table 4.8: Ambient Noise Level Analysis in dB(A)

Noise Monitoring	Noise Levels in dB(A)					
	L_{eq} day	L_{eq} Night	L_{dn}	L_{10}	L_{50}	L_{90}
Location 1	69.7	58.0	66.4	67.5	66.4	65.2
Location 2	61.9	47.3	58.7	59.6	58.6	57.6
Location 3	71.7	61.2	68.4	69.5	68.3	67.2
Location 4	55.6	41.0	52.6	53.4	52.5	51.6
Location 5	60.8	49.9	57.7	58.6	57.6	56.7
Location 6	58.5	53.9	55.9	56.7	55.8	54.8

Source: IEE report

Table 4.9: Noise Quality Standards, by Zone and Time of Day

Zone Class	Limits in dB(A)	
	Daytime (6 am – 9 pm)	Nighttime (9 pm – 6 am)
Silent zone	45	35
Residential zone	50	40
Mixed (residential/commercial/industrial) zone	60	50
Commercial zone	70	60
Industrial zone	75	70

Source: Department of Environment (DoE), Bangladesh

Table 4.10: Sound levels and human response

Common Sounds	Noise Level (dB)	Effect
Rocket launching pad (no ear protection)	180	Irreversible hearing loss
Carrier deck jet operation; Air raid siren	140	Painfully loud
Thunderclap	130	Painfully loud
Jet takeoff (200 feet); Auto horn (3 feet)	120	Maximum vocal effort
Pile driver; Rock concert	110	Extremely loud
Garbage truck; Firecrackers	100	Very loud
Heavy truck (50 feet); City traffic	90	Very annoying Hearing damage

Common Sounds	Noise Level (dB)	Effect
		(8 hours)
Alarm clock (2 feet); Hair dryer	80	Annoying
Noisy restaurant; Freeway traffic; Business office	70	Telephone use difficult
Air conditioning unit; Conversational speech	60	Intrusive
Light auto traffic (100 feet)	50	Quiet
Living room; Bedroom; Quiet office	40	Quiet
Library/soft whisper (15 feet)	30	Very Quiet
Broadcasting studio	20	Very Quiet
	10	Just audible
Threshold of hearing	0	Hearing begins

Source: Davis and Cornwell (1998)

The present noise level at EIA stage was monitored at two locations. It is observed that two areas were found to be within the standard of DOE residential area.

Table 4.11: Measured ambient noise level

Sl No.	Noise	Unit	Measured Concentration (dB)		DOE Standard (Revised 2005)
			Harina Point, Rupganj (intake point)	Dayakanda, Shambupura	
1	Ambient Noise (Day)	dB	50±1	45±2	50

4.7.2 Noise Generation, Transmission, and Reduction

Noise Sources

Sound is a pressure wave that decreases over distance from the source. Noise attenuation is typically described as a set reduction in decibel level per doubling of distance from the source. Depending on the nature of the noise source, sound propagates at different rates. Measures of sound level from a source should specify the distance from the source. The standard reference distance for sound levels at the source is 50 feet. The two most common types of noise are point source and line source. These are discussed in more detail below.

Point Source Noise

Point source noise is associated with noise that remains in one place for extended periods of time, such as with construction activities. A few examples of point sources of noise are pile drivers, jackhammers, rock drills, or excavators working in one location. Noise from a single traveling vehicle is also considered point source noise. Point source noise is commonly measured in peak decibel levels, or the highest value of a sound pressure over a stated time interval. Noise from a point source spreads spherically over distance where the wave spreading creates a dome effect, traveling in all directions equally from the source. The standard reduction for point source noise is 6 dB per doubling of distance from the source.

Line Source Noise

Line source noise is generated by moving objects along a linear corridor. Highway traffic is the best example of line source noise. Line source noise levels are measured as an average over time rather than peak levels measured in point source noise. Noise from a line source spreads cylindrically, spreading outward along the length of a line. The standard reduction for line source noise is 3 dB per doubling of distance from the source (compared to 6 dB for point source noise).

Noise Reduction Factors

Natural factors such as topography, vegetation, and temperature can further reduce noise over distance. This section covers a few of the common factors and their applicability in increasing the noise reduction per doubling of distance from the source.

Hard Site versus Soft Site

A hard site exists where sound travels away from the source over a generally flat, hard surface such as water, concrete, or hard-packed soil. These are examples of reflective ground, where the ground does not provide any attenuation. The standard attenuation rate for hard site conditions is 6 dB per doubling of distance for point source noise and 3 dB per doubling of distance from line sources.

When ground cover or normal unpacked earth (i.e., a soft site) exists between the source and receptor, the ground becomes absorptive to sound energy. Absorptive ground results in an additional noise reduction over distance of 1.5 dB per doubling of distance. Added to the standard reduction rate for soft site conditions, point source noise attenuates at a rate of 7.5 dB per doubling of distance, and line source noise decreases at a rate of 4.5 dB per doubling of distance.

Topography, Vegetation, and Atmospheric Factors

A break in the line of sight between the noise source and the receptor can result in a 5 dB reduction. Dense vegetation can reduce noise levels by 5 dB for every 100 feet of vegetation, up to a maximum reduction of 10 dB (USDOT, 1995). Atmospheric conditions can also affect the rate of sound attenuation. Sound travels farther during periods of higher humidity and also in colder temperatures. Wind can reduce noise levels by as much as 20 to 30 dB at long distances (USDOT, 1995). The influences of vegetation, topography, and atmospheric conditions as noise reduction factors can vary greatly and are often impossible to quantify. Therefore, these factors are generally not taken into account in environmental noise analysis, which likely results in predicted noise levels that are higher than actual noise levels.

Environmental Conditions

Baseline (ambient) noise levels vary greatly and depend on site-specific factors. Environmental factors can elevate baseline noise near the source, masking construction noise. The same environmental factors occurring near the receptor can change the receptor’s perception of how loud construction noise is, or hide it completely.

Weather conditions such as wind or rainfall can increase baseline noise. Locations near rivers or streams have higher baseline noise levels as well. As with the atmospheric conditions described above, these environmental factors are variable and may be impossible to quantify, so they are rarely taken into account in noise models. If no record is available with concerned authorities a baseline condition may be established by performing onsite noise measurements with a hand-held noise meter.

Traffic Noise

Identifying the amount and type of traffic helps to determine the baseline (ambient) noise conditions. The level of highway traffic noise depends on the volume of traffic, the speed of the traffic, and the volume of trucks in the flow of traffic (USDOT, 1995). Generally, the loudness of traffic noise is increased when traffic is heavier, when traffic speed is increased, and when a greater proportion of the traffic flow is heavy trucks. For traffic volume, 2,000 vehicles per hour sounds twice as loud as (or is 10 dBA higher than) 200 vehicles per hour (USDOT, 1995). As stated earlier, a noise that is increased by 10 dBA sounds twice as loud to the listener. Vehicle noise is a combination of noises produced by engines, exhaust, and tires. The loudness of traffic noise can also be affected by the condition and type of roadway, road grade, and the condition and type of vehicle tires. Predictions of noise from vehicles are usually based on reference energy mean emission levels, which correspond to the noise level expected from a single vehicle at the standard 15m distance.

Construction Noise

One of the easiest things to identify and one of the hardest things to quantify is noise associated with the actual construction of the project. How much noise will construction activities generate, how often will it occur, and how long will it last are all questions that should be answered in the assessment. This section provides an introduction to equipment noise characteristics that might be expected for typical construction projects. Construction is usually performed in a series of steps or phases, and noise associated with different phases can vary greatly. However, similarities in noise sources allow typical construction equipment to be placed into one of three categories: heavy equipment, stationary equipment, or impact equipment.

Heavy Equipment

Heavy equipment can be defined as earth-moving equipment, such as excavating machinery like excavators, backhoes, and front loaders, as well as handling equipment like graders, pavers, rollers, and dump trucks. Noise levels at 50 feet from heavy equipment range from about 72 to 97 dB (Table 4.12). These numbers were identified from several studies, and represent the range of reported values. During the phase of construction using heavy equipment, noise is generated more or less at a constant level. Therefore, noise levels can be equated to an average hourly level.

Table 4.12: Noise ranges at 50 feet from common construction equipment

Equipment	dBA	Equipment	dBA
Heavy trucks (avg.)	82 – 96	Backhoe (avg.)	72 – 90
Grader (avg.)	79 – 93	Paver (+grind) (avg.)	85 – 89
Excavator (avg.)	81 – 97	Front loader (avg.)	72 – 90
Crane (avg.)	74 – 89	Generator (avg.)	71 – 82
Pile driver (peak)	81 – 115	Jackhammer/rock drills (avg.)	75 – 99
Concrete mixer (avg.)	75 – 88	Roller (vg.)	72 – 75
Compressor (avg.)	73 – 88	Pumps (avg.)	68 – 80

Sources: Western Highway Institute (1971)

Stationary Equipment

Stationary equipment such as pumps, power generators, and air compressors generally runs continuously at relatively constant power and speed. Noise levels at 50 feet from stationary equipment can range from 68 to 88 dB, with pumps typically

in the quieter range. An averaged noise level may be assumed for stationary equipment because of its fixed location and constant noise pattern.

Impact Equipment

This category includes pile drivers, jackhammers, pavement breakers, rock drills, and other pneumatic tools where a tool bit touches the work. The noise from jackhammers, breakers, rock drills, and pneumatic tools comes from the impact of the tool against the material. These levels can vary depending on the type and condition of the material. Noise levels at 50 feet from impact equipment, including jackhammers and rock drills, can range from 75 to 99 dB. An impact pile driving hammer is a large piston-like device that is usually attached to a crane. The power source for impact hammers may be mechanical, air steam, diesel, or hydraulic.

In most impact drivers, a vertical support holds the pile in place, and a heavy weight, or ram, moves up and down, striking an anvil that transmits the blow of the ram to the pile. In hydraulic hammers, the ram is lifted by fluid, and gravity alone acts on the down stroke. Vibratory hammers can also be used on projects. A vibratory pile driving hammer has a set of jaws that clamp onto the top of the pile. The pile is held steady while the hammer vibrates the pile to the desired depth. Because vibratory hammers are not impact tools, noise levels are not as high as with impact pile drivers. However, piles installed with a vibratory hammer must often be proofed, which involves striking the pile with an impact hammer to determine its load-bearing capacity, possibly with multiple impacts. In this case, noise is elevated to levels associated with impact pile driving.

The highest in-air noise from pile driving results from the impact of the hammer dropping on the pile, particularly when hollow steel piles are used. Noise assessments by USDOT have documented peak levels of 110 dB and 105 dB, 50 feet away from driving steel piles. Although stationary equipment noise and heavy equipment noise can be averaged over a period of time, pile driving noise consists of a series of peak events. Generally, noise from pile driving has been reported at peak levels. Therefore, it is usually assumed that noise at the highest levels documented is commonly generated by pile driving. For the purposes of this assessment, 110 dB is the best descriptor of typical peak noise levels associated with pile driving.

4.8 Baseline: Water quality

For establishing baseline condition with respect to water quality, surface water and groundwater quality were established.

4.8.1 Surface water quality at Meghna River

Water quality monitoring of Meghna River at the proposed intake location at Bishnondi was carried out as part of the FS. The results are presented in Table 4.13 and Table 4.14. The water quality survey comprised three parts, as per below.

i) Survey of seasonal variation:

a) Monthly samples: June and July 2010
b) Weekly samples: The weekly basis sampling periods were March, April, and May 2010.
c) Field test analysis: The following test parameters were analyzed: temperature, pH, conductivity, turbidity, dissolved oxygen (DO), ammonia, and H_2S, using portable instruments.

ii) Survey for special pollutant:

d) One sample was collected from each point in the wet season in July 2010, and one sample was collected during the dry season in April 2010.

e) The following parameters were analyzed: nitrate (NO_3), COD, phosphate, aluminium, barium, chromium (hexavalent), cadmium, lead, mercury, zinc, arsenic, chloride, sulfate, fecal coliform, total suspended solids (TSS), total dissolved solids (TDS), hydrogen sulfide, pesticide, and TOC in the laboratory.

iii) Survey for daily variation:

f) Hourly sampling and analysis were conducted once at each sampling location, both in the dry season (March 2010) and the wet season (July 2010).

g) Field test analysis: The following parameters were analyzed: temperature, pH, conductivity, turbidity, dissolved oxygen (DO), ammonia, and H_2S using portable instruments.

Table 4.13: Surface Water Quality–Meghna River

Sl. no	Parameter	Units	Monitoring Location	
			Bishnondi (M1)	Baidder Bazar (M2)
1.	Temperature	C	30.2	29.9
2.	pH		7.55	7.4
3.	Conductivity	µs/cm	108.95	109.07
4.	Dissolved oxygen (DO)	mg/l	5.9	5.95
5.	Turbidity	NTU	28.025	24.625
6.	Ammonia (NH_4)	mg/l	0.38	0.375
7.	Nitrate (NO_3)	mg/l	0.45	41.65
8.	Chemical oxygen demand (COD)	mg/l	6.0	14.0
9.	Phosphate (PO_4)	mg/l	0.09	0.07
10.	Aluminum (Al)	mg/l	<BDL>	<BDL>
11.	Barium (Ba)	mg/l	<BDL>	<BDL>
12.	Chromium (Cr)	mg/l	0	0.005
13.	Cadmium (Cd)	mg/l	<BDL>	<BDL>
14.	Lead (Pb)	mg/l	<BDL>	0.02
15.	Mercury (Hg)	mg/l	0	0
16.	Zinc (Zn)	mg/l	0.045	0.055
17.	Arsenic (As)	mg/l	0	0
18.	Chloride (Cl)	mg/l	5.5	7.5
19.	Sulfate (SO_4)	mg/l	9	10.5
20.	Fecal coliform (FC)	CFU/100 ml	101	433
21.	Total suspended solids (TSS)	mg/l	8.0	14
22.	Total dissolved solids (TDS)	mg/l	143	73.5
23.	Hydrogen sulfide (H_2S)	mg/L	0.005	0.01

Source: Feasibility Report, 2011.

All the water quality parameters are observed to be well within the stipulated standards of inland water quality. The increase in DO concentration indicates the presence of organic pollution at M1 and M2, and the increase in nitrate concentration at M2 can be attributed to agricultural run-off.

The current water quality parameters indicate low levels of pollution, which can be attributed to absence of any major pollution sources upstream along the Meghna, coupled with dilution factors of the river system. However, given the need for sustained protection of the water source, adequate protection measures and planning of upstream developments need to be implemented through inter-agency coordination.

Water quality monitoring is going on in different points in Meghna river. Test Results at Bisnandi (4 dates ;Feb 15, 22 March 01 & 08 , 2014, samples collected by the existing DWASA water monitoring contractor and at Baidder Bazar intake, Haria, Sonargaon, Narayanganj (3 dates : July 13, August 24 & Sept 28 ,2013), water samples collected by EGIS EAW-IWM are presented in the following table. More results for Bisnandi (up to September 2014) are tabulated in **Appendix-6**.

Table 4.14: Water quality monitoring report

SL	Parameter	Unit	Bangladesh Drinking water Standard ECR '97	Meghna River at Bisnandi				Meghna River at Baidder Bazar		
				15-Feb, 2014	22-Feb, 2014	01-Mar, 2014	08-Mar, 2014	13-Jul, 2013	24-Aug, 2013	28-Sep, 2013
1	Turbidity	NTU	10	1.26	1.88	0.09	2.45	6.87	17.1	13.00
2	TDS	mg/l	1000	48	51	55	62	35	20	27
3	TSS	mg/l	10	1.00	4.6	2.00		11	13	24
4	COD	mg/l	4					8	7	8.5
5	BOD	mg/l	0.2					1.0	0.4	0.6
6	Iron	mg/l	0.3-1.0					0.38	0.44	0.32
7	Ammonia	mg/l	-	0.5	0	0	0	0.001	0.004	0.001
8	Ammonium	mg/l	0.5					0.23	0.354	0.274

Source: Monthly water quality monitoring reports. (Monitoring data by WASA)

4.8.2 Groundwater Quality

There are three main aquifers in the central region of Bangladesh, where the Dhaka City region is located:

i) an upper (composite) aquifer, which can reach depths of 50 m and is covered with an upper silty clay layer of less than 20 m;
ii) a middle (main) aquifer of fine to heavy sands, which is generally 10-60 m deep, and in most areas is hydraulically connected with the composite aquifer above; and
iii) a deep aquifer of medium, medium-to-fine, or medium-to-coarse sand, which is generally found at depths below 100 m.

In Dhaka region, about 80% of the domestic water supply is obtained from the middle aquifer, extracted by tube wells throughout the city. Recent studies have shown that water levels have fallen dramatically, and suggest that the aquifer may be changing from a confined to an unconfined condition, which could make it vulnerable to contamination. The groundwater quality is slightly acidic, the high nitrate content exceeding the permissible limit of the prescribed environmental quality standards.

Groundwater is periodically monitored by DWASA. The result of a latest monitoring is presented below:

Table 4.15: Quality of groundwater sample collected from different borings along pipeline intake and WTP sites

Ref.	Location	GPS	Sample Type	Sulphate (ppm)	Chloride (ppm)	Magnesium (ppm)	Nitrate (ppm)
p-164/175	WTP site	N 23 45' 42.5"	Water	119.4	106.38	25.33	

Ref.	Location	GPS	Sample Type	Sulphate (ppm)	Chloride (ppm)	Magnesium (ppm)	Nitrate (ppm)
		E 90 30' 52.9”					
p-164/175	WTP site	N 23 45' 38.6” E 90 30' 41.5”	Water	159.57	141.84	29.7	
p-164/175	WTP site	N 23 45' 36” E 90 30' 49”	Water	104.4	88.65	20.09	
p-20/175	WTP site	N 23 45' 42.4” E 90 30' 41”	Soil @ 1.5 m depth	98.7	78.6	26.2	
p-23/175	WTP site	N 23 45' 38.6” E 90 30' 41.5”	Soil @ 28.5 m depth	169.7	159.5	38.4	
p-25/175	WTP site	N 23 45' 35.0” E 90 30' 49.0”	Soil @ 31.5 m depth	160.5	124.1	32.2	
p-30/175	WTP site		Soil @ 0.95 – 1.35 m depth	0.201	0.483	8	
p-30/175	WTP site		Soil @ 0.95 – 1.35 m depth	0.163	0.851	8	
p-31/175	WTP site		Soil @ 0.95 – 1.35 m depth	0.135	0.881	8	
p-31/175	WTP site		Soil @ 19.5 m depth	0.399	0.283	8	
p-182/182	BH-17, pipeline, about 2 km from WTP	N 23 45' 41.3” E 90 32' 0.9”	Water	64.4	41.6	21.2	4.33
p-181/182	BH-13, pipeline, midway between WTP and intake	N 23 45' 33.8” E 90 37' 13.7”	Water	43.5	22	19.3	4.16
p-180/182	BH-11, pipeline, about 4 km from intake	N 23 45' 4.7” E 90 40' 16.3”	Water	34.7	19.7	22.4	4.48
p-179/182	BH-09, pipeline, about 1.5 km from intake	N 23 45' 11.1” E 90 41' 44.5”	Water	69.4	48	13.7	4.12
p-178/182	BH-03, Intake	N 23 44' 51.7” E 90 42' 49.7”	Water	72.2	85	26.9	3.98
			WHO Guideline	**250**	**250**		
			ECR '97 Limit	**400**	**150-600**	**30-35**	

(References were made from Subsoil investigation reports, June 2014)

4.9 Baseline: Levels of abstraction at the intake

Based on data taken at the Bhairab Bazar gauging station on the Meghna River from 2000 to 2009, approximate statistical flow determinations have been carried out at IEE level:

Q_{95}[7] = 3,815 m^3/sec

Q_5[8] = 11630 m^3/sec

Q_{50} = 4037 m^3/sec

Q mean (of actual measurements): 7,720 m^3/sec.

The proposed abstraction (for the designed intake of 1,050 MLD of raw water from Meghna) accounts for 0.3% of the lean flow (Q_{95}) for 2035, and about 0.1% of the maximum flow (Q_5) for 2035. These levels of abstraction will not adversely impact downstream uses or the ecological flows of the Meghna River.

4.10 Baseline: Fisheries in Meghna River

The indigenous species of fish in the Meghna River include hilsa, rui, katla, mighel, kalibaus, and pangas. None of these species are considered sensitive or protected, and are generally available in the inland rivers of Bangladesh. While the breeding ground for smaller fishes is all over the watercourse, there are defined grounds for larger fishes like hilsa. Barisal and Chandpur and the downstream stretches are the major breeding grounds along the Meghna.

The spawning grounds of major fish species like rui, katla, hilsa, pangas, and galda chingri have been identified and earmarked as fish sanctuaries[9], wherein concerted efforts towards conservation of the fish habitat and protection of the diversity are undertaken. The DoF undertakes necessary measures to stop indiscriminate fishing of gravid female and undersized fish. The nearest hilsa sanctuary is Chandpur, about 130 km downstream of the proposed intake location.

Though hilsa breeding in the Meghna River and estuary happens throughout the year, there is a distinct peak observed in the months of September and October and a minor peak in the months of January to March. DoF prohibits the fishing of jatka for the months of March and April to ensure sustained yield. 13. For other types of fishes (rui, katla, pangas, kalibaus, etc.) ideal temperature and other environmental conditions are essential for proper and normal breeding. Many fishes breed after and before rains.

Table 4.16:Hilsa sanctuary area and fishing ban period

S.No	***HILSA* Sanctuary Area**	**Ban period**
1	From Shatnol of Chandpur district to char Alexander of Laxmipur (100 km of lower Meghna estuary)	March to April
2	Madanpur/Char Ilisha to Char Pial in Bhola district (90 km area of Shahbajpur river, a tributary of the Meghna River)	March to April
3	Bheduria of Bhola district to Char Rustam of Patuakhali district (nearly 100 km area of Tetulia River)	March to April
4	Whole 40 km stretch of Andharmanik River in Kalapara Upazila of	November to

7 Q_{95} - The flow of a river which is exceeded on average 95% of the time—the lean flow.

8 Q_5 - The flow of a river which is exceeded on average 5% of the time—maximum flow

9 Four sites in the coastal areas of the country have been declared as *hilsa* sanctuaries under the Protection and Conservation of Fish Act-1950 for the effective conservation of *jatka* in the major nursery areas and the maintenance of fish bio-diversity. Consultations with the BFRI, Chandpur, and DoF on potential impacts on the fish sanctuaries confirmed that the intake is about 130 km upstream, and the quantum of extraction at the intake is not significant and will have no impacts on the fish diversity in the river.

S.No	*HILSA* Sanctuary Area	Ban period
	Patuakhali district	January

Source: IEE report

During IEE consultations with the DoF and BFRI officials at the research station at Chandpur confirmed that (i) there are no areas e identified as significant breeding grounds along Meghna near to the proposed intake, and the nearest breeding ground is the Chandpur sanctuary about 130 km downstream from the site; (ii) the proposed abstraction rates of less than 0.3% of the leanest flow shall not significantly impact the fish population or the livelihood of the fishermen communities; and (iii) suitable nets and screens have to be designed at the intake location to minimize impacts on fishes, especially during the lean season.

4.11 Baseline: Pollution sources in vicinity of the proposed intake

Consultations and site visits confirmed that there are no major pollution sources or development activities, existing or planned, within 25 km of the proposed intake. The pollution has not been significant at the intake location as of this writing, due to lack of any industrial activities upstream, as well as dilution.

Manikpur ferry ghat. Located about 2 km upstream of the proposed intake at Bishnondi, the Manikpur ferry ghat functions as a crossing point for passengers and vehicles to Dhaka from the Narayanganj district. Apart from a large ferry operated by the RHD every 30 minutes, there are 30 smaller vessels used for passenger movement. Being a transit node, the ferry ghat has about 50 eateries and shops that have developed around it, patronized by the passengers. There are no waste collection or toilet facilities at the ghat, and the waste generated is directly discharged into the river. The quantum of waste, though not currently significant, needs to be addressed through provision of facilities for waste collection and sanitation at the ferry ghat location. Consultations with the fishermen at the intake location and at Manikpur ferry ghat revealed that discharge from industries can be a major cause of decline of fish population in the Meghna River. The fishermen said enforcement of regulations to prohibit industrial discharges into the Meghna will be critical to protecting the water source, and also to ensure that the livelihood of the fishermen is not impacted. The project proposes to provide sanitation and solid waste collection facilities at the ferry ghat location in an effort to communicate the need to protect the source and avoid direct discharge into the river.

Other locations: The textile dyeing units and rice mills in the vicinity of the intake are currently small-scale, and the cumulative wastes discharged will not be significant, given the scale of the receiving waters and the effect of dilution. However, given the need for source protection, PMU,,with the guidance of the steering committee, shall work with the DoE in targeting treatment of effluents and prevention of direct discharges into the river. The other polluting sources in the vicinity of the proposed intake are as follows:

- **(i) Raipura,** 5 km upstream (U/S) - a cluster of 10-15 small-scale textile dyeing units
- **(ii) Madhabdi,** 9 km U/S - a cluster of 20 textile dyeing units
- **(iii) Sakerchar,** Babur Hat, Narsingdi, 13 km U/S - a cluster of 30 textile dyeing units
- **(iv) Bhairab,** 42 km U/S - rice mill effluent and 20 small-scale textile dyeing units

(v) Ashugonj, 45 km U/S - Ahsugonj Power Station (576 MW) and Ashugonj Fertilizer plant, apart from rice mills in Ashugonj

4.12 Baseline: Tidal influence in Meghna River

The FS reported that no records exist to suggest that saline intrusion extends as far as Meghna Bridge. IWM reports that sea-based salinity does not intrude beyond the confluence of the Meghna and Padma Rivers, which is about 100 km downstream of the proposed intake. To enable a better understanding of the tidal influence, the project has initiated a continuous river water quality monitoring program that includes sampling for salinity upstream of the Meghna Bridge (approximately 25 km downstream of intake).

4.13 Baseline: Other River/Water Crossings

The treated water mains cross Sitalakhya and Balu Rivers en route to the injection point at the US Embassy. In addition, the transmission mains alignment cuts across or passes close to several smaller streams (khals) and ponds. The list of such khals/water bodies along the transmission mains is presented in Table 4.17. To the extent feasible, the route shall be designed to avoid as many of the water bodies as possible.

Table 4.17: KHALS/Water Bodies in the Vicinity of the Transmission Mains

S.No	Chainage	Name	Width/Area of the Water Body	Uses	Whether Impacted
Intake to Shezan juice factory					
1	0/800	*Khal* – Chaitan Kanda village	80 m	Irrigation, fishing	Yes
2	1/000	*Khal* – Bijoy Nagar	100 m	Irrigation, fishing	Yes
3	1/900	*Khal* Uchitpur Mouza	80m	Irrigation, fishing	Yes
4	3/500	Atadi (Kadirdi) mouza	90 m	Irrigation, fishing	Yes
5	4/300	Pond	0.8 ha	Fishing	No (50 m from alignment)
6	7/150	Pond (privately owned)	0.4 ha	Fishing, bathing	Yes
7	7/800	Pond (Kandi Mouza)	o.8 ha	Fishing, irrigation	No (about 150 m from alignment
8	8/700	*Khal* (Berarkul Mouza)	75 m	Fishing, irrigation	Yes
9	9/500	Khal	100 m	Irrigation, fishing	Yes
10	10/100	Pond Lenguridi Mouza	2 acres	Irrigation, fishing	Yes
11	14/000	*Khal* – subchannel of Sitalakhya	100 m	Polluted, receives flow from industrial units	Yes
12	16/600	Pond (private), South Golakandail Mouza	0.8 ha	Fishing, poultry waste fed to pangas fish	Yes
Shezan juice factory to Taraboo (Demra Bridge) along Dhaka-Sylhet highway					
13		Drain within the RoW	Width varying from 10m to 15m for a length of about 2 km	Not used by communities. Industrial wastes discharged at few	Yes

S.No	Chainage	Name	Width/Area of the Water Body	Uses	Whether Impacted
			along the highway	locations	
Gandharbpur to US Embassy					
14		Bhatara *Khal*	150 m	Irrigation, fishing	Yes
14		Kabadia *Khal*	80 m	Irrigation, fishing	Yes
15		Chhotaboraru *Khal*	100 m	Irrigation, fishing	Yes
16		Barai *Khal*	100 m	Irrigation, fishing	Yes

Source: IEE Report

4.14 Baseline: Biological environment

There are no endangered species or critical habitats in the project areas. The ecological environment is characterized by a human managed landscape.

Terrestrial flora is classified according to their habitats. In the study areas, terrestrial floras are present mainly in the homestead regions, roadsides, village groves and cultivated lands. Homesteads and orchards include: betel nut, kadam, coconut, date palm, sofeda, mango, jackfruit, guava, grapefruit, pomelo, lemon, blackberries, plum, toddy palm, koroi, shisoo, shirish, rain tree, evcaiytta, bamboo, babla, jeol, neem, tamarind, banana, ipil-ipil, papaya, mehgani, debdaru, shimul, akashmoni, khai babla, jamrul, chalta, bel, amra, amloki, segun, etc. Roadside plantations include: datepalm, road chambol, koroi, krishnachura, rain tree, banyan, shisoo, babla, akashmoni, eucalyptus, mango, blackberries, raj koroi, etc. Fish species include rui, katal, thai puti, minar carp, silver carp, pabda, sheatfish. None of these species are listed in IUCN Red List. Table 4.18 shows various species in the area.

Table 4.18: Terrestrial Flora found near intake and location of proposed treatment plant

Sl. No.	Local Name	Scientific Name	Status
Terrestrial Flora			
1.	Betel nut	Areca catechu	Fairly Common
2.	Mashkalai (type of pulse)	Phaseolus mungo roxb	Fairly Common
3.	Potato	Solanum tuberosum	Fairly Common
4.	Ground Nut	Arachis hypogea	Fairly Common
5.	Ginger	Zingiber officinale	Fairly Common
6.	Wheat	Triticum aestivum	Fairly Common
7.	Til	Sesamum indicum	Fairly Common
8.	Kumra	Cucurbita maxima	Fairly Common
Terrestrial Fauna (Reptiles) found near intake and location of proposed treatment plant			
1.	Anjila	Mabuya carinata	Common
2.	Dhura Shap	Amphiesma stolata	Common
3.	Matia Shap	Atretium schistosum	Common
4.	Tiktiki	Hemidactylus brooke	Common
5.	Daraish Shap	Ptyas mucosus	Fairly Common
6.	Gui Shap	Varanus nubulosus	Fairly Common

Sl. No.	Local Name	Scientific Name	Status
Terrestrial Fauna (Mammals) found near intake and location of proposed treatment plant			
1.	Babur	Pteropus giganteus	Common
2.	Idur	Mus musculus	Common
3.	Shial	Vulpes bengalensis	Common
4.	Chika	Pipistrellus. Sp	Common
5.	Beji	Herpestes	Fairly Common
Avifauna (Birds) found near the location of proposed treatment plant			
1.	Choroi	Passer domesticus	Common
2	Doyel	Opsychus sularis	Common
3.	Kak	Carvus splendens	Common
4.	Ghugho	Streptapelia Orientalis	Common
5.	Shalik	Stuma contra	Common
6.	Tuntuni	Orthotomus sutorius	Common
7.	Machranga	Helcyon smyrrensis	Fairly Common
8.	Haludpakhi	Oriolus xanthornus	Fairly Common
9.	Katthokra	Picus canus	Fairly Common
10.	Pecha	Tyto alba	Rare
Fish Fauna (Large fishes) at Meghna river near intake			
1	Rui	Labeo rohita	Common
2	Katla	Catla catla	Common
3	Kalibaush	Labeo calbasu	Common
4	Boal	Wallago attu	Common
5	Ayre	Sperata aor	Fairly Common
6	Bain	Mastacembelus armatus	Common
7	Chital	Chitala chitala	Fairly Common
8	Fasha	Setipinna phasa	Fairly Common
9	Bata	Liza Persia	Fairly Common
10	Magur	Clarius batrachus	Fairly Common
11	Dari	Scistura scaturigina	Fairly Common
Fish Fauna (Small fishes) at Meghna River near intake			
1.	Pabda	Ompoc pabda	Fairly common
2	Golsha	Mystus cavasius	Fairly common
3.	Bele	Glossogobius giuris	Fairly common
4.	Tengra	Mystus vittatus	Common
5.	Puti	Puntius conchonius	Common
6.	Fali	Notopterus notopterus	Fairly common
7.	Kachki	Corica suborna	Fairly common
8	Mola	Amblypharyngodon mola	Common
9	Kakila	Xenentodon cancila	Fairly common
10	Chapila	Gudusia chapra	Fairly common
11	Kholisha	Colisha fasciatus	Common
12	Chingri	Macrobrachium eqidense	Common

Sl. No.	Local Name	Scientific Name	Status
13	Shol	Channa striates	Common
14	Taki	Channa punctatus	Common
15	Shing	Heteropneustes fossilis	Fairly common
16	Koi	Anabas testudineus	Fairly common
17	Gozar	Channa marulius	Fairly common
18	Chela	Chela cachius	
Insect Fauna at Meghna River near intake			
1.	Dragon fly nymph	Odonata	Fairly Common
2	Damsel fly nymph	Odonata	Fairly Common
3.	Water strider	Hemiptera	Fairly Common
4.	Midge	Diptera	Fairly Common
5.	Flies	Diptera	Fairly Common
6.	Ant	Hymenoptera	Common
7.	Caddisfly	Trichoptera	Fairly Common

Table 4.19: List of fresh water mollusks in the river Meghna near the intake

Common Name	Scientific Name	Class	Order	Family	Abundance	
					Intake area	Outfall area
Common Apple -Snail	Pila globosa	Gastropoda	Mesogastropoda	Pilidae	++	+
Brotia snail	Brotia costula	Gastropoda	Mesogastropoda	Pilidae	+++	++
Banded river snail	Bellamya bengalensis	Gastropoda	Prosobranchia	Viviparidae	++	+
Fresh water mussel	Parreysia corrugata	Bivalvia	Unionoida	Unionidae	+	+
Fresh water mussel	Parreysia caerulea	Bivalvia	Unionoida	Unionidae	++	+
Fresh water mussel	Lamellidense marginalis	Bivalvia	Unionoida	Unionoidae	+++	++
Fresh water mussel	Lamellidense jenkinsianus	Bivalvia	Unionoida	Unionoidae	+++	+

Status: +++Very common, ++Common, +Few, - Absent

Table 4.20: Avifauna observed near the surveyed river

English Name	Scientific Name
Pond Heron	*Ardeola grayii*
Little Cormorant	*Phalacrocorax niger*
Black Kite	Milvus migrans
Brahminy Kite	Haliastur Indus
Red Vented Bulbul	Picnonotus cafer
House Crow	Corvus splendens
Tailor Bird	Orthotomus sutorius

Some birds feed on the river fishes and thus take part in the consumer level of the river ecosystem.

Among the aquatic vegetations Helencha and Duckweed were not observed much in the intake. In general aquatic vegetation was less in this area. This might be due to heavy current in the river.

Table 4.21: List of aquatic vegetations seen in the visiting site

Common Name	Scientific Name	Abundance near Intake point
Water hyacinth	Echhornia crassipes	++
Ipomea	Ipomea aquatica	+
Helencha	Altenanthera philloxiroides	+
Duckweed	Spirodella sp	+

Status: ++Common, +Few

Herbs and shrubs grown near the visiting area was observed and listed below. These species should be conserved for ecological balance.

Table 4.22: List of vegetations (Herbs and Shrubs) grown near the visiting site

Local Name	Scientific Name	Local Name	Scientific Name
Junka	Sida cordata	Bish Katali	Persicaria hydropiper
Banmorich	Croton bonplandianum	Nakful	Synedrella nodiflora
Fulkuri	Ageratum conizoides	Bara-Halkus	Leucas cephalotes
Kanai	Commelina erecta	Bondhoney	*Scoparia dulcis*
Notey Shak	*Amarathus viridis*	Joshorilata	Mikania cordata
Ban-palang	Rumex dentatus	Helencah	Altenanthera philloxiroides
Durba	Cynodon dactylon	Sitki	*Phyllanthus reticulatus*
Chanchi	Alternanthera sessilis	Pichas-Ban	Lippia aka
Ghagra	*Xanthium indicum*	Ban-Ghagra	Urena lobata
Vat	Clerodendrum viscosum	Lalverenda	Jatropha glandulifera
Kutus Kata	Lantana camara	Dhekia	Christella dentate
Verenda	Ricinus communis	Dhanighas	Brachiaria reptans
Kanta begun	Solanum sisymbrifolium	Tridhara	Tridax procumbens

This biosurvey data might not reflect the actual biodiversity of that area. One species found in the monsoon might not see in the winter. Extensive survey over the year might give an actual status of biodiversity. Present biosurvey list is a snapshot prepared based on the species found during the survey time.

Roadside Plantations and Vegetation

There are tree plantations by the RHD along the raw water transmission mains along the Dhaka-Sylhet highway (between Shezan juice factory and Taraboo (Demra) Bridge, and along treated water mains from Gandharbpur WTP to the injection point at the US embassy, passing for 3 km along the road managed by the BWDB along the Sitalakhya River, and subsequently along the RAJUK 100-ft road. The tree species are common species characteristic of the district, and include mahogany, eucalyptus, plum, rain tree, koroi, neem, akasmoni, debdaru, and mango.

The proposed locations for the intake at Bishnondi WTP at Gandharbpur and the greenfield transmission main corridors are predominantly rice fields or low-lying

areas. The trees in these identified locations are common species found in the district, including neem, mango, and plum.

4.15 Baseline: Socio-economic environment

4.15.1 Population and Human Settlement

The project is spread east-west through Araihazar and Rupganj upazilla of Narayanganj district in Bangladesh. At the east end of the project, the intake is on the bank of Meghna river at Bishnanadi Union (adjacent GPS: N 23° 44' 45.821", E 90° 42' 45.186"), which is about 2km downstream (south) of Manikpur Ferry Ghat/crossing. The proposed pipelines and road are mostly through agricultural land. West end of the project, the Water Treatment Plant is located at Gandhrabpur village of Murapara Union of Rupganj Upazilla (GPS: N 23° 45' 32.422", E 90° 30' 50.119").

Araihazar Upazila (Narayanganj district): area 183.35 sq km, located in between 23°40´ and 23°53´ north latitudes and in between 90°35´ and 90°45´ east longitudes. It is bounded by Narsingdi Sadar upazila on the north, Homna upazila on the south, Banchharampur upazila on the east and Rupganj and Sonargaon upazilas on the west.

Rupganj Upazila (Narayanganj district): area 176.16 sq km, located in between 23°42´ and 23°54´ north latitudes and in between 90°28´ and 90°37´ east longitudes. It is bounded by Kaliganj (gazipur) and Palash upazilas on the north, Sonargaon upazila on the south, Araihazar and Narsingdi sadar upazilas on the east, Demra, Khilgaon, Badda and Khilkhet thanas on the west.

Population of Araihazar Upazila: Total 331566; male 171482, female 160084; Muslim 319854, Hindu 116553, Buddhist 22, Christian 28 and others 9.

Population of Rupganj Upazila: Total 403629; male 215019, female 188610; Muslim 379879, Hindu 23466, Buddhist 106, Christian 59 and others 119.

Water bodies near Araihazar Upazila main rivers are Meghna and Brahmaputra and near Rupganj Upazilla main rivers are Shitalakshya and Balu.

Administration of Araihazar Thana was formed in 1921 and it was turned into an upazila in 1983. Administration of Rupganj Thana was turned into an upazila in 1983.

(Source: Banglapedia, Census and Upazila)

4.15.2 Economic Activities

Main sources of income of Araihazar: Agriculture 28.48%, non-agricultural labourer 8.29%, commerce 20.19%, transport and communication 4.84%, industry 15.13%, service 5.96%, construction 1.40%, religious service 0.26%, rent and remittance 3.44% and others 12.01%. Main crops are paddy, jute, wheat, potato, mustard seed, vegetables

Ownership of agricultural land of Araihazar: Landowner 50.89%, landless 49.11%; agricultural landowner: urban 54.11% and rural 50.76%.

Main sources of income of Rupganj: Agriculture 22.72%, non-agricultural labourer 3.14%, industry 9.19%, commerce 21%, transport and communication 6.58%, service 19.75%, construction 1.98%, religious service 0.18%, rent and remittance 3% and others 12.46%. Main crops are paddy, jute, wheat, sugarcane, mustard, vegetables.

Ownership of agricultural land of Rupganj: Landowner 44.07%, landless 55.93%; agricultural landowner: urban 46.97% and rural 43.44%.

(Source: Banglapedia, Census and Upazila)

4.16 Baseline: Cultural, Religious, and Archaeological Sites

Archaeological heritage and relics at Araihazar: Two-storied building with 108 rooms (Sadasardi), mazars of Hazrat Garibullah Shah (R) and Jangali Shah (R) at Haizadi, coloured glass decorated Durga Mandir, house of Zamindar Birendra Roy Chowdhury, Dighipar Math (Araihazar), single-domed Jami Mosque (Uchitpur).

Archaeological heritage and relics at Rupganj: Bajra Mosque, residence of Mura Para Zamindar, Mura Para Shahi Mosque, At-ani Mosque and Tara Mosque at Gandharbapur, Brahmangaon Jami Mosque, Golakandail Kalim Shah Jami Mosque.

(Source: Banglapedia, Census and Upazila)

The project sites are not located within any sensitive historical, cultural, and archaeological areas. Though it is not a major religious/cultural destinations, there is a small graveyard at the location of the water treatment plant, as well as religious properties along the transmission alignments. Efforts to avoid and minimize impacts on these areas and structures through slight alignment shifts shall be taken up as part of the detailed design. If unavoidable, impacts shall be addressed in consultation with the affected groups as per the provisions of the RP for common properties. The list of cultural properties in the vicinity of the transmission mains is summarized in Table 4.23 below.

Table 4.23: List of Cultural Properties Along the Transmission Mains

SL No.	Name	Location	Chainage	No. of Floors
1	Haji Islam Uddin Darul Ulum Iskamia Madrasa	Sejun Juice, Bhulta	0+000 to 0+500	4
2	Rupshi Mosjid	Kornogop, Rupshi	5+000 to 5+500	3
3	Borpa Jame Mosjid	Borpa, Rupshi	4+000 to 4+500	2
4	Rupshi Bus stand Mosjid	Rupshi	4+000 to 4+500	1
5	Al Maksud Jame Mosjid	Max, Borabo, Tarabo	6+000 to 6+500	1

Source: IEE report

4.17 Baseline: Infrastructure and Utilities

There are sufficient infrastructures to support the project activities. The existing roads are adequate to take the load of increased traffic during the construction and operation of the project.

Regarding the availability of services, as water supply and sewage disposal is handled by DWASA, therefore, if additional facilities needed that can be created. For services like gas and electricity cooperation from respective departments would be necessary. Cooperation for the construction of pipelines along road alignments is necessary from

- RHD
- RAJUK
- LGED
- BWDB
- BIWTA, DNCC, DSCC

DWASA will maintain this cooperation and provide adequate services to maintain the project.

4.17.1 Development Activity Around the Project Area

The key development activities around the proposed project locations are summarized in Table 4.24 below.

Table 4.24: Major Development Activities Around the Project Locations

S.No	Location	Description	Remarks
1	Manikpur ferry ghat	The ferry ghat by BIWTA, with ferry service operated by RHD, has been witnessing increasing traffic, resulting in development of over 100 shops at the location.	2 km upstream of intake
2	Health and Nutrition Institute, Manikpur	A 121-ha piece of land has been acquired by the government for siting the health and nutrition institute. The project is under implementation.	2 km upstream of intake
3	Industries	Private industries are proposed in the vicinity of the WTP location. Access road leading to the proposed WTP site and beyond is being developed to enable better access to the industries.	Within 1 km of the WTP at Gandharbpur
4	Brick kilns and large-scale residential development	Agricultural lands closer to the intake are approached for development as brick kilns, while certain stretches closer to the Dhaka- Sylhet highway are proposed for residential/ industrial development.	Along transmission mains alignment from intake to Bhulta
5	Bridge across Sitalakhya River	LGED is implementing a two-lane bridge across Sitalakhya.	About 2 km from the proposed WTP
6	Other infrastructure projects	Projects in water supply and sanitation,	Along the treated

Source: IEE report

5 IDENTIFICATION AND EVALUATION OF POTENTIAL IMPACTS

5.1 Environmental Impacts During Construction Phase

5.1.1 Land acquisition and resettlement

The proposed intake site on the banks of the Meghna River at the Bishnondi village is on private agricultural lands owned by 88 families. The crops cultivated are rice, other grains, and vegetables. There are no residential/commercial structures within the identified lands. A resettlement plan in line with the SPS (2009) has been prepared based on census and socioeconomic surveys of the affected persons to address the impacts due to land acquisition and resettlement in the project.

5.1.2 Impacts on fisheries/river ecology

Intake structure at Meghna river may provide two fold impact on the fisheries and river ecology: 1) if the intake velocity is higher than the fish swimming velocity of Key fish species like Hilsa, jatka or any other small fishes or any other river ecology 2) if the proposed volume of abstraction cause impact on fisheries or river ecology or downstream users. 1st one is discussed as follows and 2nd one is discussed in 5.1.3.

Intake screens are to be designed according to the swimming characteristics of Hilsa (the key species in the Meghna), to ensure that the impacts on Hilsa as well as the smaller fish, including the jatka, are minimized. It is reported[10] that hilsa is a fast swimming fish up to 80 km/day average 71 km/day (82 cm/sec), therefore, its swimming velocity is not critical for screen design. However, as per the recommendation of National Marine Fisheries Service, National Oceanic and Atmospheric Administration (NOAA), US Department of Commerce for large river, the critical velocity for very small fish (less than 60 mm fork length) can be considered as 0.4 ft/sec (12 cm/sec) for active fish screen and 0.2 ft/sec (6 cm/sec) for passive screen. It is recommended in Water Works Engineering: planning, design & operation book[11] to use approach velocity for intake screen as 8 cm/sec for large

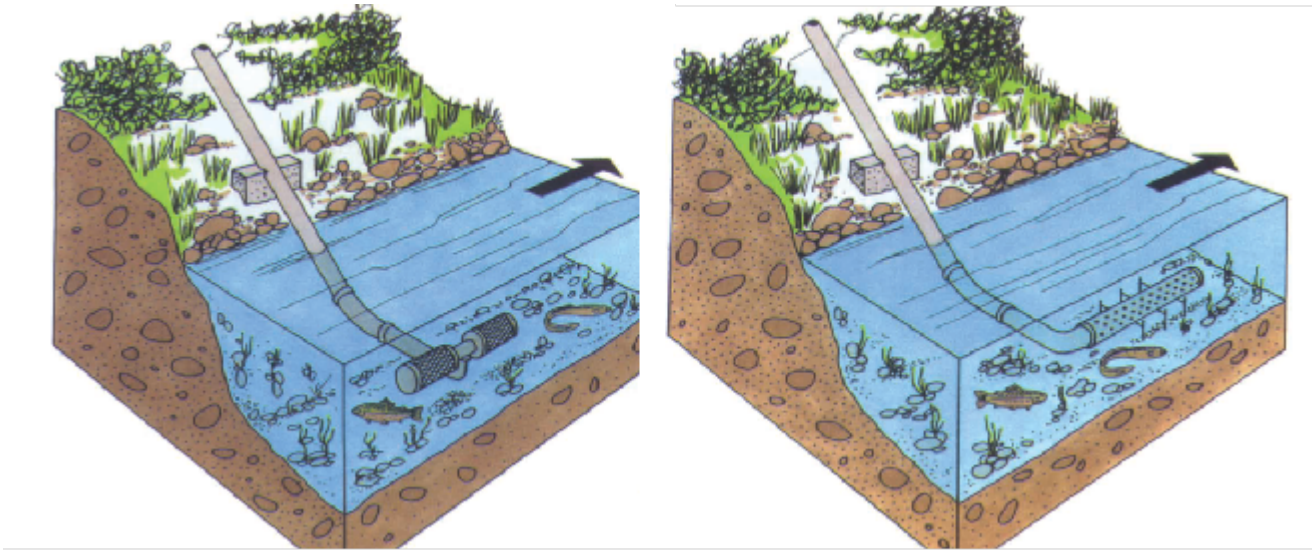


Figure 5.1: Schematic guideline for arrangement for intake screens

10 UNDP. 1985. Bay of Bengal Programme on Marine Fisheries Resources Management: A review of the biology and fisheries of Hilsa ilisha in the upper Bay of Bengal.

11 **Water Works Engineering:** planning, design & operation, by – Syed R. Qasim, Edward M. Motley, Guang Zhu, Eastern Economy Edition, PHI Learning Pte. Ltd. ISBN-978-81-203-2153-3

river. Therefore, it is recommended here to use 8 cm/sec approach velocity for screen mesh. For Screen mesh openings as per the recommendation of NOAA it is recommended that opening shall not exceed 3/32 inch (2.38 mm) for woven wire or perforated plate screens, or 0.0689 inch (1.75 mm) for profile wire screens, with a minimum 27% open area. It is also recommended to provide screen in the direction of flow to escape small fish and spawn from the screen as shown in the picture.

Finally, it is also recommended for consulting a fisheries expert as part of the detailed design to provide inputs on the design of the intake screen to minimize impacts on fish. Efforts to minimize such impacts will be integrated into the detailed designs by the fisheries expert.

5.1.3 Impacts on ecology and downstream uses for proposed abstraction

The proposed abstraction accounts for only 0.3% of the lean flow (Q_{95}) for 2035, and about 0.2% of the maximum flow (Q_5) for 2035. There is no available model on the effect of abstraction on morphology and ecology of the river. There is no allowable abstraction limit for river in Bangladesh. However, allowable abstraction limit for different river ecology (such as macrophytes, macro-invertebrates, fish) for different types of UK Rivers were analyzed (**Appendix 8**). The Meghna river can be considered as river type B. In no case lowest allowable abstraction is below 10%. However, for the least ecologically sensitive rivers, maximum abstractions in the range 15–35% of the natural flow were proposed, depending on the flow magnitude and time of year. For the most sensitive rivers, the maximum abstraction proposed was in the range 7.5–25%. There the proposed abstraction (0.3% of the lean flow (Q_{95}) and about 0.2% of the maximum flow (Q_5) for 2035 is minor.

This minor level of abstraction is considered not to adversely impact downstream uses or ecological flows of the Meghna River. Further, these levels of abstraction are not envisaged to result in any flow modifications, which can potentially lead to salinity intrusion or impacts on downstream water uses.

5.1.4 Upstream pollution impacts and protection of source

The water quality monitoring program carried out as part of the feasibility study confirmed that the key water quality parameters at the intake location are within permissible limits for inland surface waters designated for use for water supply after conventional treatment. The current low levels of pollution can be attributed to the absence of any major pollution sources upstream along the Meghna, coupled with dilution factors in the river system.

Protection of the source through regulation of upstream developments, especially discharge of industrial effluents (either untreated or partially treated), has been identified as a key policy level intervention requiring inter-departmental coordination. While consultations with the other line departments, such as the Department of Industries and the BWDB, do not indicate future large-scale industrial development upstream of the intake, enforcement of discharge standards and treatment of industrial wastes in industrial clusters, both in case of small-scale textile units and the larger industrial units in Ashuganj, shall be critical to ensure the long-term protection of the water quality at the intake.

The mandate of water quality protection and ensuring compliance to discharge standards rests with the DoE. Accordingly, DoE has established water quality monitoring stations at various locations along major rivers, including across Meghna River. Further, the DoE, through the district level offices, monitors compliance to discharge standards in the industrial units under operation. In addition to these, given the need for additional measures to ensure sustained protection of water quality at the Bishnondi source, seasonal water quality monitoring upstream of the

intake up to Ashuganj is proposed. Implementation and will be continued during the operation stage by DWASA.

Based on the analysis of the water quality results, the major sources of pollution, levels of dilution, and responsible institutions shall be identified. In addition, a semi-annual field visit by the environmental officer of the PMU, along with the environmental specialist of the consultant team and the representative of the district office of the DoE, to various locations within 50 km upstream of the intake up to Ashuganj shall be carried out. These visits shall enable identification and reporting to the PMU on any potential issues with respect to change in land uses, pollution sources, etc. The findings of the water quality analysis and the field visits, along with recommendations towards source protection, shall be summarized and presented as part of the semi-annual environmental monitoring reports. Issues pertaining to source protection shall be taken up in the steering committee meetings and provide a forum for addressing inter- agency issues towards protection of the water quality at the intake. Given that DoE is a member of the steering committee, the DoE representative shall follow up on the recommendations from the committee and monitor actions taken to address water pollution risks. In addition, it is recommended that DWASA initiate the preparation of a water safety plan as an adjunct to the EMP, at least as it would pertain to watershed protection and monitoring measures.

While the waste discharges from the existing Manikpur ferry ghat are not significant in terms of quantum of wastes, provision of sanitation facilities and waste collection facilities at the ghat (as part of the project) will provide a good starting point to communicate the need for protection of source and to avoid direct discharges into the river.

5.1.5 Transmission Mains—Intake to Gandharbpur WTP

A 31 m-wide, 17.2 km-long corridor is proposed to accommodate the transmission mains from intake to the Shezan juice factory on the Dhaka-Sylhet highway junction. From Shezan juice factory to the Gandharbpur WTP, a 25 m-wide corridor running for 4.5 km is proposed. The alignment passes through agriculture fields and low-lying areas. There are no environmentally sensitive areas in the vicinity of the proposed transmission main/access road. Land acquisition and resettlement of private agricultural lands are envisaged. The impacts are being addressed through the provisions of the RP. Cutting of trees in private lands will be minimized. Compensatory plantation for trees lost at a rate of 10 trees for every tree cut will be implemented by the design-build contractor, who will also maintain the saplings for the duration of his contract. Impact on inland water bodies, including khals and fishponds, will be addressed in the detailed designs through appropriate measures to provide for cross-drainage to minimize severance impacts. Traffic management plans and spoil management plans shall be prepared as part of the detailed designs.

5.1.6 Design Impacts for All Components

Site selection of construction work camps, stockpile areas, storage areas, and disposal areas. The detailed design shall identify suitable locations for these facilities near to the project locations. However, if it is deemed necessary to locate elsewhere, sites to be considered shall not promote social instability and result in destruction of property, vegetation, irrigation, and water bodies.

None of these temporary facilities shall be located (i) within 500 m of residential areas and rivers identified as ecologically critical areas (ECA), Balu and Sitalakhya Rivers, and (ii) within 100 m of other water courses and khals. Though the contractor will be free to decide locations, a list of feasible locations shall be included in the design specifications and plan drawings for approval by the PMU.

Site selection for sources of materials: To mitigate the potential environmental impacts, locations of quarry sites and borrow pits (for loose material other than stones) will be included in the design specifications and plan drawings, for approval by the PMU. Priority of sites shall be investigated during detailed design stage. If other sites are necessary, these shall be located away from population centers, drinking water intakes and streams, cultivable lands, and natural drainage systems, and in structurally stable areas, even if these are some distance from construction activities. It shall be the design-build contractor‘s responsibility to verify the suitability of all material sources, and to obtain the approval of the relevant government agencies, as required.

Asbestos cement pipes: The alignment of the transmission mains is mostly outside the urban areas of Dhaka, and it is unlikely that asbestos cement pipes will be encountered during the laying of the transmission mains. In the event of accidental discovery of asbestos cement pipes, these will be left in situ, undisturbed, so there will be no deliberate excavation of asbestos cement pipes. The contractor will (i) train all personnel (including manual laborers) to enable them to understand the dangers of asbestos cement pipes and to be able to recognize them in situ; (ii) report to management immediately if asbestos cement pipes are encountered; and (iii) develop and apply an asbestos cement management plan.

The contractor, as part of the detailed designs, shall develop a protocol to be applied in any instance that asbestos cement pipes are found, to ensure that appropriate action is taken. This shall be based on the approach recommended by the United States Environmental Protection Agency (USEPA), and among other things, shall involve (i) developing reporting procedures to inform the environmental officer of the PMU immediately if asbestos cement pipes are encountered; and (ii) requiring the SC to develop and apply an asbestos cement management plan, as part of the overall health and safety plan, to protect both workers and citizens in case of accidental uncovering of asbestos cement pipes.

Impacts to common property resources and other private assets due to the proposed components shall be addressed through alternative arrangements for the communities and stakeholders, as part of the designs.

Impacts arising from the inappropriate designs of proposed facilities would in general include poor design of sludge drying beds, etc. These shall be addressed through adoption of good practices as part of the detailed design.

The resettlement impacts are summarized in the project’s resettlement plan. Impacts are limited to economic displacement in the form of loss of land, assets, income sources, and means of livelihoods as a result of involuntary resettlement.

5.1.7 Construction Impacts

The impacts during construction will include typical construction-related impacts associated with construction of water intakes and treatment plants and the laying of transmission lines. While the nature of these impacts is not expected to be significant, the magnitude is, given the size and scale of the proposed facilities. However, these impacts are known and can be addressed through good engineering practices and specific mitigation measures for minimization of construction impacts on sensitive receptors and communities in the vicinity of locations and alignments.

Key impacts identified and addressed in the IEE include: (i) loss of productive agricultural lands and conservation of topsoil; (ii) impacts on low-lying areas and water bodies, wherein protection measures are required to minimize impacts on water quality, disposal of wastes/debris in the water bodies, and potential disruption of flows; (iii) air, noise, and vibration impacts due to construction vehicles,

equipment, and machinery in the vicinity of construction site and inhabited sections, in addition to dust control during construction activities; (iv) impacts on the river courses and the water quality during the construction of the transmission mains across the rivers Sitalakhya and Balu; (v) management of spoil disposal due to the excavation for the transmission mains; (vi) safety measures during construction including traffic diversions; (vii) management of sites temporarily used for construction activities, including borrow areas, construction camps, etc., and rehabilitation of the sites after completion of the temporary use; and (viii) impacts on community health and safety hazards posed to the public, specifically in inhabited areas. In addition to these measures, environmental measures that shall be implemented as part of good engineering practices during construction are laid down in the EIA.

A checklist for safety during construction is provided in **Appendix-7**.

Occupational health and safety. To address the occupational health and safety issues of workers during construction, the construction contractor will be required to:

i) develop and implement a site-specific health and safety plan which will include measures such as: (a) excluding public from the site; (b) ensuring all workers are provided with and use personal protective equipment; (c) health and safety training[12] for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents;
ii) ensure that qualified first aid can be provided at all times, and equipped first aid stations shall be easily accessible throughout the site;
iii) provide medical insurance coverage for workers;
iv) secure all installations from unauthorized intrusion and accident risks;
v) provide supplies of potable drinking water;
vi) provide clean eating areas where workers are not exposed to hazardous or noxious substances;
vii) provide health and safety orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers;
viii) provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present, and ensure also that visitor/s do not enter hazard areas unescorted;
ix) ensure the visibility of workers through their use of high-visibility vests when working in or walking through heavy equipment operating areas;
x) ensure moving equipment is outfitted with audible back-up alarms;
xi) mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; and
xii) disallow worker exposure to noise level greater than 85 dBA for duration of more than 8 hours per day. The use of hearing protection shall be enforced actively.

5.1.8 Accident prevention and monitoring

The contractor shall appoint an accident prevention officer at the site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take

12 Some of the key areas that may be covered during training as they relate to the primary causes of accidents include (i) slips, trips, and falls; (ii) personal protective equipment; (iii) ergonomics, repetitive motion, and manual handling; (iv) workplace transport; and (v) legislation and responsibilities.

protective measures to prevent accidents. Throughout the execution of the work, the contractor shall provide whatever is required by this person to exercise this responsibility and authority. The contractor shall send, to the SC, details of any accident as soon as practicable after its occurrence. The contractor shall maintain records and make reports concerning health, safety and welfare of persons, and damage to property, as the SC may reasonably require.

5.1.9 Community health and safety

Hazards posed to the public, specifically in high- pedestrian areas, may include traffic accidents and vehicle collision with pedestrians. Potential impact is negative, but short-term and reversible by mitigation measures. The construction contractor will be required to:

i) plan routes to avoid times of peak-pedestrian activities;
ii) liaise with PIU/SC in identifying high-risk areas on route cards/maps;
iii) maintain regularly the vehicles and use manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure; and
iv) provide road signs and flag persons to warn of dangerous conditions.

5.1.10 Traffic safety during construction

Along the stretches of the transmission mains proposed to be laid on existing roads, the contractor shall follow the following measures towards ensuring traffic safety during construction. The contractor shall take all necessary measures for the safety of traffic during construction and provide, erect, and maintain such barricades, including signs, marking, flags, lights, and flagmen as per the traffic management plan submitted by the contractor and approved by the SC. Before taking up any construction, an agreed phased program for the regulation of traffic on the highway shall be drawn up in consultation with the SC, and approved by the RHD/RAJUK as the case of road ownership may be.

The barricades erected on either side of the carriageway/portion of the carriageway closed to traffic shall be of strong design to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit from sunset to sunrise.

At the points where traffic is to deviate from its normal path (whether on temporary diversion or part of the width of the carriageway), the channel for traffic shall be clearly marked with the aid of pavement markings, painted drums, or a similar device to the directions of the SC. At night, the passage shall be delineated with lanterns or other suitable light source.

One-way traffic operation shall be established whenever the traffic is to pass over part of the carriageway inadequate for two-lane traffic. This shall be done with the help of temporary traffic signals or flagmen positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns/lights.

On both sides, suitable regulatory/warning signs as approved by the SC shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins, and the other 120 m away. The signs shall be of approved design and of reflective type, as directed by the SC.

All the signs, delineators, and pavement markings shall be maintained in a clean and bright condition at all times, and adequate lighting and other arrangements shall be maintained for proper visibility during the passage of the work area, until such time

they are required and as directed by the SC. The temporary travel way shall be kept free of dust by frequent applications of water.

5.1.11 Work camps

Operation of work camps can cause temporary air and noise pollution from machine operation, and water pollution from storage and use of fuels, oils, solvents, and lubricants. Potential impacts are negative, but short-term and reversible by mitigation measures. The construction contractor will be required to:

i) consult with the environment specialist of the PMU before locating work camps, sheds, and construction plants;
ii) minimize removal of vegetation and disallow cutting of trees;
iii) provide water and sanitation facilities for employees;
iv) prohibit employees from cutting trees for firewood;
v) train employees in the storage and handling of materials which can potentially cause soil contamination;
vi) recover used oil and lubricants and reuse or remove from the site;
vii) manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas;
viii) remove all wreckage, rubbish, or temporary structures (such as buildings, shelters, and latrines) which are no longer required; and
ix) request PMU to report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of work.

5.2 Operation and Maintenance (O&M) Impacts

5.2.1 Plant operation

With the careful siting of the project components to avoid environmentally sensitive areas and the efforts to incorporate environmentally sound designs to minimize impacts (as part of the design of the components), the impacts during the maintenance and operation of the proposed facilities will not be significant. There will be beneficial impacts on the communities due to the improved access to potable water and minimization of extraction of groundwater.

The proposed systems of the various project components, including the intake and WTP, shall not require major repairs or refurbishments, and shall operate with little maintenance beyond routine actions required to keep the pumps and other equipment in working order. The stability and integrity of the system will be monitored periodically to detect any problems and allow remedial action if required. Any repairs will be small-scale, involving manual, temporary, and short-term works like regular checking and recording of performance for signs of deterioration and servicing and replacement of parts, and is unlikely to result in significant environmental impacts.

5.2.2 Sludge handling

During operation of the WTP, physical and chemical sludge will be generated. This drinking water treatment sludge usually contains colloidal iron and alum hydroxides, colloidal or dissolved organic matter, clay, silt and microorganisms. It should not contain heavy metal and toxic chemicals. After dehydration and drying the sludge is proposed to use as fill material for lowlands as reclaimed land for public parks, roadsides, golf courses, lawns and home in nearby areas after analyzing characteristics of the sludge, if it doesn’t not contain any toxic chemical. The disposal of the alum sludge is proposed at the landfill site of Dhaka at Matuail, about 10 km from the proposed WTP if it is not possible to use as fill material.

5.2.3 Emergency and risk management

To address risks during the operation of the proposed facilities, DWASA shall prepare and implement an emergency action plan, which shall include environmental risks and potential pollution incidences. Capacity building and training of personnel on the emergency response systems and procedures shall be incorporated in the project.

5.2.4 Increased sewage generation

The project will result in increased sewage generation. DWASA, with support from other development banks and bilateral agencies, has a sewerage master plan (SMP) and a phased strategy to implement the SMP, which will address additional wastewater to be generated and improve the overall condition of domestic wastewater pollution in Dhaka. The increased wastewater volume from Zone 05 and 08, due to the additional water supply of 262 mld, will be fully addressed by the ongoing government-funded Dasherkandi sewage collection system and STP (500 mld) development project (Phase 1 Priority Projects).

While Zones 04 and 09 have as yet no funding for facilities to treat their share of the increased water supply (178 MLD and 60 MLD respectively), DWASA is planning the construction of sewerage systems and sewage treatment plants at Uttara and Mirpur on priority basis, and a DPP has reportedly been developed.

5.2.5 Impact on Socio-economic Environment

Impact on Employment and Family Finance

The project envisages providing permanent employment of substantial number of skilled and unskilled personnel during its operation phase. This would obviously help to present unemployment burden of the country to some extent. A person with an average gross salary of about Tk. 3000 per month will able to increase his family income by Tk. 100 per day. This will definitely provide an opportunity to improve his basic living standard. Apart from this direct benefit, there would other indirect beneficial impacts on national economy through foreign investment.

Benefit Enhancement Measure

Although labor recruitment is a matter of company who has the right to determine whom he shall and shall not employ, but still, the project proponent shall employ local people wherever possible and to give preference to employment of the land less and jobless people. This will ensure the real benefit for the poorest of the poor.

5.2.6 Impact on Health and Safety

Impact Origin

As there might be hazards to the plant workers, employees and technical personnel, provisions need to be made by the project for protecting occupational health, including protection of workers from hazards/fires/spillage etc. as well as protection of workers' health and assurance of safe drinking water supply and sanitation. The workers who work inside the treatment plant face occupational health hazard due to different operation processes.

Mitigating Measures

Safe and good occupational health status of the employees and workers is important for not only the persons working in the plant, but also for the better plant operation and maintenance. Protective clothing and accessories should be provided to the workers, who would be subjected to exposure to hazardous substances and situation. Regular medical check-up is to be done to ensure the soundness of health

of the employees and workers. Pollution control measures are to be duly adopted as necessary, including noise and odor control, so that there would not be any negative occupational health impact. Insurance for all employees should be taken out. A senior Medical officer with sufficient background and experience in occupational health problems should coordinate this issue and would be responsible for drawing up and implementing a detailed and regular program for ensuring health safety for all the workers in the industrial unit.

5.2.7 Impact on landscape

Impact Origin

Industrial building when not designed in considering the local landscape, then it creates visual intrusion to the people. The present plant changes the local landscape of the area to some extent by converting an agricultural green area into a built-up area. The present plant is relatively compact and of modern appearance which does not provide any significant visual intrusion.

Mitigating Measure

One way by which the altered green area can be turned into its original visual quality is the plantation of trees around the build area. This plantation also creates buffer zones. Buffer Zones are spaces, which provide natural environmental protection from damage by external events. These spaces, in between any development projects, are usually remain vegetated, which can provide windbreaks, erosion control, sediment traps, sound insulation and visual screening.

A green belt should be developed by planting trees of various species in all possible open spaces within factory premises. Trees take carbon-di-oxide and discharge oxygen for their photosynthesis, which helps to clean the air. Some trees also able to absorb toxic pollutant in the air. It also maintains the ecological balance and improves scenic beauty.

5.2.8 Other Mitigation Measures

a) Disaster Management Plan

The project authority will take necessary disaster management plan to protect the properties from water logging/flood etc. In this regards all construction works would be made at higher level taking maximum flood level in consideration. The plant will be designed above maximum flood level so that risks of injuries, accident, any process failure and other natural disaster could be minimized.

b) Other Safety Provisions

Beyond the above measures, the project would also have full provision for fire fighting and first aid medical services. The project has provision for purchasing safety items such as musk, aprons, hand gloves etc. from its recurring annual expenditure.

5.3 Environmental Impacts During Operation Phase

5.3.1 Impact on Occupational Health & Safety

Although work provides many economic and other benefits, a wide array of workplace hazards also present risks to the health and safety of people at work. These include but are not limited to, "chemicals, biological agents, physical factors, adverse ergonomic conditions, allergens, a complex network of safety risks," and a broad range of psychosocial risk factors. Some of the machines used in construction of intake, laying-pipelines and in the treatment plant, involve moving parts, sharp edges, hot surfaces and other hazards with the potential to crush, burn, cut, shear, stab or otherwise strike or wound workers if used unsafely.

5.4 Rapid Environmental Assessment Checklist

Checklist is comprehensive lists of environmental effects and impacts indicator designed to stimulate the analysts to think broadly about possible consequences of contemplated actions (Munn, 1979). Table 5.1 represents the checklists developed for the present plant.

It should be noted that identification indicated in the Checklists are based on assuming that no negative impacts mitigation measures are undertaken.

Table 5.1: Rapid Environmental Assessment Checklist

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area…			
Densely populated?	√		
Heavy with development activities?		√	
Adjacent to or within any environmentally sensitive areas?		√	
Cultural heritage site		√	
Protected Area		√	
Wetland	√		
Mangrove		√	
Estuarine		√	
Buffer zone of protected area		√	
Special area for protecting biodiversity		√	
Bay		√	
B. Potential Environmental Impacts Will the Project cause…			
pollution of raw water supply from upstream wastewater discharge from communities, industries, agriculture, and soil erosion runoff?		√	
hazard of land subsidence caused by excessive groundwater pumping?		√	
conflicts in abstraction of raw water for water supply with other beneficial water uses for surface and ground waters?		√	
unsatisfactory raw water supply (e.g. excessive pathogens or mineral constituents)?		√	
delivery of unsafe water to distribution system?		√	
over pumping of groundwater, leading to salinization and ground subsidence?		√	
excessive algal growth in storage reservoir?		√	
increase in production of sewage beyond capabilities of community facilities?		√	
impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage?		√	
overflows and flooding of neighboring properties with raw sewage?		√	

Screening Questions	Yes	No	Remarks
hazards to public health due to overflow flooding, and groundwater pollution due to failure of sewerage system?		√	
environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers?		√	
health and safety hazards to workers from toxic gases and hazardous materials which maybe contained in sewage flow and exposure to pathogens in sewage and sludge?		√	
inadequate disposal of sludge from water treatment plants?		√	
inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities?		√	
impairments associated with transmission lines and access roads?		√	
health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals..		√	
impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.		√	
deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity and increased waste generation to the point that both man-made and natural systems are overloaded and the capacities to manage these systems are overwhelmed?		√	
degradation of land and ecosystems (e.g. loss of wetlands and wild lands, coastal zones, watersheds and forests)?		√	
dislocation or involuntary resettlement of people		√	
degradation of cultural property, and loss of cultural heritage and tourism revenues?		√	
occupation of low-lying lands, floodplains and steep hillsides by squatters and low-income groups, and their exposure to increased health hazards and risks due to pollutive industries?		√	
water resource problems (e.g. depletion/degradation of available water supply, deterioration for surface and groundwater quality, and pollution of receiving waters?		√	
air pollution due to urban emissions?		√	
social conflicts between construction workers from other areas and local workers?		√	
road blocking and temporary flooding due to land excavation during rainy season?		√	

Screening Questions	Yes	No	Remarks
noise and dust from construction activities?	√		Project will avoid construction work during night
traffic disturbances due to construction material transport and wastes?	√		May cause some concern occasionally
temporary silt runoff due to construction?		√	
hazards to public health due to ambient, household and occupational pollution, thermal inversion, and smog formation?		√	

5.5 Impact Identification Checklist

Impact identification has also been carried out according to different project phases by using checklist method, which also provides specific idea of the impact. The methodology basically incorporates a list of environmental components which might be affected with the anticipated level of impact with respect to different project activities. Combining these lists as horizontal and vertical axis for the matrix allows the identification of cause effect relationship between the specific activities and impact levels.

Table 5.2: Effect of project activities on environmental parameters due to project location

Physico-chemical parameters	Environmental examination (SEIs without mitigation)						
	Positive impact			No impact	Negative impact		
	Low	Moderate	High		Low	Moderate	High
Land value depreciation		√					
Loss of land displacement from homestead				√			
Loss of land displacement from agriculture				√			
Damage to nearby operation				√			
Disruption to drainage pattern					√		
Inadequacy of buffer zone				√			
Encroachment into precious ecology				√			

Table 5.3: Effect of project activities on physico-chemical environmental parameters during construction phase

Physico-chemical parameters	Environmental examination						
	Positive impact			No impact	Negative impact		
	Low	Moderate	High		Low	Moderate	High
Water and soil quality					√		
Traffic flow					√		
Air quality					√		
Noise level						√	

Table 5.4: Effect of project activities on ecological parameters during construction phase

Ecological parameters	Environmental examination						
	Positive impact			No impact	Negative impact		
	Low	Moderate	High		Low	Moderate	High
Wetlands					√		
Homestead vegetables					√		
Forest cover				√			
Fisheries and macro-invertebrates					√		
Aquatic plants					√		

Table 5.5: Effect of project activities on socio-economic parameters during construction phase

Socio-economic parameters	Environmental examination						
	Positive impact			No impact	Negative impact		
	Low	Moderate	High		Low	Moderate	High
Human settlement	√						
Health and well being					√		
Navigation				√			
Transportation					√		
Employment		√					

Table 5.6: Effect of project activities on physico-chemical environmental parameters during operation phase

Physico-chemical parameters	Environmental examination						
	Positive impact			No impact	Negative impact		
	Low	Moderate	High		Low	Moderate	High
Water and soil quality			√				
Traffic flow	√						
Air quality				√			
Noise level				√			

Table 5.7: Effect of project activities on ecological parameters during operational phase

Ecological parameters	Environmental examination						
	Positive impact			No impact	Negative impact		
	Low	Moderate	High		Low	Moderate	High
Wetlands		√					
Homestead vegetables			√				
Forest cover	√						
Fisheries and macro-invertebrates				√			
Aquatic plants				√			

Table 5.8: Effect of project activities on socio-economic parameters during operational phase

Socio-economic parameters	Environmental examination						
	Positive impact			No impact	Negative impact		
	Low	Moderate	High		Low	Moderate	High
Health and well being			√				
Navigation				√			
Transport	√						
Employment		√					
Industrial activities		√					
National economy		√					

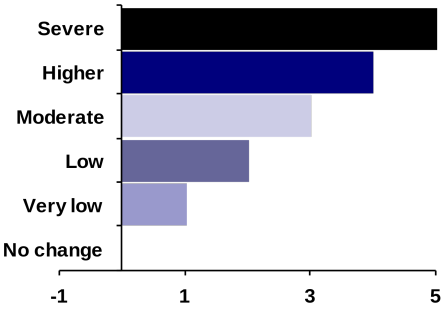
5.6 Evaluation of environmental impacts

The assessment of the beneficial and adverse changes in environment resources or values resulting from a proposed project has the following aspects:

- Essential Elements
    1. **Identification** of possible positive or negative impacts of the project.
    2. **Quantifying** impacts with respect to common base.

3. Preparation of **mitigation** plan to offset the negative impacts.

- Environmental Impact Value
- Vi = Relative change of the environmental quality of parameters
- Wi= Relative importance or weight or parameter
- N = total number of environmental parameters
- Changes of environmental parameters
    1. Severe (+5 or -5)
    2. Higher (+4 or -4)
    3. Moderate (+3 or -3)
    4. Low (+2 or -2)
    5. Very Low (+1 or -1)
    6. No change (0)



These aspects are incorporated to evaluate the environmental impact of the project which has been presented in Table 5.9. The analysis indicates that cumulative impact of the project is slightly negative. But things can turn positive by following proper mitigation measures which has been discussed in the EMP.

Table 5.9: Environmental impact evaluation (without mitigation)

ENVIRONMENTAL PARAMETERS	Relative Importance Value	Degree of Impact	EIV
I. ECOLOGICAL			
Fisheries	10	-2	
Forest	5	0	
Tree Plantation	2	+2	
Wetland/Wetland Habitat	4	0	
Nuisance Plant / Eutrophication	1	-1	-17
II. PHYSICO-CHEMICAL			
Erosion and Siltation	2	-1	
Regional Hydrology/Flooding	6	-1	
Drainage Congestion/Water logging	5	-1	
Obstruction to Waste Water Flow	3	0	
Dust Pollution/Noise Pollution	2	-1	-15
III. HUMAN INTEREST			
Loss of Agricultural Lands	8	-3	
Employment Opportunities	8	+4	
Navigation/Boat Communication	3	-2	
Commercial and Service Facilities	6	+3	
Industrial Activities	3	+2	
Irrigation Facilities	2	0	
Landscape	2	-1	+24
Total Environmental Impact Value			-8

6 EVALUATION OF ALTERNATIVES

6.1 General

This section examines alternatives to the proposed project site, technology, design, and operation in terms of their potential environmental impacts, and the feasibility of mitigating these impacts. It also states the basis for selecting alternative options for the component. The analysis of alternatives for the project components was carried out as part of the feasibility study, and has been taken forward and confirmed during the PPTA and the preparation of IEE.

Environmental impact studies typically address a minimum of two alternatives, and they can include upwards of fifty alternatives. To achieve a systematic approach to deciding among alternatives, it is desirable to use trade-off analysis. Trade-off analysis typically involves the comparison of a set of alternatives relative to a series of decision factors. Different approaches can be used to complete the trade-off matrix, i.e. I) qualitative approach, ii) quantitative approach, iii) ranking, rating or scaling approach, iv) weighting approach, and v) weighting-ranking, -rating, or -scaling approach. A weighting-rating approach is followed for analysis in the following sections.

Several alternatives were compared in this document to choose the best option considering their environmental impacts. The alternatives analyzed are as follows:

a) Intake location alternatives, b) Transmission line alternatives, c) River crossing methods alternatives, d) Route alternatives, e) Treatment plant location alternatives.

6.2 Intake Location

Two locations for intake at the Sitalakhya River and two at the Meghna River were investigated for their suitability as part of the feasibility studies. These locations are at:

i) Sitalakhya River, Kanchan Bridge–Purbachal
ii) Sitalakhya River, between Kaliganj ferry ghat and Ghorasal Bridge
iii) Meghna River, Bishnondi at the end of road # 204
iv) Meghna River, Baidder Bazar, approximately 10 km upstream of Meghna Bridge

A water quality sampling program was implemented at these locations. The four locations were inspected and analyzed by teams consisting of a geomorphologist, a geotechnical expert, water supply specialists, and civil engineers with the purpose of getting a first-hand impression, and to decide on a first prioritizing of the intake possibilities. The suggested options were reviewed for conformance to the following criteria applicable for selection of intake point:

i) Raw water should be treatable by conventional methods.
ii) The distance from intake to treatment plant should be as short as possible.
iii) The risk of near future urban (domestic) or industrial development upstream of the intake point must be acceptable.
iv) The river must be stable or controllable at the intake point site.
v) Intake points and transmission route should not involve unusual construction methods (if possible).
vi) A road should ideally be available between the intake point and the treatment site, where the transmission main can be constructed on the shoulder of the road.

The water quality monitoring of Sitalakhya River indicates heavy contamination from industrial effluents. There are large changes in the quality throughout the year from dry season to wet season, due to the large variations in flow and dilution of contaminants. The content of ammonia reaches 10-15 mg/l in the dry season, and has been steadily increasing throughout the last 10 years. It is evaluated that satisfactory treatment at Saidabad may become impossible within a few years. Other parameters are also unsatisfactory in the dry season, when, for example, a low oxygen content of 0-3 mg/l is recorded.

Based on the above, it is recommended not to consider basing the future water supply of Dhaka on Sitalakhya River, due to the risk of future deterioration of the water quality. It is recommended to use Meghna River instead, based on the conclusions regarding water quality (very good for conventional treatment) and the year-round flows of sufficient magnitude, compared with the demand at the intake. Investigations on river morphology have shown that the river reach along Bishnondi is considerably more stable than further south by Baidder Bazar. The bank at Baidder Bazaar is somewhat unstable and shifting by as much as 10-20 m/year.

The FS recommended the siting of intake at Bishnondi from the Meghna River, and a further study conducted under the PPTA endorsed that recommendation.

Table 6.1: Comparison of Intake locations by trade-off analysis

Sl	Decision Factors	Importance Weight (2=greatest)	Rating (1 = worst, 3 = best)			
			Sitalakhya – Kanchan bridge	Sitalakhya – Kaliganj	Meghna – Baidder Bazar	Meghna - Bisnondi
1	Construction cost	1	3	3	1	3
2	Technical feasibility	1	1	1	2	3
3	Environmental Effect	2	2	2	2	3
4	Social Effect	1	2	2	2	2
	Total Rating		10	10	9	**14**

6.3 Transmission Line Alternatives

The following alternatives for finalizing the 2,200-mm transmission lines were reviewed as part of the feasibility study.

Pipe in Trench

In the “pipe in trench” solution, the pipes will be buried in an excavated trench. At sections of the pipeline, it will have to be supported by piles due to weak soil. As the groundwater is high in the areas, the pipe will need to be supported against uplift. This can be achieved with approximately 2 m earth cover, but further anchoring may be necessary. Where piling is used, it may also act as anchoring against updrift.

Construction of a pipe in trench will take into account the high groundwater and poor soil conditions. Pipe-laying will not take place during the heavier rainy season (June, July, and August) and selectively in the months preceding and following. Once the pipe is buried, it will need little operation and maintenance. Access for inspection and cleaning arrangements shall be installed for routine maintenance; however, the system shall be designed to minimize such maintenance (e.g., by keeping a minimum carrying velocity in the pipeline).

There will be little impact on the daily activities in the area above and around the pipe route. The FS recommended acquisition of the corridor along the pipeline to enable easy access in case of repairs.

Pipe on Surface

In this option, the pipe is constructed at the surface and supported by concrete pillars. The solution will remove complications related to excavation of the trench, and installation will be easier than for a pipe in trench. This solution has the advantage of avoiding difficult trench work in areas with high groundwater, as well as the problems associated with uplift of pipes under groundwater level. However, the pipe will effectively be a barrier along the land and restrict cross movements across the line, although this can be mitigated by installing crossings. Further, given that the pipe will be visible, there is a likelihood of vandalism that can result in serious impacts on the water supply to Dhaka.

Culvert / Tunnel on Ground

In this option, a concrete culvert is considered instead of a pipe. Such a solution is technically feasible and less costly than a piped solution, as it can be manufactured using locally produced materials. The culvert will effectively be a tunnel at ground level, and it should be watertight in order to avoid water ingression in case of flooding. The solution would still require pumping at the intake, although with lower heads (and power costs) than a piped solution, but it would also require a booster pump station near Bhulta. The concrete should be properly protected internally and externally against corrosion. The culvert will need cleaning to remove sediments.

Bored Tunnel

The possibility of constructing the system as a bored tunnel was investigated, especially considering the location of transmission mains through populated areas, as this option will avoid interference with populated areas. Based on consultations and discussions with contractors specializing in bored tunnels, the preliminary advice received was that such a solution was not recommended, and that it would cost approximately 2-4 times that of a piped solution. Based on an evaluation of the options, PPTA recommended the laying of transmission mains in trench.

Various solutions for the transmission system have been compared in analyzed in Table 6.2.

Table 6.2: Comparison of transmission mode by Trade-off analysis

Sl	Decision Factors	Importance Weight (2=greatest)	Rating (1 = worst, 3 = best)			
			Pipes in trench	Pipes on surface	Culvert/Tunnel on Ground	Bored Tunnel
1	Construction cost	1	2	2	3	1
2	Technical feasibility	1	2	3	3	2
3	Environmental Effect	2	3	1	1	3
4	Social Effect	1	3	1	1	3
	Total Rating		**13**	11	9	12

6.4 River Crossings Along the Transmission Mains

Given the change of the configuration of the proposed project and the change in the WTP location to Gandharbpur from Khilkhet, the raw water mains do not require

crossing of rivers. However, the treated water mains, comprising two 2,000-mm pipes, will cross Sitalakhya and Balu Rivers. The feasibility study evaluated various types of river crossings along the transmission mains:

i) river crossing on a bridge structure
ii) river crossing in a covered trench below the river bed
iii) river crossing in a drilled casing below the river bed (directional drilling from the ground surface)
iv) river crossing in a bored tunnel from vertical shafts on each side of the river

Option (iii) can be carried out with a diameter of up to approximately 700 mm only. This would require about 12-14 casings to be drilled. The method is well known and assessed to be suitable for the soil conditions. If splitting the piping into this number of smaller pipes is acceptable, the method may be selected for further evaluation. However, construction cost is expected to be higher than for other options.

Options (i), (ii), and (iv) were evaluated for feasibility of construction and were found viable. Option (i) will minimize construction operations in the river, as the footprints of construction will be limited to the pier foundations as against the entire cross-section of the riverbed in options (ii) and (iv). In addition, option (i) has the advantages in maintenance of the pipe and minimum disruption to the water flow in the river during both construction and operation.

While option (iv) is technically feasible, the costs shall be higher than options (i) and (ii), considering the establishment of large diameter watertight vertical shafts and horizontal large diameter tunneling with expensive tunnel boring equipment. Further, micro-tunneling shall effectively avoid any disruption to the river flows, both during construction and operation.

Table 6.3: Comparison of river crossing methods Trade-off analysis

Sl	Decision Factors	Importance Weight (2=greatest)	Rating (1 = worst, 3 = best)			
			On a bridge structure	Covered trench below river bed	Drilled casing below river bed	Bored Tunnel & vertical shafts
1	Construction cost	1	3	2	1	2
2	Technical feasibility	1	3	2	3	2
3	Environmental Effect	2	1	1	2	3
4	Social Effect	1	2	2	2	2
	Total Rating		10	8	10	**12**

6.5 Alignment of Transmission Mains

An assessment of two options was carried out prior to finalization of routing of the raw water transmission mains from the intake to Gandharbpur along the Dhaka-Sylhet highway: alignment along existing access roads connecting to Gandharbpur WTP, and greenfield alignment through agricultural fields.

The first option involved routing the transmission mains along the internal access roads up to Bhulta, after which the mains shall be accommodated within the RoW of the Dhaka-Sylhet highway up to the Rupshi junction. The mains shall be accommodated within a RHD access road from Rupshi junction to the Gandharbpur WTP. The RoW available along the existing access roads from intake to Bhulta and from Rupshi junction to the Gandharbpur WTP varies from 12 m to 20 m, and passes

through several villages, including the town of Araihazar. The laying of the four 2,200-mm pipes will require a minimum width of 16-18 m.

The geometrics of the existing roads are poor, with several sharp curves, and shall result in significant resettlement impacts. Further, following the existing roads shall result in an increased road length of about 24 km as compared to the 22 km green field alignment through agricultural fields.

The second option of routing the transmission mains through agricultural fields, though involving private land acquisition, has been found to be more feasible than the alignment along existing access roads, as it shall result in lesser displacement of residential and commercial properties.

Based on comparison of the options, the green field alignment option for a length of 22 km from the intake to the Gandharbpur WTP via Shezan juice factory has been recommended.

Table 6.4: Comparison of transmission routes by Trade-off analysis

Sl	Decision Factors	Importance Weight (2=greatest)	Rating (1 = worst, 3 = best)	
			Along existing roads	Green-field alignment
1	Construction cost	1	2	3
2	Technical feasibility	1	2	3
3	Environmental Effect	2	1	2
4	Social Effect	1	1	2
	Total Rating		7	**12**

6.6 Location of Treatment Plant

This study concerns the future supply of water to greater Dhaka and particularly supply of water to northern parts of the city including Khilkhet.

The study highlights that there are advantages in placing the treatment plant at the location of the intake:

- Removal of any risk of siltation of long transmission lines and avoiding pre-treatment that may become necessary;
- Removal of any risk of damage caused by aggressive water, which may otherwise necessitate pre-treatment (aeration);
- Lesser pumping (savings in WTP losses and back-wash water). Savings may be up to 2-3 %.
- Land acquisition will be easier.

On the other hand it is noted that re-chlorination will be necessary near the distribution network. Furthermore the blending of the water from the intake with the water at Saidabad can lead to operational problems. Three possible sites for the treatment plant are considered for comparative study. Among the sites, Gandharbpur, Rupgonj site is located on the proposed alignment of the pipeline and is at about at the middle stretch between intake and delivery injection points at Dhaka city.

In general furthest location incurs lowest cost for land acquisition which effects the total cost of the system. As more people will be effected and will be at risk of immediate pollution, if any, the densely populated city area have higher risk of environmental pollution than lightly populated areas.

Khilkhet and along intake site needs land acquisition for treatment plant, whereas, Gandharbpur, Rupgonj site already been acquired by DWASA long ago which can be used without any further new acquisition.

Table 6.5: Comparison of transmission routes by Trade-off analysis

Sl	Decision Factors	Importance Weight (2=greatest)	Rating (1 = worst, 3 = best)		
			At Khilkhet	Along intake	Gandharbpur, Rupgonj
1	Construction cost	1	1	2	3
2	Technical feasibility	1	3	1	2
3	Environmental Effect	2	1	3	2
4	Social Effect	1	1	2	3
	Total Rating		7	11	**12**

7 ENVIRONMENTAL MANAGEMENT AND MITIGATION PLAN

7.1 Organization Management Aspects

Executive responsibility for project management commonly involves a number of organizations, each with specific responsibilities for particular aspects during the pre-construction, construction and operation and maintenance phases.

7.1.1 Pre-construction Phase

Prior to contractor mobilization and the commencement of construction, environmental management will cover six principal groups of activities:

- Review of EIA and put additional mitigation/enhancement measures as necessary for all sub-projects;
- Preparation of a detailed Environmental Management & Monitoring Plan (EM&MP) but with sections which deal with any additional matters relating to specific project activities. The EM&MP will address fully the nature and extent of other related agencies/departments involvement in environmental management, and will provide cost estimates for environmental management and monitoring;
- Preparation of detailed designs which give due consideration to minimization of adverse impacts and benefit enhancement;
- Preparation of tender and construction contract documentation which contains appropriate clauses to allow control of impacts arising from construction activities;
- Preparation of a Resettlement Action Plan (RAP), or more correctly, a Land Acquisition Plan (LAP), since no major resettlement is anticipated;
- Acquisition of land and property to accommodate the proposed works.

Responsibility for reviewing of EIA, preparation of the EM&MP, detailed design, and the preparation of tender and contract documentation lies with the study and design consultants, who are providing this service to DWASA. Overall responsibility for environmental management in these respects will, therefore, lie with the consultant's Team Leader, supported by his environmental team, and the contract document specialist.

The management, design and supervision consultant will be responsible for preparing site plans showing the extent of land which will have to be acquired in order to accommodate the project works, together with an estimate of land and property acquisition costs, for inclusion in the project budget.

Water Safety Plan

The water sector in Bangladesh has made significant efforts to develop and implement water safety plans (WSPs) for rural and urban water supplies. The World Health Organization promotes the use of water safety plans in the 3rd edition of the Guidelines for Drinking Water Quality as a key component of an overall water safety framework. The results of the study had been very positive and the success of a diverse range of organizations in implementing WSPs.

The features of WSPs are such that they ought to be dynamic and would require regular review and updating as new information is obtained about performance of WSPs, hazards and risk events. Apart from that, on a broader perspective, for the overall WSP implementation vis-à-vis identification of its limitations, area of

improvement etc. a workable but adequately robust surveillance system is a prerequisite. Furthermore, there is also a strong urge to have close linkage with WQ monitoring system.

A well built Water Safety Framework (WSF) with implementation guidelines is expected to provide such system and linkages in place. A water quality monitoring proposal is provided in the EIA report. It is recommended that the design of the treatment provided by Design Build Contractor should encompass a WSF linked with WQ monitoring, which will be implemented during construction and operation of the water treatment plant.

7.1.2 Construction Phase

Environmental management during the construction phase is essentially concerned with controlling impacts which could result from the activities of the DBO contractor, through enforcement of those contract clauses which relate to environmental protection. It is important to recognize that the clauses relating to control of construction impacts will not themselves have any effect unless they are fully implemented and enforced.

Primary responsibility for construction supervision and contract management will lie with the Engineer, as defined in the construction contract who is the Project Director. He has overall responsibility for environmental management during the construction phase. It is anticipated that the Engineer will be assisted in construction supervision by staff from management, design and supervision consultant, and that day-to-day responsibilities for site supervision, including environmental management aspects, will lie with the Engineer's Representative, who will have specific powers and responsibilities delegated to him by the Engineer.

The Consultant's Environmental Specialist will review the effectiveness of approaches adopted towards environmental management and monitoring.

During the site clearance and earthwork, it the necessary to be careful about the following:

- No soil erosion occurs, plantation can be done to protect soil erosion
- No landslides occurs
- No siltation occurs at the disposal site of soil and debris.

7.1.3 Operation and Maintenance Phase

Some of the impacts, which are expected to occur during the operational phase, are essentially related to the design of the project, and in this respect the principal environmental management functions are the responsibility of the design consultants. Matters relating to safety and risk management, will be the responsibility of the local authorities concerned.

Matters relating to routine and periodic maintenance, will be the responsibility of DWASA, and environmental management responsibilities will also lie with this body. The major part of environmental management at this stage is expected to be concerned with matters relating to maintenance and management of different units of treatment plant.

Management of runoff is important for this project. The landscape of the developed area should be such that the surface runoff is adequate and no water logging occurs. Sufficient drainage with adequate capacity should be ensured. During the implementation, this should be ensured by DWASA.

Disposal of liquid waste and sludge from the treatment plant is another important issue. A waste collection system will be in operation to handle solid wastes, oily rags, and used fuel and lube oil filters in a leak-proof container that will be stored and

disposed off at the landfill site, to ensure effective management of solid wastes at the treatment plant site. DWASA will ensure regular maintenance of the sludge-drying beds at the WTP. Utilization of dried sludge for horticultural/ agricultural purposes, as suitable, will be carried out. Disposal of alum sludge will be at the sanitary landfill site in Dhaka. Reuse of sludge will be explored after testing to meet government safety standards.

7.2 Implementation of Mitigation Measures

Table 7.1 presents the mitigation measures proposed to address the environmental impacts during the various stages of project implementation. The measures required to be taken up for each of the three procurement packages in the project are highlighted. Based on the detailed designs, the measures will be further detailed, and stand-alone EMPs developed for each of the three contract packages and incorporated in the bid documents for implementation.

Table 7.1: Environmental Impacts and Mitigation Measures

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
1.0	**Design Stage**				
1.1	Land acquisition and resettlement impacts required due to the project components and sensitive land uses	Permanent	Significant	Land acquisition and resettlement impacts will be significant for Package 1, while mostly temporary impacts will occur for Packages 1 and 2. These impacts will be addressed through the RP. The design engineers will also take all measures to avoid sensitive local land uses, such as graveyards (e.g., small grave yard at WTP site). This should be added in RAP.	PMU and RAP implementation NGO
1.2	Relocation of utility lines along the transmission mains	Permanent	Moderate	All utilities and services impacted due to the proposed components will be shifted/relocated, with prior approval of the concerned agencies.	PMU
1.3	Impacts on fisheries in Meghna River	Permanent	Moderate	Design of the water intake will be carried out to avoid impacts on hilsa fish, the key species found in Meghna River requiring protection. The design of the intake screen will be based on the following key considerations as per the recommendations of the fisheries expert of the SC: 1. The screen face will be oriented in the same direction as the flow. 2. The water velocity flowing through the structure against which the fish will have to swim must be lower than the fishes' swimming capability. 3. Screens will be located above the bottom of the watercourse to prevent entrainment of sediment and aquatic organisms associated with the bottom area. 4. Screen sizes will be determined based on assessment of fish sizes at the location and the swimming characteristics of hilsa and it is recommended that the opening shall not exceed 3/32 inch (2.38 mm) for woven wire or perforated plate screens, or 0.0689 inch (1.75 mm) for profile wire screens, with a minimum 27% open area. It is also recommended to provide screen in the direction of flow to escape small fish and spawn from the screen as shown in Figure 5.1.	Contractor, with technical guidance from the fisheries expert of the Supervision Consultant (SC)

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
1.4	Impacts on water abstraction and ecological flows of Meghna River, especially in lean flow	Permanent	Moderate	The proposed abstraction accounts for 0.31% of the lean flows for the ultimate intake capacities of 1,050 MLD (2035). Therefore, no impacts on downstream uses or impairment of ecological flows in Meghna River are envisaged.	PMU
1.5	Seismic considerations in design of structures	Permanent	Moderate	The designs of the project components, including intake structures and transmission mains, will conform to Bangladesh National Building Code, 2006.	Design Build Contractor, and SC
1.6	Damage to trees and clearance of vegetation at the project locations	Permanent	Moderate	**Intake and WTP:** Only trees that will require removal within the proposed construction areas of the sites will be cut. After the finalization of the designs and layout of the project components, the trees within proposed construction areas will be marked. For trees not proposed to be cut, taking all precautions to protect them from any damage from construction activities, including placement of tree guards, will be taken up. **Transmission mains:** Trees within the corridor of impact (area required for construction) will be felled after prior approval. **Tree Plantation:** Log trees will be planted at the suggested/appropriate distances on both slopes of the service roads, which will surplus the loss of trees cut by many times. The social plantation model as followed by the MoEF can be followed in such cases.	PMU with support from SC Design Build Contractor
1.7	Assets/facilities lost, including common property resources and religious structures	Permanent	Moderate	Designs to be worked out to minimize impacts on these assets. Compensation and assistance will be provided in accordance with the provisions of the RP. Designs to ensure cross-drainage through provision of balancing culverts and sufficient cross-movement, including movement of fishes, shall be done to minimize severance impacts on khals and fish ponds cut across by the alignment.	Design Build Contractor, and SC
1.8	Pollution control and	Permanent	Moderate	In consultation with the BIWTA, design of sanitation facilities and solid waste	Design

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
	IEC activities upstream of the source, including sanitation facilities and waste collection facilities at Manikpur ferry ghat			collection facilities shall be carried out within lands belonging to the BIWTA. The NGO implementing the RP shall be assigned responsibilities to carry out awareness campaigns on source protection at key locations within 50 km upstream of the source.	Buiild Contractor, and SC
1.9	Locations for disposal of spoil	Permanent	Moderate	**Transmission** mains: A utilization plan for the disposal of earth resulting from the excavation will be prepared by the contractor as part of the spoil management plan. It is envisaged that nearly 90% of the excavated earth will be utilized for the construction of the access road embankments. The sites for disposal of the remaining quantities will be identified prior to finalization of the designs, and the same incorporated into the BoQs. **Transmission mains within road RoW:** The entire volume of spoil generated from the trenches laid for the transmission mains will be required for refilling upon laying of the pipes. The contractor will identify locations for temporary storage of spoil outside the RoW. The identification of suitablelocations shall be carried out by the contractor in line with the siting criteria for temporary construction areas defined in item 1.8.	Design Build Contractor, and SC
1.10	Location, selection, design and layout - Construction camps and/or hot mix plants, storage areas, stockpiles, and disposal areas	Temporary	Moderate	The construction camps, hot mix plants, storage areas, stockpiles, and disposal areas will be located as per the following siting criteria – (i) at least 500 m away from habitations and areas notified as ecologically critical areas (ECA), and (ii) at least 100 m away from khals and other water bodies. At these locations, the contractor will work out layouts adhering to the air and water standards prescribed by DoE. Sites to be considered will not promote instability and result in destruction of property, vegetation, irrigation, and/or drinking water supply systems. All locations will be included in the design specifications and plan drawings.	Design Build Contractor, and SC
1.11	Identification of sources of materials	Permanent	Moderate	The contractor, at the detailed design stage, shall (i) identify all potential material sources; (ii) propose quarry sites and sources permitted by	Design Build

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
				government; and (iii) verify suitability of all material sources and obtain approval of SC.	Contractor / SC
1.12	Drinking water availability and water arrangement	Temporary	Moderate	Prior to the initiation of construction activities, the contractor will be responsible for arrangement of water in every workplace at suitable and easily accessible places for the whole construction period. Sufficient supply of cold potable water will be provided and maintained at the construction camps and other ancillary work areas.	Design Build Contractor / SC
1.13	Sludge management and disposal	Temporary	Moderate	Design of WTP to include sludge drying beds, and sludge management plan to be prepared.	Design Build Contractor / SC
1.14	Update EIA	Temporary	Moderate	The draft EIA will be updated based on detailed designs, and submitted to ADB for review, approval, and disclosure prior to commencement of work.	Design Build Contractor / SC / DWASA
1.15	Environmental clearance	Temporary	Moderate	The draft EIA will be updated to prepare government's EIA, implemented as a single unified document, and submitted to DoE as part of environmental clearance requirement. The EC is to be obtained prior to commencement of civil works.	Design Build Contractor / SC / DWASA
2.0	**Construction Stage**				
2.1	Quarry / borrow pit operations	Permanent	Moderate	The contractor will: (i) obtain approval of implementing agency if new quarries and borrow sites are necessary; (ii) store stripped materials as not to disrupt natural drainage and protect them to prevent erosion and migration of soil particles into surface waters; (iii) provide temporary ditches and/or settling basins to collect run-off water and to prevent erosion and contamination of surface water; (iv) plant exposed areas with suitable vegetation at the earliest	Design Build Contractor and SC

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
				opportunity and prevent ponding of water through temporary drains discharging to natural drainage channels; (v) restore sites after construction activities by stabilizing contours and slopes, spreading stripped materials to promote percolation and re- growth of vegetation, and draining any standing water. Land utilized for quarry sites access roads will also be restored; and (vi) ensure adequate safety precautions during transportation of quarry material from quarries to the construction site. Vehicles transporting the material will be covered to prevent spillage.	
2.2	Damages to utilities and services during construction	Permanent	Moderate	The contractor will be required to: (i) plan for immediate attendance by the service providers to any damages to utilities during construction; (ii) replace (or compensate for) public and private physical structures damaged due to construction or vibration; and (iii) provide prior public information about the likely disruption of services. In consultation and with support from DWASA, the contractor will provide alternate arrangements for water supply in the event of disruption beyond reasonable time, for instance, through tankers.	Design Build Contractor and SC
2.3	Stockpiling of construction materials, excavated earth/spoil from trenches	Temporary	Moderate	Due consideration will be given for material storage and construction sites such that it doesn't cause any hindrance to daily traffic movement. The contractor will (i) consult with implementing agency on the designated areas for stockpiling of clay, soils, gravel, and other construction materials; (ii) avoid stockpiling of earth fill, especially during the rainy season, unless covered by tarpaulins or plastic sheets; (iii) prioritize reuse of excess spoils and materials in the construction works; and (iv) protect surface water bodies from any source of contamination, such as oily wastes, debris, and spoils that will degrade its quality.	Design Build Contractor / SC
2.4	Stripping, stocking, and preservation of top soil	Permanent	Moderate	The topsoil from productive agricultural lands at the intake site, Gandharbpur WTP, borrow areas, and areas to be permanently covered will be stripped to a specified depth of 150 mm and stored in stockpiles. The stockpile will be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile will be restricted to 2 m. Stockpiles will not be surcharged or otherwise loaded, and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles will be covered with gunny bags or	Design Build Contractor and SC

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
				tarpaulin. It will be ensured by the contractor that the topsoil will not be unnecessarily trafficked, either before stripping or when in stockpiles. Such stockpiled topsoil will be returned to cover the disturbed area and cut slopes.	
2.5	Dewatering of trenches	Temporary	Moderate	For dewatering of groundwater encountered during construction of trenches, the contractor shall work out arrangements for dewatering in consultation with the SC. Prior to discharging the water in the trench onto private lands or water courses, consent of the land owner confirming his acceptance to receive the groundwater shall be submitted to the SC. In areas connected to a sewerage system, the contractor shall carryout the dewatering after obtaining permission from DWASA for the volume of water to be discharged, after payments of any charges towards the treatment of the water at the STP. The contractor shall, in consultation with the SC, work out appropriate vector control measures to minimize health impacts on the surrounding communities, during the excavation of the trenches.	Design Build Contractor and SC
2.6	River crossings required for the transmission lines at the Sitalakhya and Balu Rivers by micro-tunneling	Permanent	Moderate	The construction activities at the river crossings will be carried out in conformance with the conditions laid down by the BIWTA in the permit for river crossings. The vertical shafts shall be located outside the watercourse or riverbed to minimize migration of contaminated soil or water into the river. The contractor shall identify suitable locations for disposal of the soil and water from the tunnel. Precautionary measures will be taken by the contractor to ensure that there is no disposal of construction wastes/materials into the river or on the shores. The construction activities and operations for the river crossings will be planned to ensure that interference of cargo boats, navigation—including fishermen, and passenger movements — are minimal. Advance notices of disruption, if any, will be disclosed. The construction activities and laying of pipes will be carried out in such a manner that the dredging activities of the river are not affected.	Design Build Contractor and SC
2.7	Water crossings for the pipelines for khals and ponds	Permanent	Moderate	Trenching and backfilling operations at the stream crossings will be carried out in the lean seasons, when the flow will be minimum. In case of crossings at existing minor bridges and culverts, the contractor will ensure that there is no	Design Build Contracto

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
				impact/ disturbance to the bridges/culverts due to crossing of the water pipelines.	r and SC
2.8	Soil erosion	Permanent	Moderate	The measures to address soil erosion at the proposed facilities will consist of measures as per design, or as directed by the SC to control soil erosion, sedimentation, and water pollution. All temporary sedimentation, pollution control works, and maintenance thereof will be deemed incidental to the earthwork or other items of work.	Design Build Contractor and SC
2.9	Use of explosive materials	Permanent	Moderate	Except as may be provided in the contract or ordered or authorized by the SC, the contractor will not use explosives. The contractor will, at all times, take every possible precaution, and will comply with appropriate laws and regulations relating to the importation, handling, transportation, storage, and use of explosives and will, at all times when engaged in blasting operations, post sufficient warning flagmen. The use of explosive materials will be carried out by the contractor only after obtaining written approval of the SC of the procedures to be followed.	Design Build Contractor and SC
2.10	Loss of access to residents, businesses, and institutions during construction.	Temporary	Moderate	The contractor will provide safe and convenient passage for vehicles and pedestrians through diversions to and from side roads, and property access connecting the project roads. The contractor will ensure that (i) the construction works do not interfere with the convenience of the public or access to, use, and occupation of public or private roads, or any other access to properties, whether public or private. Temporary access to properties adjacent to the construction site will be provided through the construction of ramps with concrete slabs for use of pedestrians and light vehicles; (ii) in critical areas such as institutions, operating hours are factored into work schedules and workforce is increased for speedy completion; (iii) advance information on works to be undertaken including appropriate signages, is provided; and (iv) the diversion is done in coordination with the traffic police division for necessary rerouting of traffic and traffic management.	Design Build Contractor and SC
2.11	Soil and water	Temporary	Moderate	The fuel storage and vehicle cleaning area will be stationed such that runoff	Design

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
	pollution due to fuel, lubricants, and construction waste			from the site does not drain into the water bodies/ponds abutting the construction sites. Oil interceptors will be provided at construction vehicle parking areas, vehicle repair areas, and workshops, ensuring that all wastewater flows into the interceptor prior to its discharge. All work sites will be cleaned and restored to pre-project conditions. Discharge standards promulgated under Schedule 10, standards for waste from industrial units or projects waste, will be strictly adhered to.	Build Contractor and SC
2.12	Generation of dust	Temporary	Moderate	The contractor will (i) take every precaution to reduce the levels of dust at construction sites, and not exceeding the pre-project ambient air quality standards; (ii) fit all heavy equipment and machinery with air pollution control devices that are operating correctly; (iii) reduce dust by spraying stockpiled soil, excavated materials, and spoils; (iv) cover with tarpaulin vehicles transporting soil and sand; and (v) cover stockpiled construction materials with tarpaulin or plastic sheets.	Design Build Contractor and SC
2.13	Emission from construction vehicles, equipment, and machinery	Temporary	Moderate	All vehicles, equipment, and machinery used for construction will be regularly maintained to ensure that pollution emission levels comply with the relevant requirements of DoE. Copies of conformance will be submitted regularly to the SC.	Design Build Contractor and SC
2.14	Movement of construction vehicles	Temporary	Moderate	The movement of construction materials and equipment, to the extent possible, will be planned along major roads, with the exception of access roads to the site. In the event of movement of construction vehicles and equipment on the narrow roads, strengthening of these roads will be carried out, and timing of movement of heavy vehicles worked out to avoid peak hours and nighttime, and to ensure minimal disturbances to the communities and the resident population along these roads.	Design Build Contructor and SC
2.15	Noise from construction equipment	Temporary	Moderate	The contractor will ensure (i) regular maintenance of vehicles, equipment, and machinery to keep noise from these at a minimum; and (ii) all vehicles and equipment used for construction will be fitted with exhaust silencers. During	Design Build Contracto

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
				routine servicing operations, the effectiveness of exhaust silencers will be checked, and if found to be defective, will be replaced.	r and SC
2.16	Traffic control and safety	Temporary	Moderate	Before taking up any construction activities that would require traffic [13] diversion, traffic control plans will be prepared and submitted to the SC for approval 5 days prior to commencement of work on any section of road. The contractor will ensure that the running surface is always maintained in good condition, particularly during the monsoon. The contractor will provide road signs and flag persons to warn of dangerous conditions. All necessary measures for the safety of traffic during construction and the erection and maintenance of such barricades, including signs, marking flags, lights, and flagmen, will be undertaken as per SC's direction and approval.	Design Build Contractor and SC
2.17	Material handling at site	Temporary	Moderate	All workers employed for mixing asphaltic material, cement, concrete, etc. will be provided with protective footwear and goggles. Workers engaged in welding works will be provided with welder's protective eyeshields. The use of any toxic chemical will be strictly in accordance with the manufacturer's instructions.	Design Build Contractor and SC
2.18	Disposal of bituminous wastes / construction waste / debris / cut material	Temporary	Moderate	For project components involving demolition of structures, the contractor will prepare and implement a waste management plan. Safe disposal of the extraneous material will be ensured in the pre-identified disposal locations. To enable minimization of waste disposal and do this in an environmentally safe manner, the waste management plan will (ii) recover used oil and lubricants and reuse or remove from the site; (ii) manage solid waste according to the following preference hierarchy: reuse, recycle, and dispose of in designated areas; (iii) reuse bituminous waste generated in road construction, based on its suitability for reuse, to the maximum extent possible. Cut material generated because of construction will be utilized as filling material. Remaining material if any will be disposed off safely at the disposal sites; (iv) remove all wreckage, rubbish, or temporary structures that are no longer required; and (v) restore pre-project	Design Build Contractor and SC

13 The traffic control plans will contain details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day.

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
				environmental conditions through implementation of environmental restoration work.	
2.19	Safety measures during construction	Temporary	Moderate	All relevant provisions of the Bangladesh Labor Act, 2006 and Bangladesh National Building Code, 2006 will be adhered to, with regards to provision of adequate safety measures during construction. The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches, and safe means of entry and egress.	Design Build Contractor and SC
2.20	Temporary measures for construction activities around habitations/ institutional uses	Temporary	Moderate	The contractor will provide the following measures during the laying of transmission mains for sections in the vicinity of habitations and commercial and institutional areas, to minimize access and livelihood disruption: (i) place walkways and metal sheets where required to maintain access across trenches for people and vehicles; (ii) increase workforce in front of critical areas such as institutions, places of worship, business establishments, hospitals, and schools; (iii) consult businesses and institutions regarding operating hours and factoring this into work schedules; and (iv) provide signboards for pedestrians to inform them of nature and duration of construction works and contact numbers for concerns/complaints.	Design Build Contractor and SC
2.21	Risk caused by force majeure	Temporary	Minor	All reasonable precaution will be taken to prevent danger to the workers and the public from fire, flood, drowning, etc. Specifically, the contractor will (i) provide medical and accident insurance for workers; (ii) provide first aid in the construction camp site; and (iii) provide access to hospitals/clinics within the project site that can be accessed in case of emergency by arranging necessary transport for safe carriage of the injured.	Design Build Contractor and SC
2.22	Malaria risk	Temporary	Moderate	The contractor will, at his own expense, conform to all anti-malaria instructions given to him by the SC.	Design Build Contractor and SC
2.23	First aid	Temporary	Moderate	At every workplace, a readily available first aid unit, including an adequate supply of sterilized dressing material and appliances, will be provided as per the	Design Build

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
				factory rules. Suitable transport will be provided to facilitate transfer of injured or ill persons to the nearest hospital. At every workplace and construction camp, equipment and nursing staff will be provided.	Contractor and SC
2.24	Hygiene in the construction camps and sites	Temporary	Moderate	All temporary accommodations will be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking, and washing. Safe drinking water in sufficient quantity for the work force will be provided at the construction site as well as at the construction camps. Adequate toilets, separate for women and men, shall be provided at the construction sites, with septic tanks. Garbage bins will be provided in the camps and regularly emptied, and the garbage disposed of in a hygienic manner. Adequate health care will be provided for the work force. Unless otherwise arranged for by the local sanitary authority, the local medical health or municipal authorities will make arrangement for disposal of excreta. On completion of the works, all such temporary structures will be cleared away, all rubbish burned, excreta tank and other disposal pits or trenches filled in and effectively sealed off, and the outline site left clean and tidy, at the contractor's expense. The site will be restored to pre-project conditions through removal of all extraneous material on site.	Design Build Contractor and SC
2.25	Archaeological property chance find	Permanent	Moderate	In the event of an archaeological chance find at the construction site, the contractor will prevent workmen or any other persons from removing and damaging any chance find artifacts and will, immediately upon discovery thereof, inform the SC of such discovery and carry out the SC's instructions for dealing with the same, awaiting which all work will be stopped for 100 m in all directions from the site of discovery. The SC will seek direction from the Department of Archaeology before instructing the contractor to resume work on the site.	Design Build Contractor and SC
2.26	Clearing of construction camps and restoration	Temporary	Moderate	Contractor will prepare site restoration plans for approval by the SC. The plan will be implemented by the contractor prior to demobilization. On completion of the works, all temporary structures will be cleared away, all rubbish burned,	Design Build Contracto

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
				excreta or other disposal pits or trenches filled in and effectively sealed off, and the site left clean and tidy, at the contractor's expense. The site will be restored to pre-project conditions through removal of all extraneous material on site. During the site clearance and earthwork, it the necessary to be careful about the following: • No soil erosion occurs, plantation can be done to protect soil erosion • No landslides occurs • No siltation occurs at the disposal site of soil and debris.	r and SC
3.0	**Operation Stage**				
3.1	Environmental conditions	Permanent	Moderate	DWASA will undertake seasonal monitoring of air, water, noise, and soil quality through an approved monitoring agency. The parameters to be monitored, frequency and duration of monitoring, as well as the locations to be monitored will be as per the monitoring plan prepared.	DWASA
3.2	Impacts on downstream uses at the intake point	Permanent	Moderate	Assessment of flows will be done annually by DWASA, especially during the lean season, to ensure that there is no impact on the downstream uses.	DWASA
3.3	Effectiveness of intake screens	Permanent	Moderate	DWASA will periodically monitor the effectiveness of the intake screens, in terms of fish sizes and quantities of fish passing through the screen. Any modifications to the screen as required will be taken up in consultation with the fisheries department.	DWASA
3.4	Source protection - water quality	Permanent	Moderate	Continuous water quality monitoring at the upstream locations as defined in the monitoring plan will be carried out, in addition to semi-annual field visits by DWASA jointly with the DoE representative to assess any potential polluting activities/ threats. The findings shall be documented, taken up, and presented to the steering committee for decision.	DWASA/ DoE
3.5	Survival of trees,	Permanent	Moderate	Proper care will be taken to increase survival rate of saplings, like regular	DWASA

Sl No.	Environmental Issues	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
	maintenance of landscaping, and the green buffer zone			watering, pruning, provision of tree guards, provision of manure for better nourishment, etc., including timely replacement of perished saplings.	
3.6	Occupational health and safety at the intake /treatment facilities	Permanent	Moderate	DWASA will establish procedures and systems to maintain sound occupational health and safety for personnel at the various facilities, including use of PPE, provision of training on occupational health and safety to all workers, etc. To address environmental risks, during the operation of the facilities, DWASA will develop and implement an emergency action plan, which will include training and systems on emergency response systems and procedures.	DWASA
3.7	Management of sludge and waste at the treatment plant	Permanent	Moderate	During operation of the WTP, physical and chemical sludge will be generated. This drinking water treatment sludge usually contains colloidal iron and alum hydroxides, colloidal or dissolved organic matter, clay, silt and microorganisms. It should not contain heavy metal and toxic chemicals. After dehydration and drying the sludge is proposed to use as fill material for lowlands as reclaimed land for public parks, roadsides, golf courses, lawns and home in nearby areas after analyzing characteristics of the sludge, if it doesn't not contain any toxic chemical. The disposal of the alum sludge is proposed at the landfill site of Dhaka at Matuail, about 10 km from the proposed WTP if it is not possible to use as fill material.	DWASA
3.8	Effective maintenance of the sludge-drying beds at the WTP	Permanent	Moderate	DWASA will ensure regular maintenance of the sludge-drying beds at the WTP. Utilization of dried sludge for horticultural/ agricultural purposes, as suitable, will be carried out. Disposal of alum sludge will be at the sanitary landfill site in Dhaka. Reuse of sludge will be explored after testing to meet government safety standards.	DWASA
3.9	Management of solid waste at the treatment plant	Permanent	Moderate	A waste collection system will be in operation to handle solid wastes, oily rags, and used fuel and lube oil filters in a leak-proof container that will be stored and disposed off at the landfill site, to ensure effective management of solid wastes at the treatment plant site.	DWASA

7.3 Detailed Environment Monitoring Plan

Table 7.2: Monitoring Plan for proposed developments

Sl. No	Attributes	Stage	Parameters to be Monitored	Location	Frequency	Responsibility
1	Air Quality at each location of items (especially at road side)	Construction Stage	PM, SPM, SO_2, NOx, CO	at the construction areas (2 locations)	Once in a Year (dry season) for the entire construction period	Contractor, to be monitored through approved Monitoring Agency and PMU (DWASA and SC)
2	Noise Levels in silence zone	Construction Stage	Equivalent Day & Night Time Noise Levels	At WTP, and @ 2km intervals along the pipe alignment.	Twice in a year	Contractor, to be monitored through approved monitoring Agency and PMU (DWASA and SC)
		Operation Stage		At boundary of WTP	Once in a year	DWASA
3	Water quality	Construction stage	TDS, TSS, pH, Hardness, BOD and Faecal Coliform	At 150 m downstream of river / stream crossings and intake location.	Twice a year (pre monsoon and post monsoon) for the entire period of construction	Contractor, to be monitored through approved monitoring Agency and PMU (DWASA and SC)
4	Water Flow Rate	Construction and Operation phases	Q_{lean}	Nearest BWDB measurement gauge near intake	Once in a year	DWASA in conjunction with BWDB
5	Adequacy of solid waste management systems proposed to handle sludge and other treatment plant wastes	Post Construction Stage & Operation stage	Functionality of sludge drying beds. Disposal route for alum sludge.	WTP	Before, during and after the monsoons, annually for 3 years	DWASA

Sl. No	Attributes	Stage	Parameters to be Monitored	Location	Frequency	Responsibility
6	Survival Rate of Plantation and landscaping	Operation Stage	Survival Rate of Proposed roadside plantations	Along the project road and in the landscaped portions within the WTP	Twice a year till the trees reach a minimum height of 2m	DWASA
7	Socioeconomic monitoring	Operation Stage	Compensation disbursement accuracy and efficiency, public feedback on this issue.	Affected population who have faced land acquisition	Monthly basis till all compensations are paid and feedbacks gathered	DWASA

7.3.1 Institutional Arrangements

DWASA will be the executing agency responsible for overall guidance and project implementation. Through a Project Director, DWASA will implement the project investments and will be responsible for overall planning, management, coordination, supervision, and progress monitoring of the Project. The DWASA will be responsible for day-to-day monitoring of project activities and will ensure compliance with the statutory and legal requirements of the Government, and ADB. The DWASA will prepare and submit an updated EIA and Project Monitoring Reports to ADB. Figure 7.1 shows the organizational chart for EIA implementation

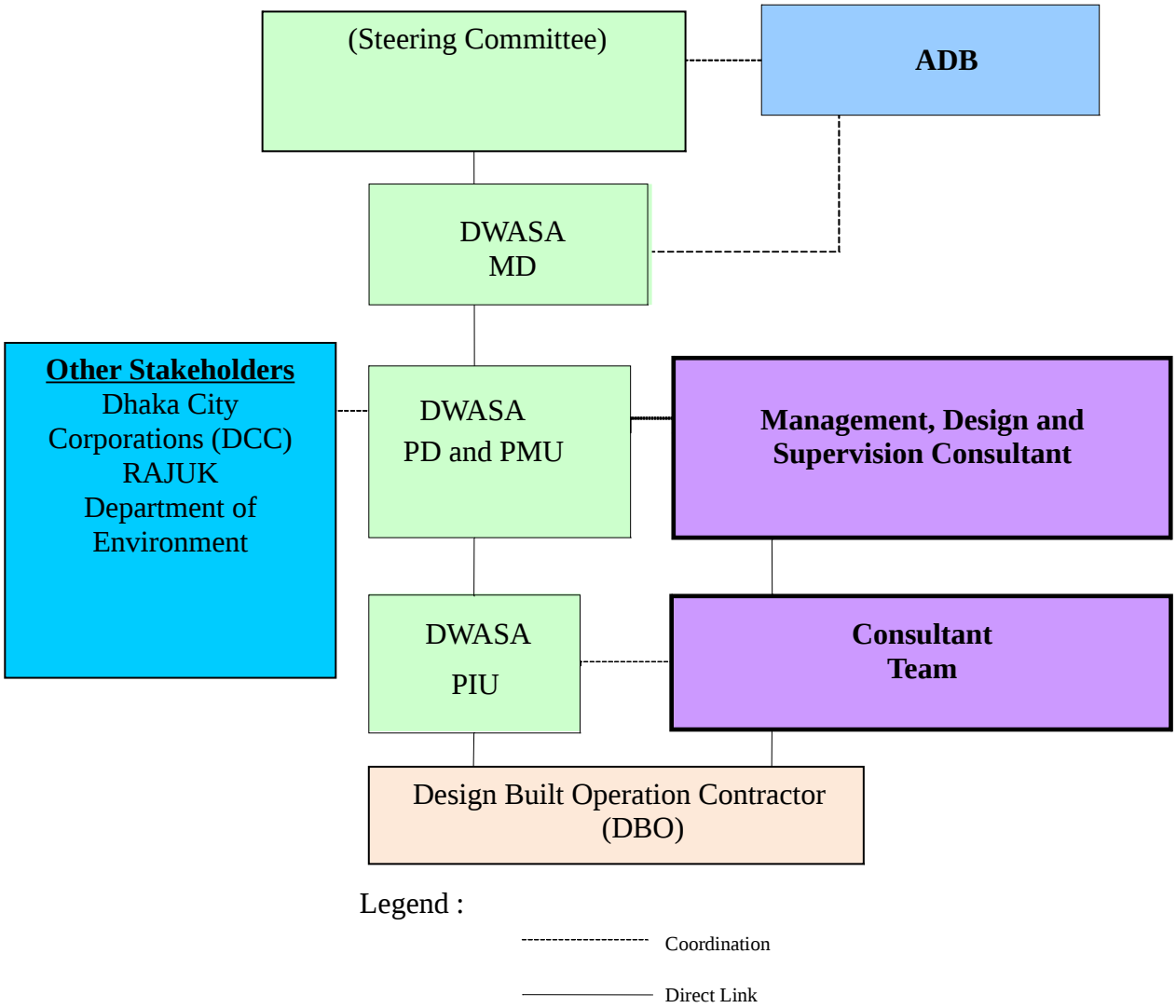


Figure 7.1: Organization Chart for EIA Implementation

7.3.2 Implementation of Environmental Management Plan (EMP)

Responsibility of implementation of EMP will be brought by the DBO contractor. EMP implementation will be the part of the DBO contract document. All cost for implementing EMP will be the part of the civil works contract and to be quoted by the contractor in their proposal as per this EIA. This EIA will be the part of the contract document. Environmental monitoring will be done during construction in three levels; namely monitoring development of project performance indicators done by the Environmental Specialist of the Design Supervision Consultant monitoring implementation of mitigation measures done by the Contractor; and overall regulatory monitoring of the environmental issues done by Environmental Officer of the DWASA. The environmental monitoring plan for the Project is presented in Table

7.2. The table shows proposed monitoring of all relevant environmental parameters, with a description of the sampling stations, frequency of monitoring, applicable standards and responsible agencies. The monitoring of the environmental attributes in the first season (first year of implementation) will be carried out prior to the start of implementation works at tehe site, and shall form a baseline for the environmental parameters. Monitoring will be the responsibility of civil works contractors who would likely outsource this responsibility.

7.4 Capacity Building

At present, the capacity on safeguards planning and implementation at DWASA is not adequate to handle safeguard implementation. To ensure effective implementation of environmental aspects as outlined in this EIA, a DWASA environmental safeguard officer/responsible person will be recruited to oversee Environment Management Plan (EMP) implementation ADB components. The Design Supervision Consultant's Environmental Specialists will train and assist the DWASA according to the training program outlined below, to ensure smooth implementation and monitoring of the EIA.

The proposed capacity building program will include (i) sensitization of DWASA staff and stakeholders on environmental management, including on the ADB, and Government of Bangladesh requirements on environment; (ii) capacity building programs to improve the capability of environment staff at all levels in carrying out/monitoring and implementing environmental management measures for the Project; and (iii) capacity building programs on environmental issues including quality monitoring. The Environmental Specialist of the Project Management Design and Supervision Consultant (PMDSC) will provide the basic training required for environmental awareness followed by specific aspects of infrastructure improvement projects along with environmental implications for projects. Specific modules customized for the available skill set will be devised after assessing the capabilities of the members of the Training Program and the requirements of the Project. The entire training would cover basic principles of environmental assessment and management mitigation plans and programs, implementation techniques, monitoring methods and tools. The proposed training program along with the frequency of sessions is presented in Table 7.3.

7.5 Environmental Budget

As part of good engineering practices in the Project, there have been several measures as erosion prevention, rehabilitation of borrow areas, safety, signage, provision of temporary drains, etc., the costs for which will be included in the design costs of the Project. The EIA costs include monitoring costs during construction and capacity building costs on environmental management of which are absorbed into contractors work packages. The costs for training proposed include the costs incurred toward site visits, travel to the training program by participants, printing of training materials, and other logistic arrangements. The costs involved towards preparation of training material and training are covered in the consultancy budget for the Design Supervision Consultant. The budget for the environmental management costs for the Project is presented in Table 7.4 below.

The cost estimates mentioned in Table 7.4 is an indicative price. The bidder can provide their own reasonable quoted rate. The bidder will include the detail cost of EMP in the Summary Cost Table.

Table 7.3: Training Modules for Environmental Management

Program	Description	Participants	Form of Training	Duration	Trainer /Agency
Introduction And sensitization to environment issues	Sensitization on Environmental concerns Environmental impacts of urban infrastructure improvement projects Environmental regulations of the Government and ADB environmental regulations Coordination between departments for implementation of environmental issues	DWASA engineers / management team, officials responsible for implementing the Project, and other DWASA Officials	Workshop	One day workshop during construction	Project Management, Design and Supervision Consultant's Environmental Specialist/ DWASA
Project training on hazards, health, safety and environmental issues pertaining to the Project	Sensitization and training for engineering and management professionals, to be involved in on-site execution and operation of the proposed facilities.	DWASA engineers/ management team	Workshops, site visits	Three days at during construction	Tailor made training programs by the Safety Board of Bangladesh (ISBB), College Engineering Staff etc. organized by Contractors
EMP implementation	Implementation of EMP Identification of environment impacts Monitoring and reporting for EMP Public interactions and consultations Coordination for consents with various departments Monitoring formats filling and review of impacts	DWASA engineers, officials responsible for implementing the Project, and other DWASA / Design Supervision Consultant staff	Lectures and field visit	Two-day session at construction stage	Project Management, Design and Supervision Consultant's Environmental Specialist

Table 7.4: Cost Estimates to Implement the EMP

Sl. No.	Particulars	Stages	Unit	Total number	Rate (BDT)	Cost (BDT)	Costs covered by
A. Mitigation Measures							
A 1	Environmental mitigation / enhancement measures integrated into the designs and costs included as part of civil works	Construction					DB Contractor (Design Build Contractor)
	Sub-Total (A)					1,350,000.00	
B. Monitoring Measures							
B 1	Air Quality monitoring	Construction	Per location	12	20,000.00	240,000.00	DB Contractor
B 2	Noise level	Construction	Per location	16	7,500.00	120,000.00	DB Contractor
B 3	Noise level	Operation	Per location	1	7,500.00	7,500.00	DWASA
B 4	Water Quality monitoring	Construction	Per location	10	8,000.00	80,000.00	DB Contractor
B 5	Water Quality monitoring	Operation	Per location	3	8,000.00	24,000.00	DWASA
B 6	Adequacy of solid waste management system	Post construction & operation	Per visit	9	10,000.00	90,000.00	DWASA
B 7	Survival Rate of Plantation and landscaping	Operation	Per location	4	25,000.00	100,000.00	DWASA
B 8	Socioeconomic monitoring	Operation	Per location	4	25,000.00	100,000.00	DWASA
	Sub-Total (B)					761,500.00	
C	Capacity Building						
C 1	Introduction and sensitization to environmental issue	Pre construction	LS	-	-	100,000.00	DB Contractor
C 2	Project training on hazards, health, safety, and environmental issues	Pre construction	LS	-	-	300,000.00	DB Contractor
C 3	EMP implementation	Construction	LS	-	-	200,000.00	DB Contractor

Sl. No.	Particulars	Stages	Unit	Total number	Rate (BDT)	Cost (BDT)	Costs covered by
	Sub-Total (C)					**600,000.00**	
	Total (A+B+C)					**2,711,500.00**	
	Total (in USD) @ 80.0 Taka					**33,893.75**	

8 CONSULTATION WITH STAKEHOLDER/ PUBLIC CONSULTATION

8.1 Approach

The team of environmental experts have contacted the local people through field workers local people. Meetings were arranged with the consent of the local stakeholders at scheduled venues chosen by the locals.

Besides, there were consultation meetings held with key government agencies, departments, and institutes to get their feedback on this project. Participant list and scanned field-notes for the FGDs' during EIA is provided in **Appendix-9.**

8.2 Major Findings

Table 8.1: Focus group discussion during IEE

Place and Date	Participants	Purpose of Consultation	Key issues discussed
Old Dayakandha Bazar, 800 m downstream of the proposed Bishnondi intake, Meghna River, 15-Jan-2013	Fishermen communities, farmers, elected representatives of Old Dayakandha Bazar No. of participants: 45	Consultations with the fishermen and community on the fishing activities, types of fishes, and understanding grievances of the communities, if any	• There are 200 families in the village dependent on fishing. The fishermen have a society that regulates fishing. During the lean flows of the year, the fishermen erect cages with • bamboo, and expenses and profits are usually shared by families. • The fishermen revealed that the types of fishes caught are those generally found along the entire stretch of Meghna River, and include hilsa, katchki, prawn, katla, rui, puti, baim, bele, gozar, boal, pangash, tangram, poya, and different cat fishes. • No special or rare species have been encountered in this stretch. Species such as pabda and kalboush have become more rare in the past few years. The larger fishes are usually found in the deeper channels of the river, and the catch is significantly less along the banks of rivers and in shallow waters. • The community was aware of the arsenic contamination of groundwater and was averse to using it. • The community said that they have not had experiencedany salinity in river water, and mentioned that salinity intrusion was up to Chandpur, about 130 km downstream from Bishnondi. • The fishermen said that there are no specific locations identified as breeding grounds near the intake. The breeding season differs for different species, and

Consultation with stakeholder/ public consultation

Place and Date	Participants	Purpose of Consultation	Key issues discussed
			as per the orders of the fisheries department, fishing is totally banned for particular periods. • Fishermen welcomed the project, and requested that there should be no adverse impacts on the water quality due to the proposed construction activities. The fishermen mentioned that degradation of water quality shall result in long-term losses to their livelihood, and requested that polluting industries and d
Bishnondi village, intake, Meghna River 19-Jan-2013	Village residents, affected land owners, elected representatives, and Chairman Araihazar Upazilla. No. of participants: 60	Consultations with the communities on the proposed intake facility, land acquisition impacts	• Policy for entitlements of the affected people and cut-off date for listing of affected properties were explained to the people. • The communities said that acquisition of land will result in loss of agricultural lands, their only source of livelihood • The communities requested that land and structures affected be paid for at market rates, and compensation and other assistance be paid before displacement. • The communities were informed that ADB policy on resettlement will be conformed to, all impacts will be compensated for at replacement costs, and there will be a mechanism for grievance redressal in the project .
Manikpur ferry ghat, Meghna River	Shopkeepers at the ferry ghat location, boat operators, passengers using the ferry ghat No. of participants: 30	Consultations with the stakeholders on the nature of pollution at the ghat site, and potential efforts required to minimize pollution	• This is a new ferry ghat, which has been operational for less than a year. There are two ferries that transport vehicles and passengers across the river, in addition to about 30 smaller boats for passenger crossing. • About 50 small-scale shops have been established on government land, catering to the needs of the passengers. • Currently there are no waste management or toilet facilities at the ghat, and waste is discharged directly into the river. The shopkeepers confirmed that in the event of any facilities being created by the project for toilets/waste collection and management, they would maintain and operate the same.

Table 8.2: Focus group discussion outputs during EIA

Place and Date	Participants	Purpose of Consultation	Key issues discussed and information exchanged
25-Aug-2014 Premises of Shahin Member GPS: N23°44´39.689˝ E90°42´44.568˝ (About 3km d/s of Manikpur Ferry port)	21 participants: Village residents, affected land owners, elected representatives	Consultation of the landowners of proposed Intake site and adjacent pipe line alignment.	• The owner was initially against this development which includes his land. But during this discussion he was very positive and was looking forward for the development. • There are no public school nearby. Therefore, a straight road along with the pipeline will improve the situation as the kids can have good access to public schools. • People complained that unplanned dredging for sand-mining to fill up the land for acquired land for the university near Manikpur port is causing river erosion. They urged to stop this kind of dredging by imposing some embargo as for the pollution sources upstream. • Previous project involving land acquisition (the university near Manikpur Ferry port) had not compensated the real owners of the acquired land rather, they have collected old documents from the land office and paid according to those which wrongly paid compensation to the previous owners. They does not want the same happening in this project. • They will prefer log-trees on the planned road sides. • The meeting informed that former honorable Minister or water resources and MP Mr. Ramesh Chandra Sen promised them to build embankment road on this side of the river in a public meeting a few days ago.
25-Aug-2014 Golakandail Union Parisad Office GPS: N23°46´50.818˝ E90°34´9.617˝ About 0.5km south of Golakandail (Vulta) Intersection (crossing of roads N2 & N105)	5 participants; Chairman and members of the union parisad.	To inform and collect feedback from the stakeholders.	• The Chairman ensured full cooperation to acquire land when that comes through an official order. • Rate of land price is quite high in this area compared to the intake area. Therefore, proper compensation package considering the local market price of land should be offered. • They demanded future extension of the treated water supply by DWASA in their locality.
26-Aug-2014		To inform	• DWASA acquired land from this char in

Place and Date	Participants	Purpose of Consultation	Key issues discussed and information exchanged
Char Gandhrarbpur, Rupgang. WTP area.		and collect feedback from the local land owners.	1982 at a very low price. They have paid only Tk. 99 lakh for almost 360 acre of land. The rate was Tk. 20,000 per Bigha. But to get that money they had to pay middlemen. Some did not even get any compensation. There is a water body nearby and later DWASA have sold 7-acre of land to WAPDA by Tk. 7 cror. The farmers still need proper compensation for their land. • This land is very fertile and can grow anything. All kind of vegetables, sugarcane and jute is cultivated here. Most of the land owners lives on agriculture therefore, losing land is losing income to them. • Present market price for land is about Tk. 1 cror per bigha. The landowners will be happy even if they get half or one third of that price. Alternatively providing jobs to the farmers is also acceptable. But DWASA have started constructing boundary walls without their consent. The people are annoyed and will protest. • About 30% of population of this area are educated-unemployed. Arranging jobs for them can be a solution.

8.3 Summary

The basic concern of the affected people is to get proper compensation for their lost land and livelihoods in a smooth manner without the interference of any middlemen. The discontents of the locals can be mitigated following proper resettlement plan, which has already been prepared as a separate document.

Figure 8.1: FGD at Golakandail

Figure 8.2: FGD beside Intake site

9 CONCLUSION AND RECOMMENDATION

The proposed interventions will improve the environmental conditions in the Dhaka metropolitan areas through improved access to treated water, and significantly contribute to the DWASA's long-term objective to reduce the existing pressure on groundwater extraction.

Field visits and consultations with the stake holders and affected population were taken into considerations in the evaluation and mitigation proposals in this assessment report.

The citable impact of the plant is the impact of intake structure at Meghna river on the fiheries and river ecology. If the intake velocity is higher than the fish swimming velocity of Key fish species like Hilsa, jatka or any other small fishes or any other river ecology then there might have some impact on river ecology. Therefore, intake screens are to be designed according to the swimming characteristics of Hilsa (the key species in the Meghna), to ensure that the impacts on Hilsa as well as the smaller fish, including the jatka, are minimized. Therefore, it is recommended here to use 8 cm/sec approach velocity for screen mesh to avoid such impact. For screen mesh openings it is recommended that the opening shall not exceed 3/32 inch (2.38 mm) for woven wire or perforated plate screens, or 0.0689 inch (1.75 mm) for profile wire screens, with a minimum 27% open area . It is also recommended to provide screen in the direction of flow to escape small fish and spawn from the screen. It is further recommended for consulting a fisheries expert as part of the detailed design to provide inputs on the design of the intake screen to minimize impacts on fish. Efforts to minimize such impacts will be integrated into the detailed designs by the fisheries expert.

During operation of the WTP, physical and chemical sludge will be generated. This drinking water treatment sludge usually contains colloidal iron and alum hydroxides, colloidal or dissolved organic matter, clay, silt and microorganisms. It should not contain heavy metal and toxic chemicals. After dehydration and drying the sludge is proposed to use as fill material for lowlands as reclaimed land for public parks, roadsides, golf courses, lawns and home in nearby areas after analyzing characteristics of the sludge, if it doesn't not contain any toxic chemical. The disposal of the alum sludge is proposed at the landfill site of Dhaka at Matuail, about 10 km from the proposed WTP if it is not possible to use as fill material.

Key construction stage impacts identified are loss of productive agricultural lands and destruction of topsoil; impacts on low-lying areas and water bodies; air, noise, and vibration impacts due to construction vehicles, equipment, and machinery; impacts on the river courses and the water quality during the construction of the transmission mains across the rivers and streams; soil disposal due to the excavation for the transmission mains; accident hazards; impacts on community health and safety hazards posed to the public.

The impacts from construction and operation will be manageable, and no insurmountable impacts are predicted, provided that the EMP is included in the contract and its provisions implemented and monitored to their full extent.

It is to be noted that the resultant potential impacts can be offset through proven mitigation measures during the design and adoption of good engineering practices in construction and operation. The specific management measures laid down in the EIA effectively addresses any adverse environmental impacts due to the project. The

effective implementation of the measures proposed will be ensured through the building up of capacity towards environmental management within the PMU, supplemented with the technical expertise of an environmental safeguards specialist as part of the design-build contractor. Further, the environmental monitoring plans provide adequate opportunities towards course correction to address any residual impacts during construction or operation.

There are no significant or irreversible environmental impacts envisaged due to the project interventions. The impacts are largely construction related, and can be addressed through adoption of good engineering practices during project implementation. While the project components are rather simple, the scale and magnitude of facilities proposed trigger the need for an effective integration of environmental measures at all stages of the project.

The project will have a positive impact in terms of production of pure drinking water supply from surface water conserving meager ground water, although a negligible amount (0.3%) would be abstracted from Meghna River during lean flow which off course would have negligible impacts on ecological flow and downstream uses. The other positive impact of the project will be employment during construction and operation phases. An outline of EMP has been given in the present report to mitigate/ enhance the impacts, which are expected to be occurred during operation phase of the project.

The findings of this EIA suggests that the project involves potential but limited environmental impacts to which further careful attention should be given in the construction, operation and maintenance of the project in order to minimize and offset the adverse effects. The possible negative impacts are not severe, and the adverse impacts if duly addressed could be minimized without much effort, though they would require attention and positive commitment from the DWASA authority. It is understood that DWASA will take necessary steps to control, and minimize any adverse impact to an acceptable level through institutional measures and incorporating standard engineering practices. The selected location for the construction of intake, WTP and transmission line for raw water and treated water is considered acceptable.

The location of the proposed project is environmentally acceptable as has already been mentioned. However, adequate and effective pollution prevention, abatement and control measures, proper and careful operation and maintenance, regular and effective environmental monitoring with adequate staff and budgetary provision, creation of an environmental Cell, ensuring preventive management practices, adoption of the Disaster Risk Management Plan and reporting to DOE should be ensured.

However, no development can be expected without any adverse impact on environment. The beneficial impacts on the nation as well as human beings would only be meaningful and sustainable development would only be possible if the adverse effects were minimized through strict maintenance and control measures as adopted and further suggested for this project. Further, to mitigate adverse impact on environment, there should be strict observance of EMP guidelines as specified in the report. All this would need vigilant care and subsequent monetary involvement, and the project authority should take these into consideration. It is expected that DWASA will follow all environmental compatible steps during operation and maintenance by which it sets a positive example as an environment friendly water supply project. It is also expected that DOE will do surveillance monitoring of the project performance, particularly that of sludge management. DOE should also continue its encouragement for water supply project of DWASA for initiatives to save precious

underground water resource and to ensure a better environment.

The potential benefits, which are expected due to the project, considered substantial, and will offset the anticipated negative impacts.

So it is concluded that:

There are no environmental grounds whatsoever as to why the project, as envisaged at present, should not be implemented. Hence DOE should consider positively issuing the necessary clearance for implementation of such project.

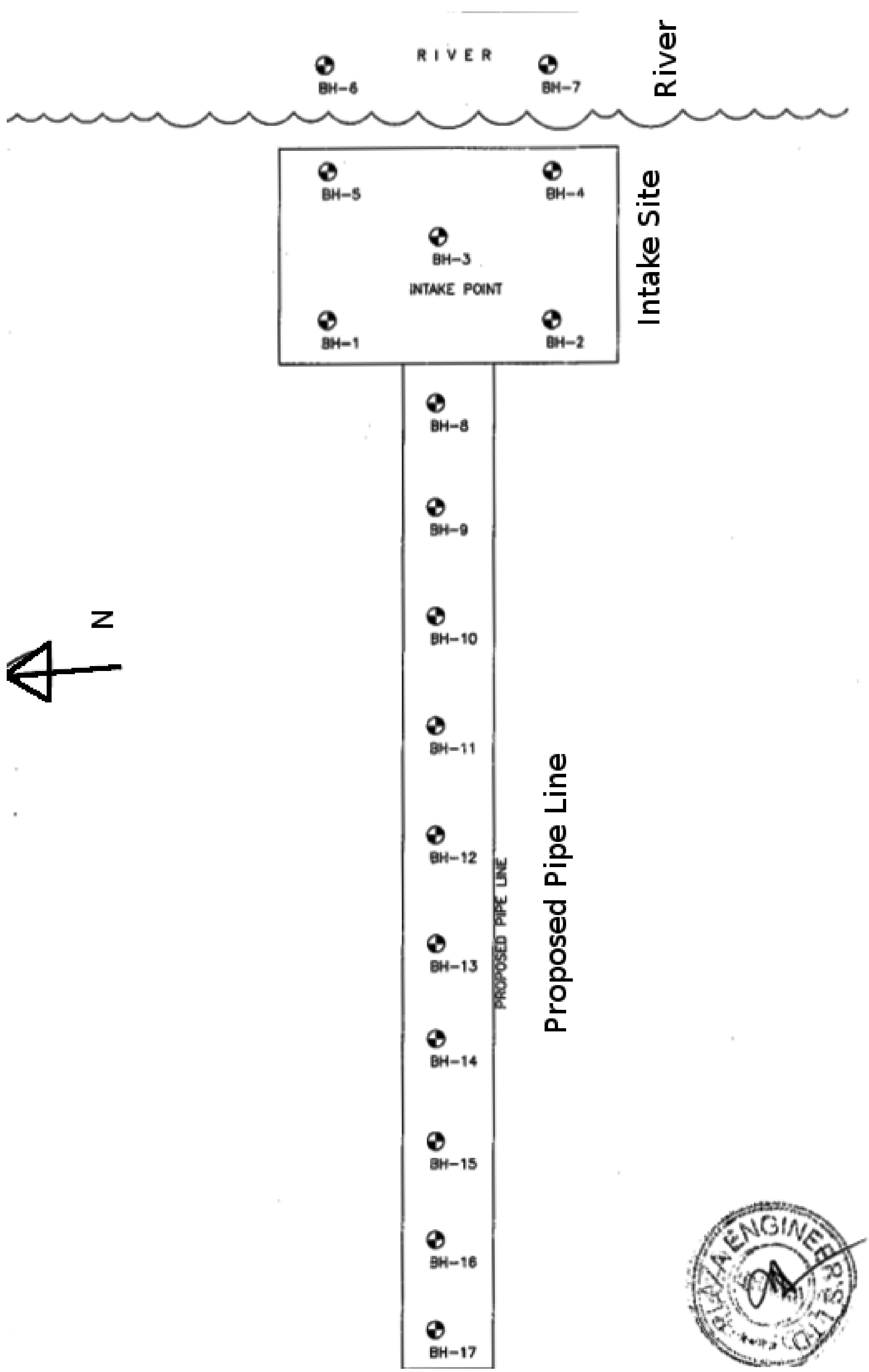
Appendix-1: Terms of Reference

Appendix-2: Environmental Standards for Bangladesh

Appendix-3: Topo-map along project alignment

Appendix-4: Project Schedule

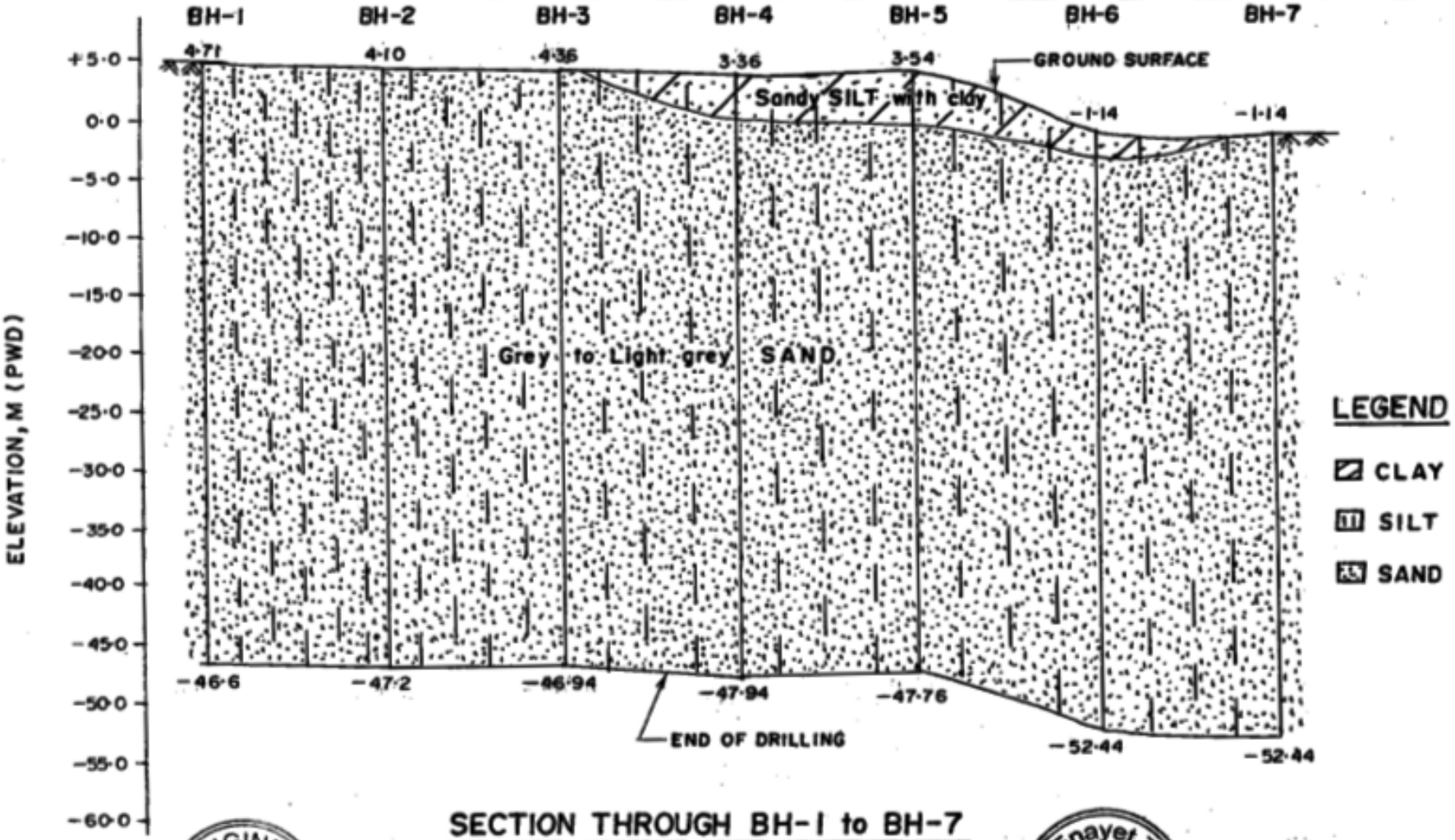
Appendix-5: Geologic Profile


RIVER
BH-6
BH-7
River
BH-5
BH-4
BH-3
INTAKE POINT
BH-1
BH-2
Intake Site
BH-8
BH-9
N
BH-10
BH-11
BH-12
PROPOSED PIPE LINE
Proposed Pipe Line
BH-13
BH-14
BH-15
BH-16
BH-17

M/S. PLAZA ENGINEERS LIMITED
SOUDIA SUPER MARKET (2ND FLOOR)
79, KAZI NAZRUL ISLAM AVENUE
FARMGATE, DHAKA- 1215

GEOLOGIC PROFILE

CLIENT : Dhaka Water Supply and Sewerage Authority
LOCATION : Arihagar, Narayangonj



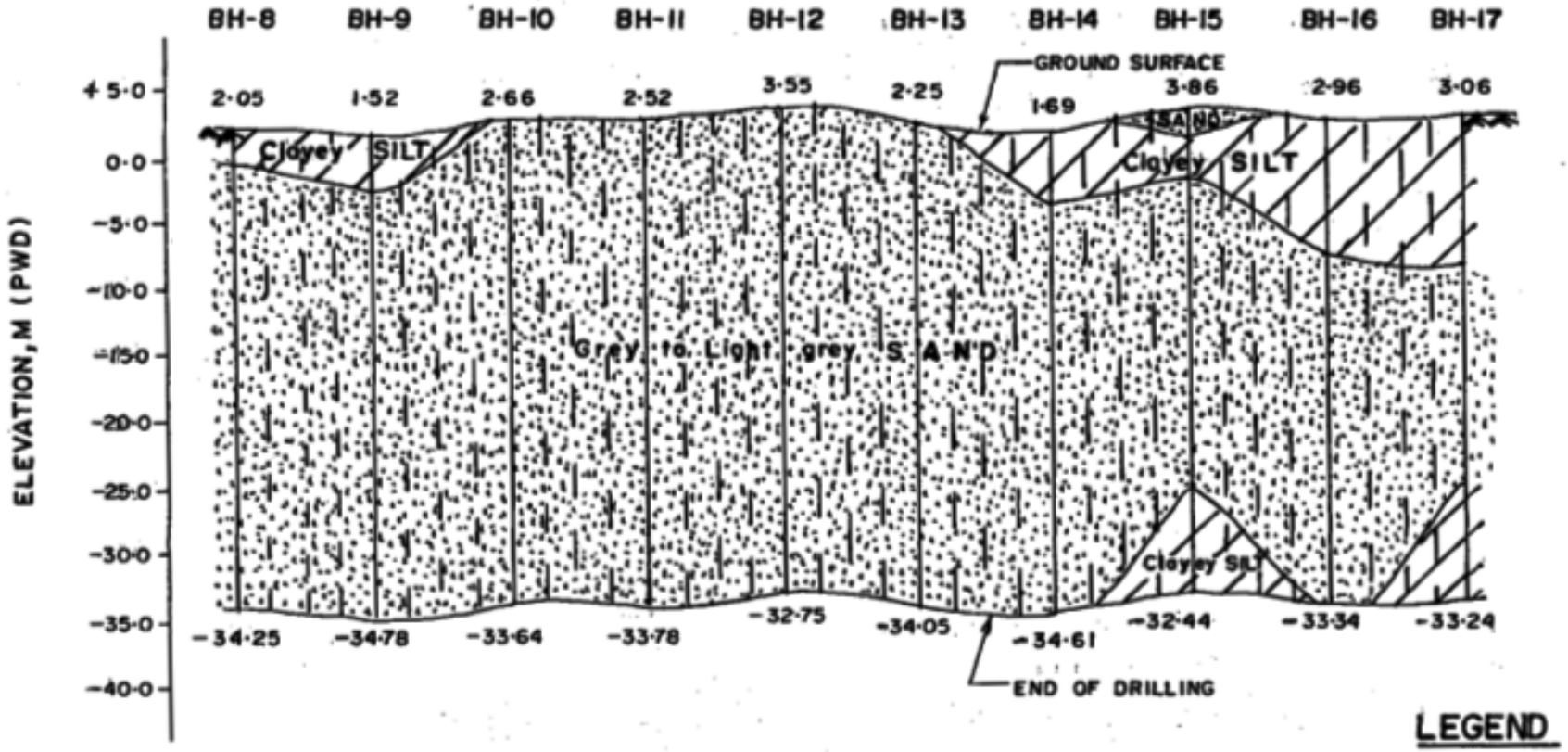
SECTION THROUGH BH-1 to BH-7

M/S. PLAZA ENGINEERS LIMITED
SOUDIA SUPER MARKET (2ND FLOOR)
79, KAZI NAZRUL ISLAM AVENUE
FARMGATE, DHAKA- 1215

GEOLOGIC PROFILE

CLIENT : Dhaka Water Supply and Sewerage Authority

LOCATION : Arihagar, Narayangonj



LEGEND

- CLAY
- SILT
- SAND

SECTION THROUGH BH-8 to BH-17

Appendix-6: Water Quality Reports (Bisnandi)

Appendix-7: Checklist of safety measures during construction

Appendix-8: Allowable Water abstraction for UK Rivers

Appendix-9: Participant list and scanned field notes from FGD