Draft Initial Environmental Examination

Document Stage: Draft for Consultation
Project Number: 42173

BAN: Dhaka Environmentally Sustainable Water Supply Project

Prepared by Dhaka Water Supply and Sewerage Authority, Government of Bangladesh for the Asian Development Bank.

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CURRENCY EQUIVALENTS

(as of 8 July 2013)

Currency unit	–	Taka (Tk)
Tk.1.00	=	$0.01285
$1.00	=	Tk. 77.770

ABBREVIATIONS

ADB	Asian Development Bank
AAQ	ambient air quality
BIWTA	Bangladesh Inland Waterways Transport Authority
BWDB	Bangladesh Water Development Board
BNBC	Bangladesh National Building Code
BOD	biological oxygen demand
COD	chemical oxygen demand
CAMS	continuous air monitoring station
CNG	compressed natural gas
DO	dissolved oxygen
DoF	Department of Fisheries
DWSSDP	Dhaka Water Supply Sector Development Project
DWASA	Dhaka Water Supply and Sewerage Authority
DoE	Department of Environment
DPHE	Department of Public Health Engineering
EA	executing agency
EIA	environmental impact assessment
ECA	Environmental Conservation Act
ECR	Environmental Conservation Rules
ECC	environmental clearance certificate
EMP	environmental management plan
FS	feasibility study
GoB	Government of Bangladesh
GRC	grievance redress committee
GRM	grievance redress mechanism
IEE	initial environmental examination
km	kilometer
mg/l	milligram per liter
mld	million liters per day
NGO	nongovernment organization
O&M	operation and maintenance
PPTA	project preparatory technical assistance
PMU	project management unit
RoW	right of way
SPS	Safeguard Policy Statement
UNCED	United Nations Conference on Environment and Development
WTP	water treatment plant
WHO	World Health Organization

WEIGHTS AND MEASURES

ha	–	hectare
km	–	kilometer
m	–	Meter
Mm	–	millimeter
km/h	–	kilometer per hour

NOTE

In this report, "$" refers to US dollars.

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EXECUTIVE SUMMARY

1. 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[1] (mld) Gandharbpur Water Treatment Plant Project. DWASA published a comprehensive feasibility study[2] (FS) in 2011. A project preparatory technical assistance (PPTA) to review the findings of the FS and endorse or identify gaps was initiated by ADB.

2. The PPTA prepared an initial environmental examination (IEE) with an environmental management plan (EMP) as part of the feasibility study update. During the detailed design, the IEE/EMP shall be further updated as a stand-alone EMP for each of the procurement packages and appended to the contract document.

3. The project intends to withdraw, in two phases, up to 2,000 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.

4. 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.

5. In accordance with ADB's Safeguard Policy Statement (SPS, 2009) the project is classified as category B, as no significant impacts are envisioned. In accordance with the Government of Bangladesh's (GoB) environmental impact assessment (EIA) requirements as outlined in the Environmental Conservation Act (ECA, 1997) (Amendment 2000) and the Environmental Conservation Rules (ECR, 1997), the project is classified as a red category, requiring EIA for necessary environmental clearance requirements.

[1] This is Phase 1, with an expansion of 500 mld. The intake is proposed to be designed for 2,000 mld—i.e., the future supply for Gandharbpur 1 and 2 as well as Saidabad 1, 2, and 3.

[2] DWASA, 2011. *Feasibility Study for Augmentation of Water Supply to Dhaka*, Design and Management Consultancy Services. Dhaka, August 2011.

6. Consultations with the Department of Environment (DoE) on the nature of documentation required for the environmental clearances confirmed that conformance to ADB safeguard policies will be considered as compliance to government requirements. The IEE has been prepared as a uniform document satisfying both ADB and government requirements, and no any additional studies are envisaged.

7. The design-build contractor for the project is expected to mobilize by mid-2015, and the implementation will be completed in 2018.

8. 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 2,000-mld intake accounts for 0.6% of the lean flow, and would have negligible impacts on ecological flow and downstream uses. Consulting a fisheries expert is proposed as part of the detailed design, to provide inputs for the design of the intake screen to minimize impacts on fish from Meghna River.

9. 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.

10. Key construction stage 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 where 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 and other smaller streams ; (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 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 to be implemented as part of good engineering practices during construction are laid down in the IEE.

11. Watershed management for source protection will involve good interagency coordination led by the DoE. To provide inputs for effective interagency coordination, a water quality monitoring program at locations upstream of the intake is proposed during the implementation, along with semi-annual joint site visits by DWASA and DoE to the upstream locations. The findings of the water quality monitoring and site visit recommendations shall be taken up with the steering committee for any coordination or measures required by agencies. Institutionalizing this process during the operation stage of the project will ensure sustained source protection.

12. The stakeholders were involved in developing the IEE through consultations with the communities, affected persons, and institutional stakeholders. The views expressed were incorporated into the IEE and the planning and development of the project. The consultation process will be carried forward during the subsequent stages of project design and implementation by the project management unit (PMU), with support of the implementing nongovernment organization (NGO) for the resettlement plan (RP) and the supervision consultant. To provide for more transparency in planning and for further involvement of the public and other stakeholders, project information will be disseminated through disclosure of project planning documents. The DWASA, through its PMU, will keep the public informed of the impacts and the compensation and assistances proposed for them, and will facilitate addressing any grievances. The information will also be made available at convenient places in the project area, especially the DWASA office, offices of the Upazila, Union Parishad in the project locations, and at other key locations (such as market places) accessible to the public.

13. A grievance redressal mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of affected people's concerns, complaints, and grievances. The GRM aims to provide a time-bound and transparent mechanism to voice out and resolve social and environmental concerns linked to the project.

14. The effective implementation of the measures proposed will be ensured through the building of capacity for environmental management within the PMU. The PMU will contain an environmental and social safeguards unit staffed with an environmental officer, who will oversee EMP implementation, including monitoring and reporting requirements to ADB. The PMU will be provided with capacity building through consultant support in managing environmental impacts. Further, the environmental monitoring plans provide adequate opportunities towards course correction to address any residual impacts during construction or operation stages.

15. 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. There is no need for further environmental impact assessment (EIA), as the provisions in the IEE and EMP will mitigate the impacts.

I. INTRODUCTION

A. Background

1. 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[3]. 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. The project further aims to strengthen the distribution system, thereby adding to the service areas and significantly reducing non-revenue water (NRW).

2. 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[4] (MLD) Gandharbpur Water Treatment Plant Project. DWASA published a comprehensive feasibility study[5] (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).

3. The project intends to withdraw up to 2,000 MLD from Meghna River in two phases 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 into 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 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.

4. This document is 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 environmental impact assessment (EIA) 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 IEE/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.

5. The EIA carried out as part of the FS confirmed that there are no significant or irreversible impacts envisaged due to the project interventions. The impacts are largely construction-related and can be addressed through good engineering practices during project implementation. The location impacts associated with the water intake from the river Meghna are generic to such large-scale water intake works, and can be addressed through and incorporation of environmental measures in the detailed designs and continued conformance to the environment performance standards during the operation of the facilities. While the project

[3] 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.

[4] 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 2,000 mld—i.e., the future supply for Gandharbpur 1 and 2 as well as Saidabad 1, 2, and 3.

[5] DWASA, 2011. *Feasibility Study for Augmentation of Water Supply to Dhaka*, Design and Management Consultancy Services. Dhaka, August 2011.

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. In accordance with ADB's Safeguard Policy Statement (SPS, 2009) the project is classified as category B, as no significant impacts are envisioned.

6. In accordance with the Government of Bangladesh's (GOB) environmental impact assessment (EIA) requirements as outlined in the Environmental Conservation Act (ECA, 1997) (Amendment 2000) and the Environmental Conservation Rules (ECR, 1997), the project is classified as a red category, requiring EIA for necessary environmental clearance requirements.

B. Purpose of IEE

7. In accordance with the government's environmental assessment requirements and ADB's safeguard policies, this draft IEE assesses the environmental impacts due to the proposed project. Consultations with the Department of Environment (DoE) on the nature of documentation required for the environmental clearances indicated that conformance to ADB safeguard policies shall be considered as compliance to government requirements. This IEE therefore presents a uniform document satisfying ADB and Government of Bangladesh requirements. While any additional studies to conform to clearance requirements are not envisaged, data updating, if required, shall be carried out based on the designs prior to seeking DoE approval.

C. IEE Methodology

8. The IEE was based on a review of the environmental impact assessment prepared as part of the feasibility study and identification of gaps. These gaps were addressed through field visits, apart from primary and secondary data to characterize the environment and identify potential impacts, and substantiated through consultations with stakeholders. The key gaps identified in the EIA are as follows:

i) While the EIA confirms that there are no significant or irreversible impacts envisaged due to project interventions, this is not based on a comprehensive assessment of potential environmental impacts.

ii) The baseline information on the environment is not complete, and the report did not include information like general environment of the project area, climate and weather conditions and data, soil characteristics, seismicity, etc.

iii) The baseline environmental status with respect to air, water, and noise quality along the project locations is not presented. In addition, specific information on the following key aspects is not included: (a) impacts on fisheries at the intake, (b) impacts on crossing of rivers notified as ecologically critical areas (ECA)[6] and the low-lying areas in the project locations, (c) impacts from spoil disposal, and (d) impacts on flora and fauna in the project locations.

[6] Considering the serious pollution threat to the river system in Dhaka, DoE has notified the four rivers in Dhaka as ecologically critical areas. Given the high pollution levels in the Dhaka rivers, in line with the provisions of the ECA 1995 (Section 5), through a gazette notification dated 1 September 2009, the High Court declared the four rivers surrounding Dhaka, namely Buriganga, Turag, Balu, and Sitalakhya, as ecologically critical areas. Subsequently, pollution-creating activities that are detrimental to the water and aquatic life in those rivers have been forbidden.

iv) The EIA methodology includes public consultations and focus group discussions (FGDs). However, the report does not document the consultations carried out, the key issues discussed and identified, and whether stakeholder concerns have been integrated into the project designs.

v) While a series of mitigation measures are proposed to address the identified impacts, the measures are not location specific, and need to be described in sufficient detail to allow integration into the contract documents.

vi) The section on institutional arrangements is generic and does not specify the institutional structure with respect to safeguards implementation, roles and responsibilities of the environmental personnel of DWASA, capacity building requirements, and consultant support required.

vii) The costs for implementation of environment measures have been considered integral to the civil works/construction, and hence an environmental budget has not been provided. There is a need to include the following provisions in the environment budget: (a) monitoring of environmental parameters during construction and operation stages, and (b) capacity building.

viii)

9. Data collection and consultations. Secondary and primary data were used in updating the IEE. All possible secondary information and data were collected from relevant sources and from field observations. Primary surveys on air and noise levels at the project locations were carried out to establish the environmental baseline. Consultations with relevant agencies were held to gather information, including DWASA, DoE, Bangladesh Inland Waterways Transport Authority (BIWTA), Department of Fisheries (DoF), Bangladesh Water Development Board (BWDB), Department of Forests, RAJUK, etc.

10. Review of government's statutory requirements. This included review of relevant laws, ordinances, acts, rules, public notices, standards governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, etc. at the local, national, and international levels.

11. Review of ADB policies. This assessed the compatibility of the core principles of the governments' policies with the ADB Safeguard Policy Statement (2009). The IEE is prepared to meet the safeguard policies of the ADB. During the detailed design phase, if required, DWASA shall update the IEE to ensure compliance with government requirements.

12. Mitigation and monitoring measures. The impacts during pre-construction, construction, and operation stages were identified, for which mitigation/monitoring measures are prescribed.

D. Report Structure

E.

13. This IEE report, in addition to a summary of the key issues and findings of the IEE, includes the following sections: (i) introduction; (ii) description of project; (iii) description of the environment; (iv) potential environmental impacts and mitigation measures; (v) analysis of alternatives; (vi) environmental monitoring plan; (vii) public consultation and information disclosure; (viii) findings and recommendations; and (ix) conclusions.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

A. Policy and Legal Framework

14. The implementation of the project will be governed by Government of Bangladesh environmental acts, rules, policies, and regulations. Table 1 summarizes the applicable national and local laws, regulations, and standards for environmental assessment and management, including applicable international environmental agreements.

Table 1: Government Policies, Laws, Regulations, and Environmental Standards

Laws, Regulations, and Standards	Details	Relevance
Environmental 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 Environmental 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.
Environmental Conservation Rules (ECR), 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 be obtained prior to commencement of civil works.
Environmental 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.	An environmental court has been established in Dhaka. The court has jurisdiction, in accordance with the act's provisions, over trial for an offense or for compensation under an environmental law, imposing penalties for violation, etc.
National Policy for Arsenic Mitigation, 2004	Provides a framework for provision of water supply for areas/aquifers with high arsenic levels. Roles of agencies are specified for development of water supply systems, certification of arsenic removal technology, and disposal of treatment sludge. Also, arsenic-prone *upazila* are identified.	Considered in project preparation
City Corporation Ordinances of 1983 and the recently revised unified ordinance for all City Corporations of 14 May 2008 (Local Government Ordinances 16 and	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 all populations within their jurisdiction. They have the authority to address all related issues with their legal and administrative mandate.	The project integrated community health and hygiene of the residents and workers in the construction stage, to be taken forward during the operation and maintenance of the infrastructure facilities.

Laws, Regulations, and Standards	Details	Relevance
17 of 2008); City Corporation Act 2009, 15 Oct 2009		
Bangladesh Labor Act, 2006	Provides guidance on employer's extent of responsibility and workmen's extent of right to get compensation in case of injury by accident while working	Provides for safety of work force during construction period
National Water Policy (1999)	Explicitly states five main objectives: (i) to address the use and development of groundwater and surface water in an efficient and equitable way; (ii) to ensure the availability of water to all sectors of society; (iii) to 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) to formulate institutional changes, encouraging decentralization and enhancing the role of women in water management; and (v) to provide a legal and regulatory framework that encourages decentralization, consideration of environmental impacts, and private sector investment.	The project proposes expansion of the surface water system for the Dhaka residents.
East Bengal Protection and Conservation of Fish Act (1950)	The East-Bengal Protection and Fish Conservation Act of 1950, as amended by the Protection and Conservation of Fish (Amendment) Ordinance of 1982 and the Protection and Conservation of Fish (Amendment) Act of 1995, provide provisions for the protection and conservation of fish in inland waters of Bangladesh. This is relatively unspecific and simply provides a means by which the government may introduce rules to protect inland waters not in private ownership. This is framework legislation with rule-making powers. Among others, some of these rules include prohibiting the destruction of, or any attempt to destroy, fish by poisoning of water or the depletion of fisheries by pollution, trade effluents, or otherwise.	The project requires compliance with any rules set out to protect fish in the inland waters of Bangladesh.
The Protection and Conservation of Fish Rules (1985)	These are a set of rules in line with the overall objectives of the Fish Act. The rules require that "no person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters." The Rule further states, "No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents, or otherwise in inland waters."	The project requires compliance with any rules set out to protect and conserve fisheries.
The Inland Shipping Ordinance, 1976	An ordinance to provide for survey, registration, and control of navigation of vessels plying inland waters. Clause 57A of this ordinance specifies that no person shall, by setting any fishing net or by any other means, cause obstruction to navigability of any inland ship in any navigable water route.	The project requires permit from the BIWTA.
Bangladesh Standard Specification for Drinking Water (1990)	Formulation and revision of national standards.	To be complied with
Inspection and Enforcement Manual (2008)	This manual has been written to provide national standards and uniformity in environmental sampling for the inspections and investigations to be carried out by chemists in the DoE.	To be complied with
Acquisition and Requisition of Immovable Properties Ordinance (1982)	The Acquisition of Immovable Property Rules, 1982 (No. S. R. O. 172-U82) were made by government in exercise of the powers conferred upon it by section 46 of the Acquisition and Requisition of Immovable Properties Ordinance, 1982 (Ordinance No. II of 1982).	To be complied with. See resettlement plan.
International Conventions		
Rio Declaration 1992	United Nations Conference on Environment and Development (UNCED) adopted the global action program for sustainable development called the Rio Declaration and Agenda 21, Principle 4 of the Rio Declaration,	There is no threat to the conservation of flora or fauna.

Laws, Regulations, and Standards	Details	Relevance
	1992, to which Bangladesh is a signatory along with 177 other 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 three Ramsar Sites: parts of Sundarban Reserved Forest (southwest of Bangladesh), Tanguar Haor, and Hakaluki Haor.	No impact. The Ramsar sites are not in the vicinity of the project locations (at least 200 km away).

During construction, the project will conform to the occupational and health related rules as outlined in Table 2 below.

Table 2: Relevant Occupational Health and Safety Laws and Rules

Title	Year	Review
The Employer's Liability Act	1938	The Employer's Liability Act, 1938 declares that the doctrine of common employment and of assumed risk shall not be raised as a defense in suits for damages with respect to 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 XXX
Public Health (Emergency Provisions) Ordinance, 1994	1994	Calls for special provisions with regards to public health. When an emergency has arisen, it necessary to make special provisions for preventing the spread of human disease, safeguarding the public health, and providing adequate medical service and other services essential to the health of respective communities and workers, in particular during construction-related work.
The Employees State Insurance Act	1948	It has to be noted that health, injury, and sickness benefits should be paid to people, particularly respective workers at the work place under this act.
Bangladesh Factory Act	1979	Calls for every workplace, whether small or large , i.e. DWASA, and where women are employed, to make an arrangement for childcare services. As per this factory act and labor laws, medical facilities, first aid, and accident and emergency arrangements are to be provided by the authorities to the workers at workplaces like the DWASA project.
Water Supply and Sewerage Authority Act, 1996	1996	The act calls for specifically ensuring water supply and sewerage systems for the public and their development and preservation, while considering other factors related to health and environmental facilities for the community.
Labor Relations under Labor Laws	1996	Some major revisions combine 25 scattered acts and ordinances to formulate an updated code.

Source: Bangladesh Government Rules and Regulation book.

B. ADB Environmental Compliance Requirements

15. ADB requires the consideration of environmental issues in all aspects of ADB‘s operations, and the requirements for environmental assessment are described in ADB SPS, 2009. This states that ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, loans involving financial intermediaries, and private sector loans.

16. Screening and categorization. The nature of the environmental assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project; the sensitivity, scale, nature, and magnitude of its potential impacts; and the availability of cost-effective mitigation measures. Projects screened for their expected environmental impacts are assigned to one of the following four categories:

Category A. Projects could have significant adverse environmental impacts. An EIA is required to address significant impacts.

Category B. Projects could have some adverse environmental impacts, but of lesser degree or significance than those in category A. An IEE is required to determine whether significant

environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

Category C. Projects are unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are reviewed.

Category FI. Projects involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system, unless all projects will result in insignificant impacts.

17. Public disclosure. The IEE will need to be disclosed in an accessible place (e.g., local government offices, libraries, community centers, etc.), and a summary translated into local language (Bengali) for the project-affected people and other stakeholders. ADB will post the following safeguard documents on its website so affected people, other stakeholders, and the general public can provide meaningful inputs into the project design and implementation: i) final IEE upon receipt, and (ii) environmental monitoring reports submitted by the PMU during project implementation upon receipt.

18. The project has been categorized as B. This IEE is prepared to address potential impacts, in line with the recommended IEE content and structure laid down in the SPS, 2009. Stakeholder consultation was an integral part of the IEE. An environmental management plan (EMP) outlining the specific environmental measures to be adhered to during implementation of the project has been prepared.

C. Government of Bangladesh Environmental Clearance Requirements

19. The Environmental Conservation Rules (ECR), 1997 lays down the processes and requirements of environmental clearances for specific types of projects, and stipulates that "no industrial unit or project shall be established or undertaken without obtaining, in the manner prescribed by rules, an 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 proposed project is categorized as red.. The list of project/industry types (69 in all) categorized as red under the ECR is in Appendix 2. The following project types (from the list of red category projects) are part of the proposed project.

(i) 60. Engineering works: capital above 10 hundred thousand taka
(ii) 62. Water treatment plant.
(iii) 64. Water, power, and gas distribution line laying/relaying/extension
(iv) 66. Construction/reconstruction/expansion of flood control embankment, dyke, etc.
(v) 67. Construction/reconstruction/expansion of road (regional, national, and international).
(vi) 68. Construction/reconstruction/expansion of bridge (length of 100 meters and above).

The ECR categorization of the projects is based on project types and does not consider the location, scale, extent, and magnitude of environmental impacts. As a result, two stages of environmental clearances are triggered for all water treatment plants, transmission mains, roads, and bridge construction, irrespective of the size, scale, and location of the proposed facilities. Further, the financial threshold of Tk 1 million (about USD 150,000) for engineering works to be categorized as red is outdated, given the cost increases over the past 15 years. The existing low thresholds for environmental clearances in terms of cost and scale of projects result in significant non-compliance in terms of clearances, especially infrastructure projects by the government agencies. DoE is in the process of revising the categorization of the EIA requirements.

20. Rule 7 of the ECR indicates that the application for ECC should be made to the DoE divisional officer. For red category projects, a two-stage clearance process is required, the location clearance and environmental clearance for the project. The environmental clearance process chart is provided in Figure 1.

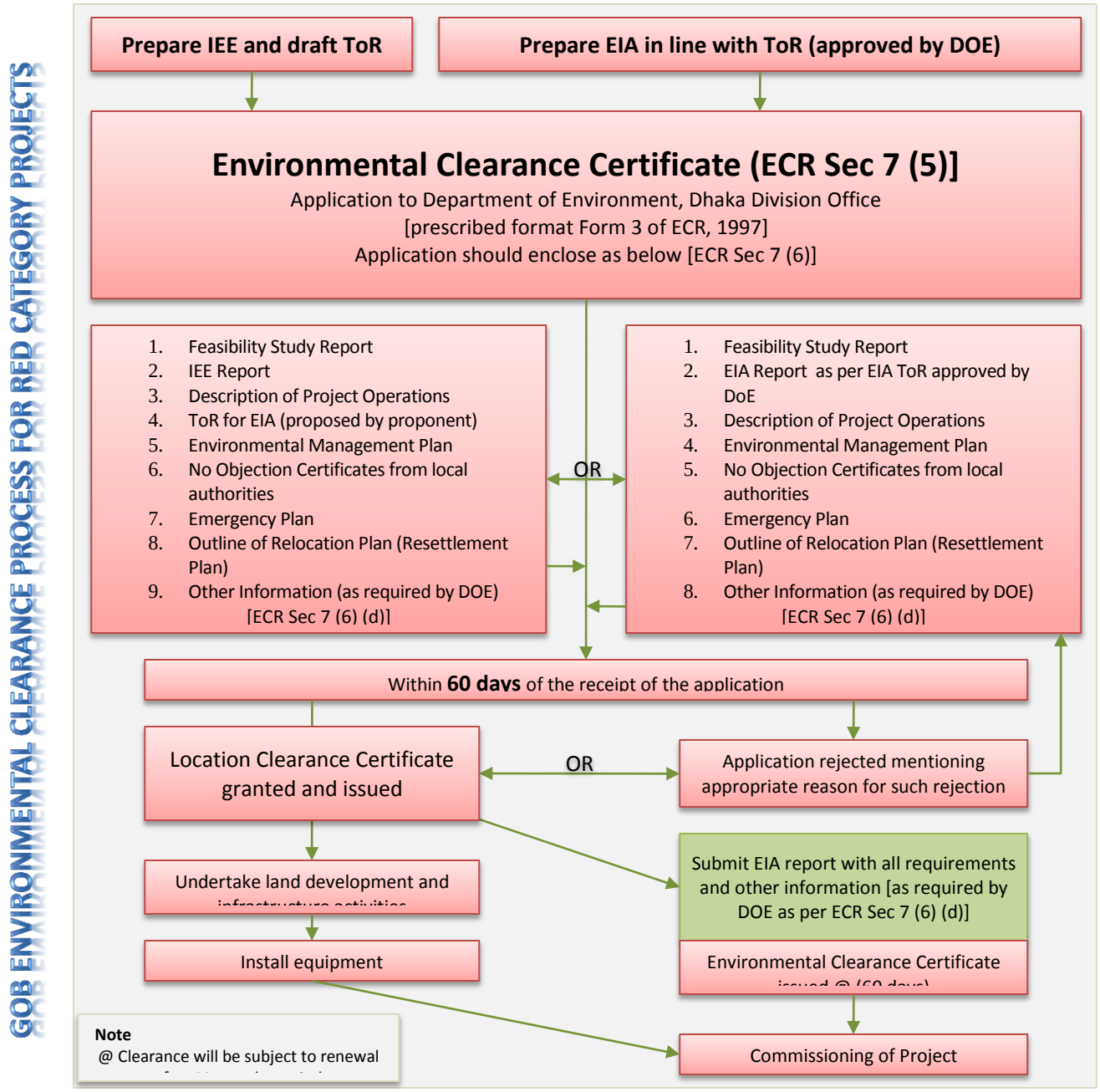


Figure 1: Government of Bangladesh Environmental Clearance Process for Red Category Projects

D. Institutional Capacity Assessment of DWASA

21. Safeguards capacity assessment of DWASA was carried out through consultations with DWASA officials. In terms of preparing environmental assessment reports (i.e., IEEs, EIAs, EMPs, etc.) and conformance to DoE requirements, the experience of DWASA is limited. The implementation of environment safeguards for various ongoing donor-funded projects, including the ADB projects, is carried out with the support of external consultants, and internal capacities to address safeguards do not exist.

22. While there is an environmental monitoring division within DWASA headed by an executive engineer, the role of this division has been limited to approval of private tube wells. While several DWASA engineers may be trained in environmental issues associated with public health engineering, there has been no formal training in assessment of environment impacts, compliance to DoE clearance requirements, and ADB requirements. A formal training program is included in the EMP, along with additional consultant resources to help DWASA implement environmental safeguards in accordance with the IEE and EMP and manage day-to-day issues of environmental management. Training shall be carried out by the environmental specialist (national) of the supervision consultant (SC) for the project.

23. The proposed capacity building program will include (i) sensitization of the PMU staff and stakeholders on environmental management, including on ADB and government requirements on the environment; and (ii) capacity building programs to improve the capability of PMU staff in carrying out, monitoring, and implementing environmental management measures for the project.

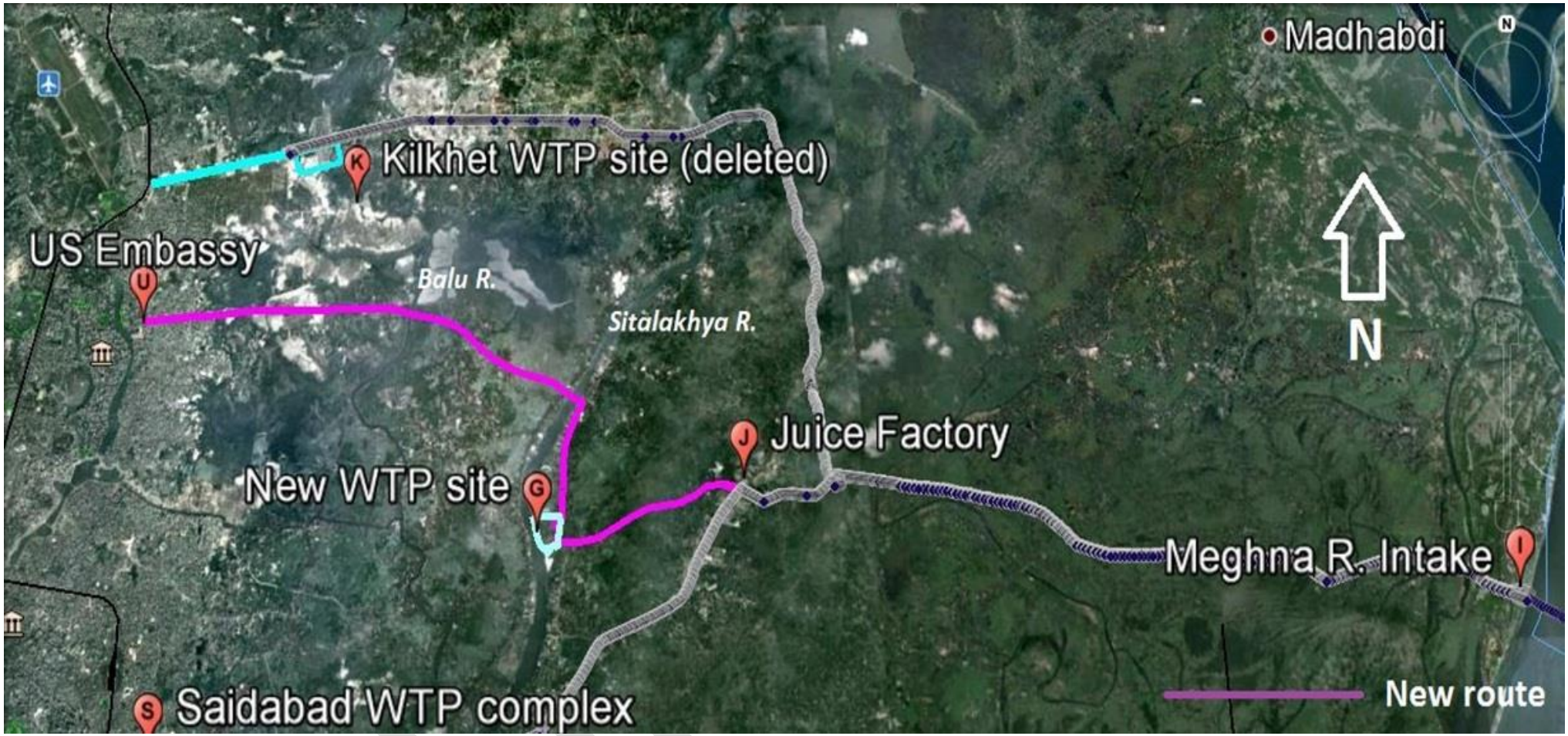
III. DESCRIPTION OF THE PROJECT

A. Overview of Project Components

24. The proposed system includes the following components. Figure 2 provides an illustration.

Table 3: Project Components

		Infrastructure	Contract Package
1.	Intake structures	2,000 mld capacity intake	Design-build contract
2.	Pumping station	2,000 mld capacity pumping station with 500-MLD pumping equipment	
3.	Raw water transmission lines	17.2 km raw water pipe from intake to Sejan juice factory, and then 4.5 km raw water pipe from Sejan to Gandharbpur WTP	
4.	Water treatment plant	500 mld capacity WTP at Gandharbpur	
5.	Treated water mains	13 km treated water mains from Gandharbpur WTP to US Embassy injection point	Construction contract
6.	Distribution reinforcement	21 km of distribution reinforcements within the existing network	Construction contract



Map 1. Project Lay-out Plan

Dhaka Environmentally Sustainable Water Supply Project

Schematic Project Layout

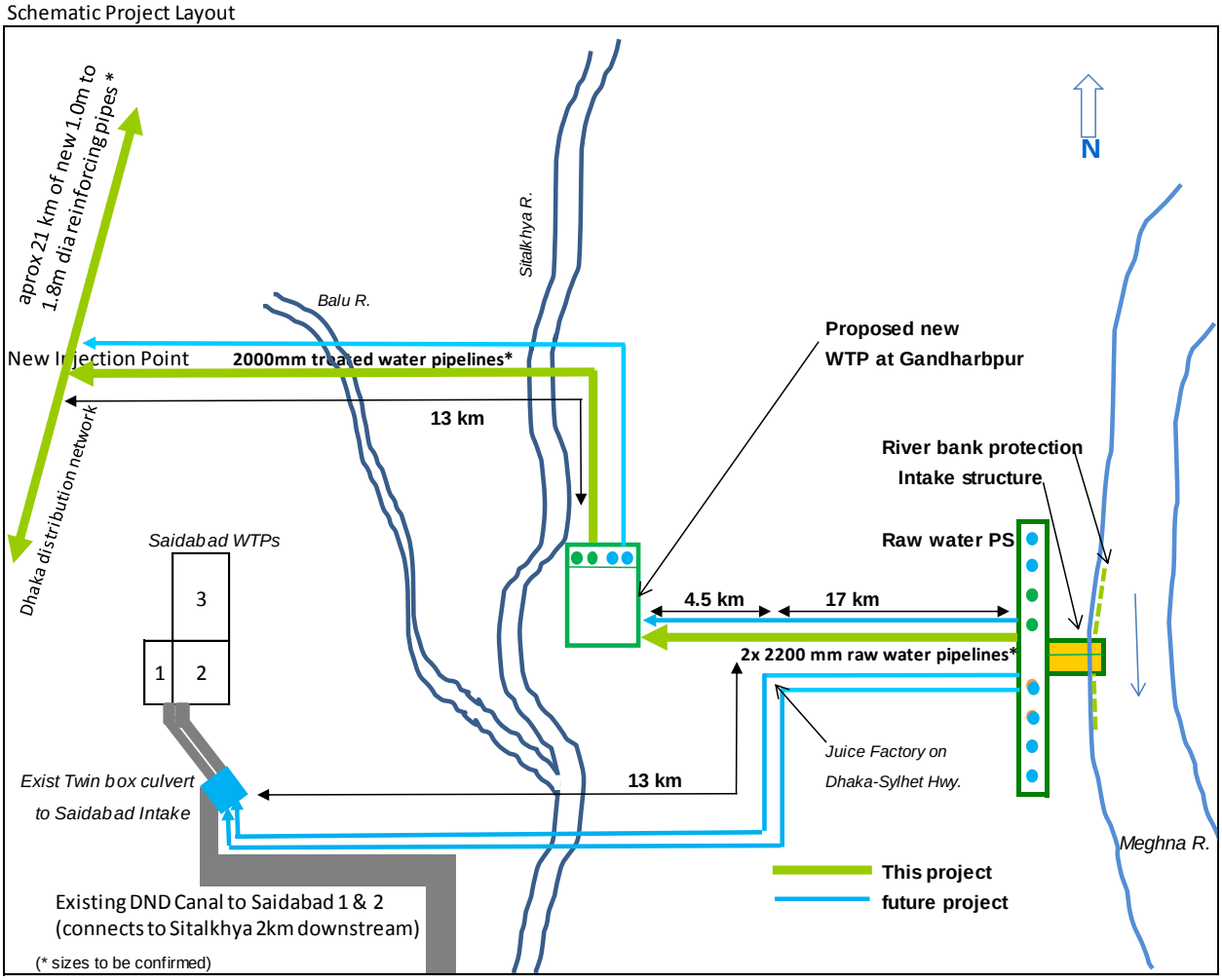


Figure 2: Schematic of Project Components

Intake Structures

25. 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 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. 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.

Pumping Station

26. The pumping station structure will be designed for full capacity in year 2030. The pumping station will consist of two sections: one pumping to Gandharbpur treatment plant and one pumping to the box culvert feeding the Saidabad treatment plant complex. 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.

Transmission Mains

27. 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 Sejan 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 Sejan juice factory to the Gandharbpur WTP, to be accommodated within a 25 m-wide corridor through agricultural lands and open areas.

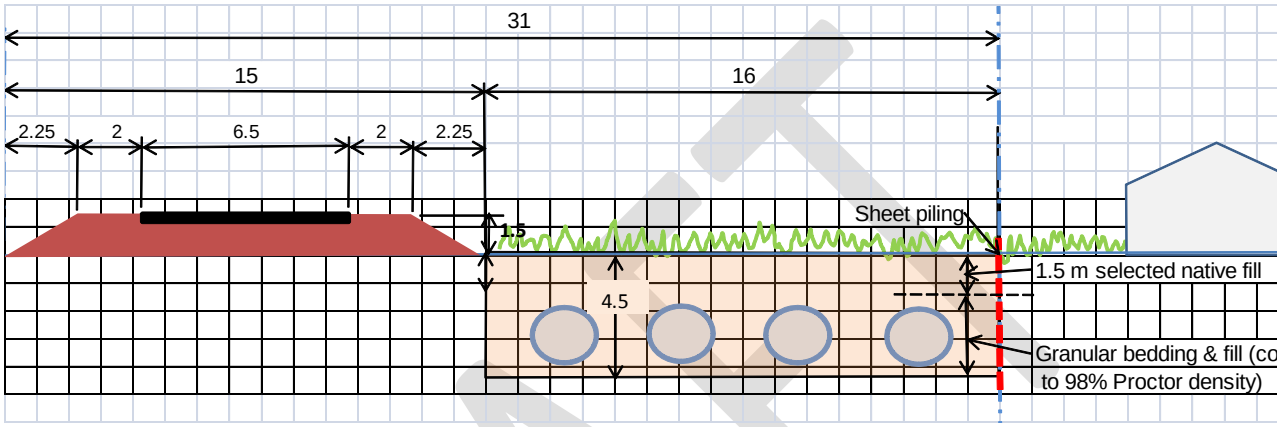


Figure 3: Transmission line—Intake to Dhaka-Sylhet Highway Junction

a) Intake to Sejan 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[7] 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 three pipes 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) Sejan Juice factory to Gandharbpur WTP

The transmission lines along this 4.5-km stretch from Sejan 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.

Gandharbpur Water Treatment Plant

28. 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

[7] The FS proposal of a 20 m-wide pipeline corridor to accommodate the four 2,200-mm pipelines was reviewed by the PPTA, and the 20-m width was found inadequate for construction purposes.

treatment plant will include prechlorination, coagulation, flocculation, sedimentation, filtration, 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;
(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.

29. 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.

Treated Water Mains

30. The water supply from the Gandharbpur WTP will serve the population, as listed in Table 4.

Table 4: Water Supply from Gandharbpur WTP

Zone	Name	Population	%	Water Supply (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

31. Treated water from Gandharbpur 1 WTP will be conveyed to the US Embassy injection point through two 2,000-mm pipes. 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.

32. 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 IWM under the DMC.

B. Procurement Packages

33. The project has been structured for implementation under three packages:
    (i) Procurement Package 1. 2,000-mld intake, 2,000-mld pump station, and 500-mld WTP at Gandharbpur (design-build contract)
    (ii) Procurement Package 2. Raw water and treated water pipelines

C. Project Implementation Schedule

34. The detailed designs to be carried out by the design-build contractor for the project are expected to be completed in mid-2015. Implementation will start by late 2015, and will be completed in 2018, over a period of 3 years.

IV. DESCRIPTION OF THE ENVIRONMENT

35. This section describes the environmental conditions of the study area. The area includes (i) Narayanganj District, location of intake from Meghna River, transmission mains to the treatment plant, and WTP at Gandharbpur; and (ii) Dhaka District, where the treated water transmission lines are proposed.

A. Physical Environment

Topography and Drainage

36. Dhaka is located mostly on river deposits at the southern fringe of the Madhupur Tract, which is an elevated Pleistocene inlier. Large parts of the city are located on this inlier, which is surrounded by very young riverine sediments occupying the surrounding valleys. The elevation of the inlier tract varies from 2 to 14 m above mean sea level, and the drainage patterns within can be either dendritic or trellis. The terraces are surrounded by the Ganges-Meghna floodplain in the south, the old Brahmaputra floodplain in the east, and the Jamuna floodplain in the west.

37. The topographic elevation in the project area is reflected in specific landforms as “high” lands, lowlands, depressions, and abandoned channels. Around the outskirts of Dhaka, the rivers Buriganga, Turag, and Balu drain a complex of low areas, which are a system of low-lying alluvial plains. The average elevation here is less than 2 m above mean sea level. Broad streams cut through the central high area and fall into this unit. The broad streams are locally known as *khals*, and the broad depressions are called *bils*.

Climate

38. The climate in the project area is average tropical monsoon type, with alternating dry/wet seasons. With an average annual rainfall of about 2,100 mm, the annual rainfall varies from 1,800 mm to 2,400 mm and is unevenly distributed, with peak falls occurring in July and August. Including the pre-rainy season, there are three marked seasons:

    (i) November to February: The dry (winter) season is the coolest and driest period. Monthly average temperatures are below 29^0C, with a minimum of 13^0C. Rainfall is very rare during this period (below 30 mm/month). Winds are predominantly blowing from the northwest, but with a high frequency of calm wind situations.
    (ii) March and April: In the pre-rainy season (summer) and the early months of the west seasons, the highest temperatures are reached. The monthly average temperature can rise up to 34^0C. During this period, air becomes more humid, rainfall increases, and heavy rains with thunderstorms occur.
    (iii) May to October: In the wet season (“monsoon period”), more than 85% of the total annual rainfall occurs. Monthly average temperatures remain high, with a maximum of 33^0C. The period of periodic heavy thunderstorms lasts until June.

June to mid-September to early November is the transitional period, with decreasing rainfall and frequent thunder. During the wet season, the winds are predominantly blowing from the south. Monsoon rains are generally not stormy, but downpours of 50-75 mm per day are not uncommon, and rainfall of more than 250 mm per day is occasionally experienced.

i)

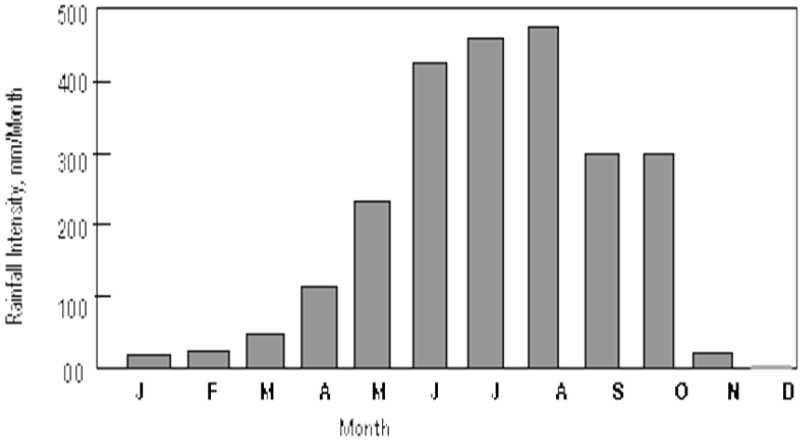


Figure 4: Typical Rainfall Intensity Distribution

Earthquakes

39. Dhaka is located in a seismic zone II[8], 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 mains.

Surface Water Resources

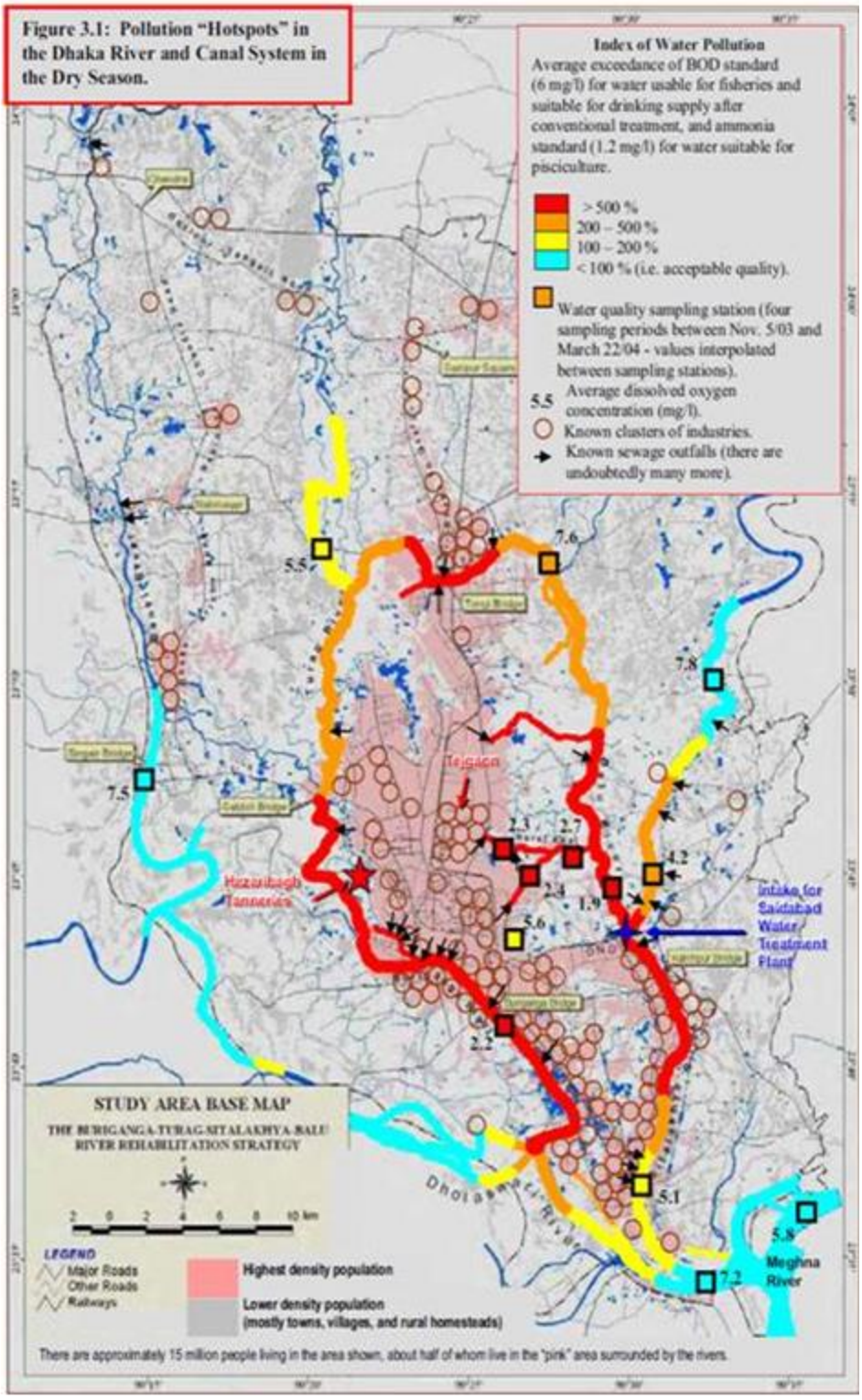
40. The river system in the Dhaka watershed includes Dhaleswari, Turag, Tongi Khal, Buriganga, Balu, Bangshi, and Sitalakhya Rivers. Dhaka is primarily surrounded by three rivers: Buriganga on the southwest, Turag in the northwest, and Balu in the northeast. The Sitalakhya River flowing by the southeastern 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.

41. 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.

8 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.

42. 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.

43. 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). The index of water pollution in the rivers of Dhaka is illustrated in Figure 5 below.



Source: Dhaka Metropolitan Development Plan, Strategic Environmental Assessment, 2007

Figure 5: Index of Water Pollution in Dhaka Rivers

44. Given the high pollution levels in the Dhaka rivers, in line with the provisions of the ECA 1995 (Section 5)[9], through a gazette notification dated 1 September 2009, the 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.

45. 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. Consultations were held with the DoE on the clearance requirements for laying transmission mains at these river crossings. 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.

Groundwater Resources

46. 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.

47. 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.

Meghna River

a. Water quality

48. 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 5. 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.

[9] 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.

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 5: 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.

49. 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.

b. Levels of abstraction at the intake

50. 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:

Q 95[10] = 3,815 m^3/sec
Q 5[11] = 11630 m^3/sec
Q 50 = 4037 m^3/sec
Q mean (of actual measurements): 7,720 m^3/sec.

51. The proposed abstraction (for the designed intake of 2,000 mld of raw water from Meghna) accounts for 0.6% of the lean flow (Q95) for 2035, and about 0.2% of the maximum flow (Q5) for 2035. These levels of abstraction will not adversely impact downstream uses or the ecological flows of the Meghna River.

c. Fisheries in Meghna River

52. 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.

53. The spawning grounds of major fish species like *rui, katla, hilsa, pangas*, and *galda chingri* have been identified and earmarked as fish sanctuaries[12], 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.

54. 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* (*hilsa* fry) 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.

10 Q95 - The flow of a river which is exceeded on average 95% of the time—the lean flow
11 Q5 - The flow of a river which is exceeded on average 5% of the time—maximum flow
12 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**
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 Patuakhali district	November to January

13 The *hilsa* fry grows from about 2 cm to 15 cm by end of April.

55. 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 0.6% 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.

c) Pollution sources in vicinity of the proposed intake

56. 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.

57. 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.

Shops at the Manikpur ferry *ghat*

	
Ferry *ghat*	Lack of toilet facilities at the ferry *ghat*

58. 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

d) Tidal influence in Meghna River

59. 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).

Other River/Water Crossings

60. 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 6. To the extent feasible, the route shall be designed to avoid as many of the water bodies as possible.

Table 6: *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 Sejan juice factory				
1	0/800	*Khal* – Chaitan Kanda	80 m	Irrigation, fishing	Yes

S.No	Chainage	Name	Width/Area of the Water Body	Uses	Whether Impacted
		village			
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
	Sejan juice factory to Taraboo (Demra Bridge) along Dhaka-Sylhet highway				
13		Drain within the RoW	Width varying from 10 m to 15 m for a length of about 2 km along the highway	Not used by communities. Industrial wastes discharged at few locations	Yes
	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: Site visits and consultations.

Pond cut across by transmission mains (Ch 10/100) – Lengurdi Mouza

Water crossing at Ch 14/000 –Dorikandi village

Air Quality

61. The AAQ monitoring and analysis carried out by the DoE, as part of the Dhaka City–State of the Environment, 2005 indicates a deterioration in the air quality, largely attributed to the growth of settlements, brick fields, and the number of motor vehicles. Tejgaon in the vicinity of Banani has a significant number of industries. In addition to the industries, the increased

vehicle traffic has resulted in air pollution impacts. The condition of carbon monoxide and lead in the air has improved, due to the banning in 2003 of two-stroke three wheelers, buses older than 20 years, and trucks older than 25 years, as well as the introduction of vehicles using unleaded gasoline (1999) and compressed natural gas (CNG). In Dhaka City, the emission of volatile organic compounds is significant, due to open dumping grounds within the city.

62. The summary of air quality for Dhaka obtained at the Continuous Air Monitoring Station (CAMS) of the DoE indicates that the main pollutant of concern is particulate matter. Both PM_{10} and PM_5 are above the standards. The lead (Pb) concentrations are now low (around 100ug/m^3), and therefore, airborne lead is not considered a health issue in Dhaka.

63. To establish the baseline air quality concentrations in the vicinity of the project locations, ambient air quality (AAQ) monitoring was carried out under the PPTA for representative land uses. The locations for monitoring are presented in Table 7. The monitoring results are presented in Table 8.

Table 7: Ambient Air Quality (AAQ) Monitoring Locations

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

Source: Primary Monitoring

Table 8 : 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 Standards		65	150	200	120	100	10

Source: Primary Monitoring

64. The outcome of the monitoring reveals that, except for those at the Intake Tetia village and the transmission main intake, all other monitoring locations show higher concentrations with respect to $PM_{2.5}$, $PM_{10,}$ and suspended particulate matter (SPM). This can be attributed to the rural context of the intake and the transmission main alignment, where traffic levels and construction activities are minimal. The increased concentrations at other locations are representative of the land uses, and can be attributed to the construction activities and traffic.

The concentrations of other noxious parameters, SO_2, NO_x and CO, are observed to be within the ambient air quality standards stipulated by DoE for all the monitoring locations.

Noise Levels

65. To establish the baseline noise levels in the vicinity of the project locations, monitoring of noise levels was carried out under the PPTA for representative land uses. The locations for monitoring are presented in Table 9.

Table 9: 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
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: Primary Monitoring.

Table 10: Ambient Noise Level Analysis in dB(A)

Noise Monitoring	Noise Levels in dB(A)					
	Leq day	Leq 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: Primary Monitoring

Table 11: 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.

66. The observed daytime and nighttime noise levels exceed the permissible noise levels at residential zones for locations 1, 2, 3, and 4. Locations 5 and 6 are categorized as industrial zones, and the observed noise levels are considerably higher than DoE industrial zone noise quality standards. Given the already high noise levels along the project locations, there is a need for integration of noise protection measures during construction, especially in and around the settlements.

A. Biological Environment

67. There are no protected areas, forests, wetlands or, environmentally sensitive areas or endangered species in or within the project sites.

Flora and Fauna

68. The project area is similar in character to many alluvial deltas in Bangladesh, with mixed crop vegetation. Rice, grains, and seasonal vegetables are the main crops in this area. Other than monoculture tree plantations, no forest land is involved. Terrestrial plants are mainly limited to crops and fruit trees planted in agricultural areas. The plants include low growing grasses and herbaceous vegetation, as well as other flora. The list of plant/tree species that are commonly available in the project area was obtained through field visits and consultations with the forest department, and is presented in Table 12 below.

Table 12: Plant and Tree Species Commonly Found in the Project Area

English Name	Scientific Name	Local Name	Use
Grass	*Spontaneum*	*Khar*	Fuel/covering
Trees	*Saccharum*	*Gash (kaichi kash, dubla*, etc.)	Soil binder
Lichi	*Cynodon dactylon*	*Lichu*	
Mango	*Lichi chinensis*	*Aam*	Fruit
Date palm	*Mangifera indica*	*Khejur*	Fruit, timber
Black berry jackfruit	*Phoenix sylvestris*	*Jam*	Fruit, timber
VI. *Jambul*	*Syzygium cumini*	*Khatal*	Brown sugar
Jackfruit	*Artocarpus heterophyllus*	*Narikel*	Fruit, timber
Coconut	*Cocos nucifera*	*Pape*	Fruit, timber
Papaya	*Carica papaya*	*Piara*	Fruit, fuel
Guava	*Psidium guajva*	*Kala*	Fruit
Banana	*Musa sepientum*		Fruit fuel
Wood tree (timber/fuel wood)		*Shil kiroi*	
VII. *Mehagani, shal, shilkoroi, shimul*	*Shorea Robusta, Albizia procera, Salmalia malabarica*	Silk cotton	Fuel, timber Fuel, timber Fuel, pillow

Source: Forest Department, GoB.

69. No wild animals inhabit the project areas, and no endangered species are present or their movements recorded. Aside from common birds like crows, sparrows, mayna, shaliks, cuckoos, etc. and some domestic cattle, no other wild animals inhabit the area. The common types of reptiles found in the rural areas of the district include water snakes and house lizards. In terms of amphibians, mostly toads and frogs are prominent. No mammal species of national significance are present in this area. The list of animal/ faunal species commonly available in the project area was obtained through field visits and consultations with the forest department, and is presented in Table 13 below.

Table 13: Fauna in the Project Area

Scientific Name	English Name	Local Name
Reptiles		
Enhudris enhydris	Smooth water snake	*Painnya shap/huriya*
Hemidactylus	House lizard	*Goda tik tiki*
Naja naja kaouthia	Narrow-headed softshell	
Chitra indicad	turtle	*Chitra katchap*
Amphibians		
Bafo melanostictus	Common toad	*Bang*
Rana cyanophyctis	Skipper frog	*Bang*

Scientific Name	English Name	Local Name
Mammals		
Callosciurus sp.	Squirrel	*Kat biral*
Cynopterus spinex	Short-nosed fruit bat	*Badur*
Funumbalus pennanti	Squirrel	*Kat biral*
Herpestes Auropuncatus	Mongoose	*Bheji*
Mus booduga	Field mouse	*Idur*
Mus musculus	House mouse	*Nengti idur*
Pteropus giganteus	Giant flying fox	*Boro badur*
Birds		
Alcedo atthis	Common kingfisher	*Machranga*
Copsychus saularis	Robin	*Doel*
Corvus splendens	House crow	*Kak*
Egretta albe	Great egret	*Boro bak*
Egretta gazetta	Small egret	*Chhoto bak*
Dirrurus adsimilies	Black drongo	*Fingry*
Passer domesticus	House sparrow	*Choroi*

Source: Forest Department, Government of Bangladesh.

Forests and Protected Areas

70. There are no forests or protected areas in the vicinity of the project locations. The nearest protected area is the Bhaval National Park, located about 50 km northwest of the proposed intake at Bishnondi. Bhaval National Park (24°01'N, 90°20'E) in the Dhaka Forest Division, was established as a national park in 1974. The area is actually honeycombed with habitations and rice fields. The topography is characterized by low hills, which rise 3-4.5 m above the surrounding paddy fields, locally known as *chalas*, and intersected by numerous depressions. The dominant forest trees of the park, *sal* (*Shorea robusta),* have been almost completely removed, but now protection programs have planted *sal,* which covers 90% of the area. No impacts are envisaged on the forest and protected areas due to the proposed project interventions.

Wetlands

71. There are no protected wetlands or wetlands of international significance[14] in the proposed project locations. Though not a protected wetland, major parts of eastern Dhaka have a natural drainage system comprising *khals* and low -ying areas. These areas functioned as water retention zones, thereby minimizing flooding of the Dhaka urban areas. Over the past two decades, there have been massive real estate developments in these areas, both by private and government agencies, resulting in a filling up of these low-lying areas[15]. Pollution Abatement Strategies for Rivers and Wetlands In and Around Dhaka City (2010)[16] recommended that in order to protect Dhaka from frequent internal floods, a total of at least 40% of the 166 km^2 drainage catchment area (within eastern Dhaka) must be delineated and protected as wetlands and water bodies under the purview of the Wetland Conservation Act 2000.

72. A stretch of about 8 km of treated water transmission mains from the Sitalakhya Bridge until the Bhatara *Khal* passes through low-lying areas, which are part of eastern Dhaka's low-

[14] 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 three Ramsar Sites: (i) parts of Sundarban Reserved Forest (southwest of Bangladesh); (ii) Tanguar Haor; and (iii) Hakaluki Haor.

15 The water bodies and low-lying areas in the project area can be categorized into permanent and seasonal. While the permanent bodies include rivers, *khals*, and perennial water bodies, the seasonal water bodies include the low-lying areas in between and usually cultivated either for crops or fish. The development pressure on these lands in the vicinity of Dhaka, and lack of any definite measures (policy and regulatory) for conservation of these seasonal water bodies, has resulted in filling up of most of the low-lying areas in eastern Dhaka.

16 Report by the Parliamentary Standing Committee on Ministry of Environment & Forests

lying areas and water bodies. Major portions of these areas have been filled and developed for large-scale townships by private developers. The project does not propose any additional filling of low-lying areas or water bodies, as the treated water transmission mains will be accommodated within the available road RoW.

73. Similar development pressure, leading to the filling up of low-lying areas, is also witnessed along the 17.2-km transmission line alignment through agricultural fields and low-lying areas from the intake to the juice factory.

Fisheries

74. In addition to the Meghna River, a major fishing ground, fresh water fish habitats such as rivers, *khals*, ponds, and ditches exist along and around the project locations, providing shelter, feeding, and spawning grounds for different types of fresh water fish. These include catfishes (*magura* and *shing*), carps (*katla, rui, and mrigal*), minor carps (*puti*), and others (*tengra, boal, mola, shol*) as well as prawn, particularly the popular small prawns, locally known as *ichha*. Small fishes are available, particularly during early monsoon and pre-winter season. The fish species found in the Balu and Sitalakhya Rivers and the water bodies in the project area as gathered during the consultations with the fishermen and communities in the surrounding locations are presented in Table 14 below.

Table 14: Fish Species Available in Water Bodies Along the Transmission Mains

Local Name	English Name	Scientific Name
VIII. *Bai-la*	-	*Awaous guamensis*
Baim	Zigzag eel/tire-track eel	*Mastacembelus armatus*
Bata/bangna	Bata	*Labeo bata*
Boal	Wallago	*Wallago attu*
Magor/shing	Indian torrent catfish	*Amblyceps mangois*
Chitol	Clown knifefish	*Chitala chitala*
Darkina	Slender rasbora	*Rasbora daniconius*
Gutum	Annandale loach	*Lepidocephalichthys annandalei*
Kalibaus	Orange-fin labeo	*Labeo calbasu*
Katol	Catla	*Catla catla*
Koi	Climbing perch	*Anabas testudineus*
Magur	African catfish /north African catfish	*Clarias gariepinus*
Mrigol	Mrigal	*Cirrhinus cirrhosus*
Pangas	Yellowtail catfish	*Pangasius pangasius*
Punti (fish)	Puntio barb	*Puntius puntio*
Shoul	Snakehead murrel	*Channa striata*
Snake eel *(kuicha)*	Long-fin snake-eel	*Pisodonophis cancrivorus*
Tara baim	Lesser spiny eel	*Macrognathus aculeatus*
Tengra		*Batasio batasio*
Tilapia	Mozambique tilapia	*Oreochromis mossambicus*
Source: Field visits and consultations		

Roadside Plantations and Vegetation

75. There are tree plantations by the RHD along the raw water transmission mains along the Dhaka-Sylhet highway (between Sejan 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.

76. 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.

Cultural, Religious, and Archaeological Sites

77. 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 15 below.

Table 15: 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

Development Activity Around the Project Area

78. The key development activities around the proposed project locations are summarized in Table 16 below.

Table 16: 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 in Dhaka	Projects in water supply and sanitation, drainage, urban transport, etc.	Along the treated water lines
Source: Site visits and consultations			

IX. ANALYSIS OF ALTERNATIVES

79. 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.

A. Intake Location

80. 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 located 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

81. 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.

82. 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.

83. 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.

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

B. Transmission Line Alternatives

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

Pipe in Trench

86. 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.

87. 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).

88. 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

89. 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

90. 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

91. 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.

C. River Crossings Along the Transmission Mains

92. 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

93. 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.

94. 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.

D. Alignment of Transmission Mains

95. 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.

96. 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.

97. 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.

98. 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 Sejan juice factory has been recommended.

X. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

99. The ADB Rapid Environmental Assessment Checklist for Water Supply was prepared to screen the project for environmental impacts and categorization of the project. Specific impacts anticipated in the various stages of the project are summarized below.

A. Location and Design Impacts

Intake

a) Land acquisition and resettlement

100. 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.

b) Impacts on fisheries/river ecology

101. 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* (*hilsa* fry), are minimized. Consulting a fisheries expert as part of the detailed design is proposed, 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.

c) Impacts on downstream uses

102. The proposed abstraction accounts for only 0.6% of the lean flow (Q 95) for 2035, and about 0.2% of the maximum flow (Q 5) for 2035. 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.

d) Upstream pollution impacts and protection of source

103. 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.

104. 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.

105. 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.

106. 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. A sample semi-annual environmental monitoring report template is included in Appendix 5. 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.

107. 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.

Transmission Mains—Intake to Gandharbpur WTP

108. A 31 m-wide, 17.2 km-long corridor is proposed to accommodate the transmission mains from intake to the Sejan juice factory on the Dhaka-Sylhet highway junction. From Sejan 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.

Design Impacts For All Components

109. 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.

110. 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.

111. Site selection of 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.

112. 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.

113. 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.

114. 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.

115. 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.

116. 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.

B. Construction Impacts

117. 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.

118. 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 IEE. A checklist for safety during construction is provided in Appendix 4.

119. 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[17] 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;

[17] 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.

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.

120. 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 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.

121. 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.

122. 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.

123. 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.

124. 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.

125. 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.

126. 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.

127. 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.

128. 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.

C. Operation and Maintenance (O&M) Impacts

129. 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.

130. 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.

131. Sludge handling. During operation of the WTP, physical and chemical sludge will be generated. The disposal of the alum sludge is proposed at the landfill site of Dhaka at Matuail, about 10 km from the proposed WTP.

132. 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.

133. 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.

D. Environmental Impacts and Mitigation Measures

134. Table 17 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 17: Environmental Impacts and Mitigation Measures

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
	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).	PMU and RP 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	√	X	X	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	Contractor, with technical guidance from the fisheries expert of the SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							based on assessment of fish sizes at the location and the swimming characteristics of *hilsa*.	
1.4	Impacts on water abstraction and ecological flows of Meghna River, especially in lean flow	Permanent	Moderate	√	x	x	The proposed abstraction accounts for 0.61% of the lean flows for the ultimate intake capacities of 2,000 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.	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.	PMU with support from SC
1.7	Assets/facilities lost, including common property resources and religious	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.	Contractor and SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
	structures						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.	
1.8	Pollution control and IEC activities upstream of the source, including sanitation facilities and waste collection facilities at Manikpur ferry *ghat*	Permanent	Moderate	√	x	x	In consultation with the BIWTA, design of sanitation facilities and solid waste 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.	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 suitable	Contractor and SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							locations shall be carried out by the contractor in line with the siting criteria for temporary construction areas defined in item 1.8.	
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 *khal*s 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.	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 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	Contractor/ SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							and other ancillary work areas.	
1.13	Sludge management and disposal	Temporary	Moderate	√	√	√	Design of WTP to include sludge drying beds, and sludge management plan to be prepared.	Contractor/ SC
1.14	Update IEE	Temporary	Moderate	√	√	√	The draft IEE will be updated based on detailed designs, and submitted to ADB for review, approval, and disclosure prior to commencement of work.	Contractor/ SC/DWASA
1.15	Environmental clearance	Temporary	Moderate	√	√	√	The draft IEE 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.	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 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	Contractor and SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							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.	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	Contractor / SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							surface water bodies from any source of contamination, such as oily wastes, debris, and spoils that will degrade its quality.	
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 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.	Contractor and SC
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 and SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							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.	
2.6	River crossings required for the transmission lines at the Sitalakhya and Balu Rivers by micro-tunneling	Permanent	Moderate	x	√	√	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 navigation—including cargo boats, fishermen, and passenger movements—	Contractor and SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							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.	
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 impact/ disturbance to the bridges/culverts due to crossing of the water pipelines.	
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.	Contractor and SC
2.9	Use of explosive materials	Permanent	Moderate	x	x	x	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	Contractor and SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							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.	
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.	Contractor and SC
2.11	Soil and water pollution due to fuel, lubricants, and construction	Temporary	Moderate	√	√	√	The fuel storage and vehicle cleaning area will be stationed such that runoff from the site does not drain into the water bodies/ponds abutting the	Contractor and SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
	waste						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.	
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.	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.	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	

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							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.	
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 routine servicing operations, the effectiveness of exhaust silencers will be checked, and if found to be defective, will be replaced.	Contractor and SC
2.16	Traffic control and safety	Temporary	Moderate	√	√	√	Before taking up any construction activities that would require traffic diversion, traffic control plans[18] 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	Contractor and SC

[18] 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	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							maintenance of such barricades, including signs, marking flags, lights, and flagmen, will be undertaken as per SC's direction and approval.	
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.	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	Contractor and SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							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 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.	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	Contractor and SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							work schedules; and (iv) provide signboards for pedestrians to inform them of nature and duration of construction works and contact numbers for concerns/complaints.	
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.	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.	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 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	Contractor and SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							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.	
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	Contractor and SC

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							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.	
2.26	Clearing of construction of 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, 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.	Contractor and SC
	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	√	x	x	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	√	x	x	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	DWASA

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							will be taken up in consultation with the fisheries department.	
3.4	Source protection - water quality	Permanent	Moderate	√	x	x	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
3.4	Survival of trees, maintenance of landscaping, and the green buffer zone	Permanent	Moderate	√	x	x	Proper care will be taken to increase survival rate of saplings, like regular watering, pruning, provision of tree guards, provision of manure for better nourishment, etc., including timely replacement of perished saplings.	DWASA
3.5	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
3.6	Management of sludge and waste at the treatment plant	Permanent	Moderate	√	x	x	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	DWASA

Sl No	Environmental Issues	Duration/ Extent	Magnitude	Package 1	Package 2	Package 3	Mitigation Measures	Responsibility
				Intake, pump station, raw water pipeline, Gandharbpur WTP 500 mld	**Treated water pipelines**	**Distribution reinforcement**		
							ensure effective management of solid wastes at the treatment plant site.	
3.7	Effective maintenance of the sludge-drying beds at the WTP	Permanent	Moderate	√	x	x	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

XI. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

135. The consultation process during the project preparation stage was carried out with the following objectives: (i) to promote public awareness on the proposed project, especially among the potentially impacted communities/individuals; (ii) to familiarize the stakeholders/government agencies with technical, environmental, social, and economic issues of the project for better understanding; (iii) to educate the potentially impacted communities/individuals about the proposed course of action and the project alternatives; (iv) to solicit the views of affected communities/individuals on environmental and social problems; (v) to gather inputs from the affected communities/individuals for crucial decisions regarding mitigation of the identified environmental and social issues; (vi) to foster cooperation among officers, communities, and the stakeholders to achieve a cordial working relationship for smooth implementation of the project; (vii) to identify the environmental issues relating to project components; (viii) to secure people's inputs with respect to project design, selection of mitigation measures, and monitoring strategies, and incorporating suggestions made during consultations into project design as found feasible; and (ix) to assess the views of the beneficiary community and their willingness to participate in the project planning and decision making.

136. The consultation process so far has solicited inputs from a range of stakeholders, including government officials, experts, and researchers, including elected representatives, residents at the project locations, and project affected persons.

A. Public Consultations

137. The formal consultation meetings carried out with the communities are summarized in Table 18. In addition, during the site visits and social surveys, extensive smaller group discussions on specific environment and social issues were held. Suggestions and concerns of the affected persons focused mostly on resettlement and land acquisition issues, which have been incorporated in the RP. Specific concerns with respect to fish protection, participation of communities during construction, carrying out construction activities without any adverse impacts on the water quality of the river, etc. have formed the basis for formulation of the mitigation measures, and have been incorporated in the EMP.

Table 18: Details of Public Consultations

S. No.	Place, Date	Participants	Purpose of Consultation	Key Issues Discussed
1	Old Dayakandha Bazar, 800 m downstream of the proposed Bishnondi intake, Meghna River, 15 January 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 experienced any salinity in river water, and mentioned that salinity intrusion was up to Chandpur, about 130 km downstream

S. No.	Place, Date	Participants	Purpose of Consultation	Key Issues Discussed
				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 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 discharges into the river should not be permitted upstream.
2	Bishnondi village, intake, Meghna River 19January 2013	Village residents, affected land owners, elected representatives, and ChairmanAraihazar 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 .
3	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.

Public consultations at intake site

Public consultations, Manikpur ferry *ghat*

B. Institutional Level Consultations

138. Table 19 summarizes the consultations held with key government agencies, departments, and institutes.

Table 19: Stakeholder Consultations

S.No	Agency/Department	Issues Discussed
1	Department of Environment Purpose of consultation: To provide information on the project Understanding clearance requirements for the project Specific requirements on ecological critical areas—Dhaka rivers	DoE stated that the following precautionary measures shall be critical in ensuring the sustainability of the proposed project: (i) protection of the source from any pollution upstream, including potential siting of industries and other polluting uses,for which consultation with other agencies shall be critical; (ii) measures to ensure environmentally safe disposal of sludge from the treatment facilities; (iii) choice of machineries, including pumps of good quality, to ensure minimal noise and uninterrupted operations; (iv) systems to ensure chlorination and public health; and (v) understanding developments along the transmission lines proposed, through interactions with various agencies, especially conforming to the land use plans of the area. In the event of the transmission mains being taken under navigable rivers/streams, potential damage to pipes due to movements of dredgers/trawlers shall require consideration.
		The four rivers (Buriganga, Sitalakhaya, Turag, and Balu) surrounding Dhaka City are among the 12 ECA, as part of the plan to protect the rivers from encroachment as well as conservation of the biodiversity of the watercourses. There is no management plan prepared for the rivers. While no specific clearance requirements exist for interventions/activities around these rivers, it was explained that control of pollution, hunting, disposal of wastes, etc. were to be taken care of by project proponents. Apart from the four rivers, DoE informed that there are no protected wetlands of significance in the proposed project locations.
		The DoE confirmed that the project, as per Government of Bangladesh requirements, shall be categorized as red, and would require a two-stage clearance process: the location clearance certificate and the environment clearance. The project proponent, upon submission of the application, shall make a presentation to the committee for clearance. The meetings are held on a fortnightly basis, and clearance for location and the approval of the terms of reference for EIA study is usually accorded in a month's time, if required information is provided.
		DoE confirmed that conformance of a project to either World Bank or ADB guidelines shall be generally considered sufficient for the DoE to accord clearances to a project.
2	Department of Fisheries, Dhaka Purpose of consultation: To provide information on the project, discuss the potential impacts on fishery resources	DoF agreed that this project is critical for provision of water supply to the residents of Dhaka, thus impacts pertaining to fish productivity, plankton, and juveniles shall need to be carefully addressed.
		DoF advised interacting with the extension officer of fisheries at the Araiazar Upazilla (in which the proposed intake is located) and the scientists at the Chandpur Institute of the Bangladesh Fisheries Research Institute (BFRI), to discuss further the specific details of the project.
		DoF said that the breeding ground for smaller fishes is all over the watercourses, while there are defined grounds for larger fishes. The major indigenous species of fish in the Meghna River include *hilsa, rui, katla, mighel, kalibaus*, and *pangas*. Barisal and Chandpur are the major breeding grounds along the Meghna.
		DoF inquired about the quantum of water that would be drawn at the intake during the lean season. There was an apprehension that, in the event of large withdrawal of water during the lean season, there could be impacts on the fishes. DoF was informed that the extent of abstraction is about 0.6% of the lean flow.
		DoF agreed to provide any support through field officers and staff in providing any information on the fisheries, and also sought invitations to the project workshops/ meetings so that they can provide informed inputs to the project development.
3	Araihazar Upazilla fisheries office Purpose of consultation: To provide information on the project, discuss the potential impacts on fishery resources at the intake location	*Hilsa* breeding grounds were not identified in and around the Araihazar area. Though not alarming to date, there is a need to control pollution from the small-scale and large-scale industrial units upstream, as this will have long-term effects on the fisheries in the river. There are fishermen communities living just downstream of the intake. The project must be designed to ensure that the livelihood of the fishermen is not affected. Protection measures to minimize impacts on fishes through design of nets, screens, etc. at the intake must be part of the designs.

4	Chandpur Research Station, BFRI, Purpose of consultation: To provide information on the project, discuss the potential impacts on fishery resources	There is no sanctuary at present in the vicinity of the intake, and there is no plan to establish a sanctuary in the upstream of Meghna River. *Hilsa* breed all year in the major river and estuary. During the breeding period, catching of *hilsa* and *jatka* is banned by the government. For other types of fishes (*roi, katal, pangas, kalibous*, etc.), ideal temperature and other environmental conditions are essential for proper and normal breeding. Many fishes breed after and before rains. There is no ban on catching other fishes during the breeding period. The need for design of screens at intake structures to ensure minimum impacts on fisheries must be taken up.
5	Department of forests Purpose of consultation: To provide information on the project, understand potential implications of the project on forests, clearance requirements for roadside trees	It was confirmed that there are no forest areas in the proposed project locations. The roadside trees along RHD roads shall require approval from the Upazilla committee. There are no regulations to regulate the felling of private trees. Species of flora and fauna found in the project locations were discussed, and it was confirmed that there are no sensitive/endangered species in the project locations.
6	RAJUK Purpose of consultation: To provide information on the project, discuss environmental issues pertaining to eastern Dhaka water bodies	It was confirmed that there have been significant development pressure on the lands in the periphery of Dhaka, including on the eastern side, resulting in development of major portions of eastern Dhaka. Development plan includes provisions for effective drainage and provides for protection of water bodies.
7	Bangladesh Inland Water Transport Authority (BIWTA) Purpose of consultations: To provide information on the project, to understand the operations of the ferry *ghats* and existing and future traffic flows in the Meghna River, and permissions required, if any, for the crossings	It was confirmed that there is no passenger ferry along the Meghna River along this stretch. The movement of vessels along the river is mostly commercial, apart from fishing vessels. Ferry *ghats* were established and operated by BIWTA. Permits are required from BIWTA in the event of work being undertaken within the reaches of the navigable rivers. The clearances will address the following key issues: (i) any installations in the river, including pipelines, shall not hamper the dredging activities; (ii) to avoid accidents, there will be public disclosure in local newspapers on the proposed works; and (iii) measures must be taken to ensure dredge materials are not discharged into the river or on the shores.

C. Plan for Continued Public Participation

139. The consultation process will be carried forward during the subsequent stages of the project design and implementation by the PMU, with support from the design consultants and the implementing NGO for RP.

140. Consultation during detailed design. This will be through (i) focus group discussions with affected persons and other stakeholders (including women's groups, NGOs) to hear their views and concerns, so that these can be addressed in project design where necessary; and (ii) structured consultation meetings with the institutional stakeholders (government bodies and NGOs) to discuss and approve key aspects of the project.

141. Consultation during construction. This will be through (i) public meetings with affected communities to discuss and plan work programs and allow issues to be raised and addressed

once construction has started; and (ii) smaller-scale meetings to discuss and plan construction work with individual communities to reduce disturbance and other impacts, and to provide a mechanism through which stakeholders can participate in project monitoring and evaluation.

142. Information disclosure. To provide for more transparency in planning and for further active involvement of the public and other stakeholders, project information will be disseminated through disclosure of project planning documents. The DWASA, through its project management unit (PMU), will keep the public informed about impacts, compensation, and assistances proposed for them, and facilitate addressing any grievances. The information will also be made available at convenient places in the project area, especially the office of DWASA, offices of the Upazila, Union Parishad in the project locations, and at other key accessible locations (such as market places) convenient to the public. For the benefit of the community, a summary of the IEE will be translated in Bangla and made available at (i) the office of the PMU, DWASA and (ii) the office of the Narayanganj district. Hard copies of the IEE will be available in the PMU, and accessible to citizens as a means to disclose the document, and at the same time create wider public awareness. On demand, the person seeking information can obtain a hard copy of the complete IEE document at the cost of photocopy from the office of the PMU, on a written request and payment for the same to the project director. The PMU will issue notification on the disclosure mechanism in local newspapers, ahead of the start of the project, providing information on the project as well as start dates. The notice will be issued by the PMU in local newspapers 1 month ahead of implementation. This will create awareness among the public. Posters designed for a mass campaign on the basic tenets of the IEE will be distributed to libraries in different localities for generating awareness.

D. Grievance Redress Mechanism

143. The project will establish a grievance redress mechanism to ensure greater accountability. DWASA will prepare a grievance redress mechanism, acceptable to ADB, and establish a special committee to receive and resolve complaints/grievances or act upon reports from stakeholders on misuse of funds and other irregularities, including grievances due to resettlement. The special committee will (i) make public the existence of this grievance redress mechanism; (ii) review and address grievances of stakeholders of the project, in relation to either the project, any of the service providers, or any person responsible for carrying out any aspect of the project; and (iii) proactively and constructively respond to them. The GRM for the project is outlined below, and consists of three levels with time-bound schedules for addressing grievances.

144. The first level and most accessible and immediate venue for the fastest resolution of grievances is the PMU, chiefly through the PMU environmental officer and project director. The contact phone number of the PMU will be posted in public areas in the project area and construction sites. Grievances will be resolved through continuous interactions with affected persons, and the PMU will answer queries and resolve grievances regarding various issues, including contractor performance, environmental impacts of the project (noise, air, traffic, etc.), land acquisition, structures acquisition, livelihood impacts, entitlements, and assistance. Corrective measures will be undertaken at the field level itself within 7 days. All grievances will be documented, with full information on the person (name, address, date of complaint, etc.) and the issue.

145. Should the grievance remain unresolved, the PMU's project director will activate the second level of the GRM by referring the issue (with written documentation) to the local grievance redress committee (GRC) of the DWASA, who will, based on review of the grievances, address them in consultation with the PMU resettlement officer and project director and affected persons. The local GRC will consist of the following persons: (i) project pirector or project manager of DWASA (GRC chair); (ii) affected person or representative of the affected persons; (iii) representative of the local district commissioner’s office; (iv) representative of the

Department of Environment (DoE)'s divisional office; and (v) SC environmental specialist (national). A hearing will be called with the GRC, if necessary, where the affected person can present his/her concern/issues. The process will promote conflict resolution through mediation. The local GRC shall meet as necessary when there are grievances to address. The local GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within 15 days.

146. The functions of the local GRC are as follows: (i) provide support to affected persons on problems arising from land acquisition (temporary or permanent), asset acquisition, and eligibility for entitlements, compensation, and assistance; (ii) record grievances of affected persons, categorize and prioritize them, and provide solutions within a month; and (iii) report to the aggrieved parties about developments regarding their grievances and decisions of the GRC. The PMU environmental officer will be responsible for processing and placing all papers before the PMU GRC, recording decisions, issuing minutes of the meetings, and taking follow-up action to see that formal orders are issued and decisions carried out. In the event that a grievance is not addressed by the PMU or GRC, the affected person can seek legal redress of the grievance in the appropriate courts, the third level of the GRM. The GRM proposed is depicted in Figure 6.

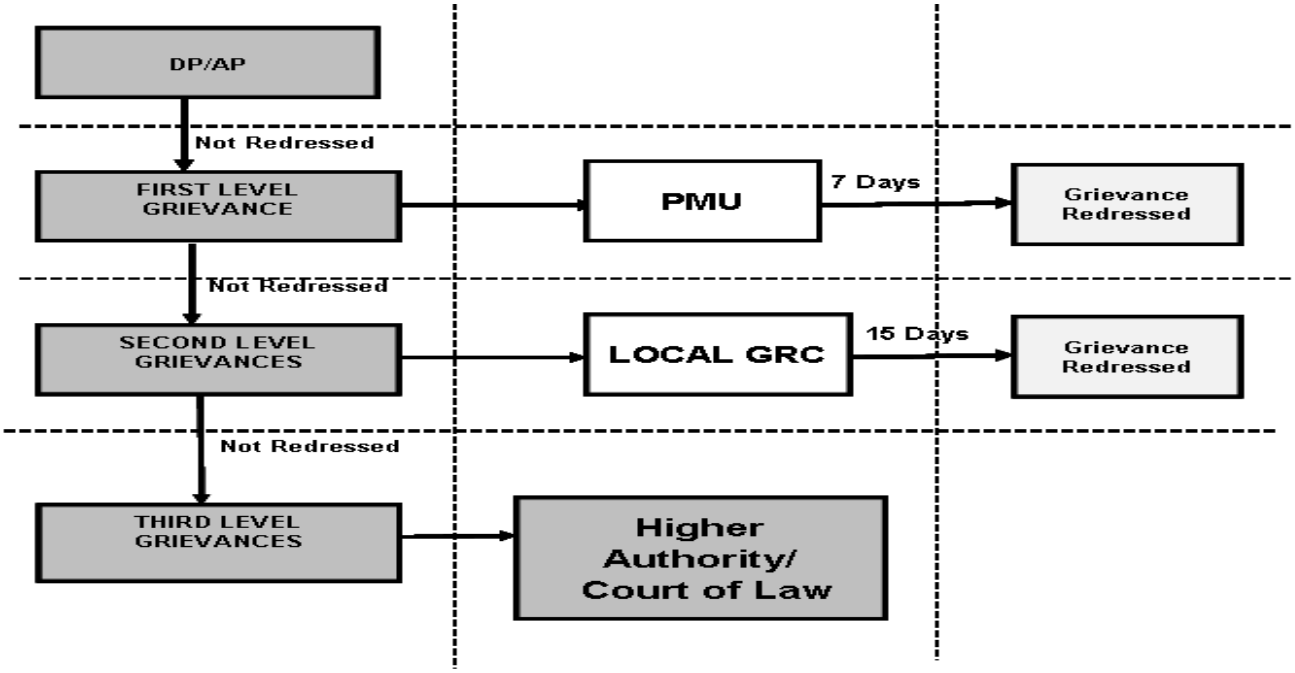


Figure 6: Grievance Redress Mechanism (GRM)

XII. Environmental Management Plan

147. This EMP provides guidance to the contractor, PMU, and SC on the implementation of the environmental measures included in Table 17 above. The same shall be integrated as part of the contract document for the project.

A. Institutional Arrangements

148. DWASA will be the executing agency (EA) responsible for overall guidance and project implementation. A project management unit (PMU), headed by a project director, will implement the project investments and will be responsible for overall planning, management, coordination, supervision, and progress monitoring of the project. The PMU will be responsible for day-to-day monitoring of the project, and will ensure compliance with the statutory and legal requirements of the Government of Bangladesh and ADB. The PMU will contain an environmental and social safeguards unit staffed with two qualified deputed officials (one environmental officer, and one social safeguards officer), with assistance from the environmental specialists on the supervision consultant team.

149. The PMU will be responsible for the following activities related to environmental safeguards: (i) confirm that existing IEE/EMP is updated in accordance with ADB's Safeguard Policy Statement (SPS, 2009) and based on detailed designs submitted to ADB for review and approval prior to contract award; (ii) confirm whether the EMP and specific EMPs (SEMPs) prepared at the detailed design stage are included in the bidding documents and civil works contracts; (iii) provide oversight on environmental management aspects of the project and ensure the EMP is implemented by contractors; (iv) establish a system to monitor environmental safeguards of the project, including monitoring the indicators set out in the monitoring plan of the EMP; (v) facilitate and confirm overall compliance with all government rules, such as the Environmental Conservation Rules (ECR 1997), and obtain all required location and environmental clearances as well as any other environmental permits prior to contract award; (vi) review, monitor, and evaluate the effectiveness with which the SEMPs are implemented, and recommend necessary corrective actions to be taken as necessary; (vii) consolidate quarterly environmental monitoring reports from the contractor/supervision consultants and submit semi-annual environmental monitoring reports to ADB; (viii) ensure timely disclosure of final IEE/EMP in locations and forms accessible to the public, and (ix) address,record, and report on any grievances brought about through the grievance redress mechanism in a timely manner, as per the IEE.

B. Environmental Monitoring Plan

150. Environmental monitoring will be done during construction on three levels: (i) monitoring development of project performance indicators by the environmental specialist of the SC; (ii) monitoring implementation of mitigation measures by the contractor; and (iii) overall regulatory monitoring of the environmental issues by the environmental officer of the PMU. In addition to regular monitoring onsite by the SC and the PMU on the implementation of the environmental measures, such as adoption of good engineering practices during construction, arrangements for temporary use of lands for borrow areas, spoil disposal, etc., monitoring of key environmental parameters is proposed. The environmental monitoring plan for the project is presented in

Table 20. The monitoring of all relevant environmental parameters, with a description of the sampling stations, frequency of monitoring, applicable standards, and responsible agencies are presented. The monitoring of the environmental attributes in the first season (first year of implementation) shall be carried out prior to the start of implementation, and shall form a

baseline for the environmental parameters. Monitoring will be the responsibility of the civil works contractors, who will likely outsource this responsibility.

Table 20: Environmental Monitoring Plan

Sl. No.	Attributes	Stage	Parameters to be Monitored	Location	Frequency	Standards	Responsibility
Procurement Package 1							
1	Air quality	Construction stage	SPM $PM_{2.5}$ PM_{10} SO_2 NOx CO	• Intake location • Raw water transmission main – village 2 km from intake • Raw water transmission main – Sejan juice factory • Gandharbpur WTP • two construction camps/site locations	24-hour monitoring once in a season (except monsoons) for the construction period	Bangladesh Standards for Ambient Air Quality Schedule-2; Rule 12, Environment Conservation Rules of 1997	Contractor
2	Noise and vibration levels	Construction stage	Equivalent day and nighttime noise levels	• Intake location • Raw water transmission main – village 2 km from intake • Raw water transmission main - Sejan juice factory • Gandharbpur WTP • two construction camps/site locations	Once in a season (except monsoons) for the construction period	Bangladesh Standards for Noise, Schedule 4; Rule 12, Environment Conservation Rules, 1997	Contractor
3	Fish diversity	Construction stage	Yield and impacts on fish /shrimp species	• Along *khals* cut across by the transmission mains (two to be identified by the SC)	Once in a year during construction	Interviews and consultations, including with fisheries department	PMU, with support from SC
4	Water quality	Construction	TDS, TSS, pH, hardness, BOD, fecal coliform, total nitrogen, total phosphorus, heavy metals, temperature, DO, hydrocarbons, mineral oils, phenols, cyanide, temperature	• Meghna River - intake	Twice a year (pre-monsoon and post-monsoon) for the entire period of construction	Bangladesh Standards for Industrial and Project Effluent, Schedule 10; Rule 13, Environment Conservation Rules, 1997	Contractor
5	Water quality (source related)	Construction and operation stages	TDS, TSS, pH, hardness, BOD, fecal coliform, total nitrogen, total phosphorus, heavy metals, temperature, DO, hydrocarbons, mineral oils, phenols, cyanide, temperature	• Upstream of Ashuganj fertilizers, before the discharge point into Meghna River • Ashuganj fertilizers/power plant – discharge point into Meghna River • three intermediate points between Ashuganj and Bishnondi intake • At the intake point	Monitoring of water quality (once in 3 months) for the construction period, to be followed up during the operation stage by DWASA	Bangladesh Standards for Industrial and Project Effluent, Schedule 10; Rule 13, Environment Conservation Rules, 1997	DWASA
6	Surface	Operation	23 parameters	• Gandharbpur WTP	Daily, during the	National	DWASA

Sl. No.	Attributes	Stage	Parameters to be Monitored	Location	Frequency	Standards	Responsibility
	water quality	stage	defined in the National Standards for Drinking Water Quality		operation of the facilities	Standard for Drinking Water	
7	Leachate monitoring	Operation stage	Leachate quality, TDS, TSS, pH, hardness, BOD, fecal coliform	• At the location of the sludge-drying bed at the treatment plant	Twice a year, before, during and after the monsoons	-	DWASA
8	Survival rate of landscaping, tree plantation	Operation stage	Survival rate	• In the areas where plantation/ landscaping proposed	Twice a year for 2 years	-	DWASA
9	Socioeconomic monitoring	Operation stage	Income levels, livelihood options	• DPs impacted due to the project components	Once a year for 5 years from the completion of the project	Primary surveys and consultations	DWASA
Procurement Package 2							
1	Air quality	Construction stage	SPM $PM_{2.5}$ PM_{10} SO_2 NOx CO	• Habitations along treated water lines (i) between WTP and Murapara Bridge and (ii) US Embassy • One location along the feeder mains along arterial roads within Dhaka • Two construction camps/site locations	24-hour monitoring once in a season (except monsoons) for the construction period	Bangladesh Standards for Ambient Air Quality Schedule 2; Rule 12, Environment Conservation Rules, 1997	Contractor
2	Noise and vibration levels	Construction stage	Equivalent day and nighttime noise levels	• Habitations along treated water lines (i) between WTP and Murapara Bridge and (ii) US Embassy • One location along the feeder mains along arterial roads within Dhaka • Two construction camps/site locations	Once in a season (except monsoons) for the construction period	Bangladesh Standards for Noise, Schedule 4; Rule12, Environment Conservation Rules, 1997	Contractor
3	Fish diversity	Construction stage	Yield and impacts on fish /shrimp species	• Bridges across treated water mains at (i) Sitalakhya River and (ii) Balu River	Once a year during construction	Interviews and consultations, including with fisheries department	PMU, with support from SC
4	Water quality	Construction	TDS, TSS, pH, hardness, BOD, fecal coliform, total nitrogen, total phosphorus, heavy metals, temperature, DO, hydrocarbons, mineral oils, phenols, cyanide, temperature	• Sitalakhya River - bridge location • Balu River – bridge location	Twice a year (pre-monsoon and post-monsoon) for the entire period of construction	Bangladesh Standards for Industrial and Project Effluent, Schedule 10;Rule 13, Environment Conservation Rules, 1997	Contractor
5	Survival rate of landscaping, tree	Operation stage	Survival rate	• In the areas where plantation proposed	Twice a year for 2 years	-	DWASA

Sl. No.	Attributes	Stage	Parameters to be Monitored	Location	Frequency	Standards	Responsibility
	plantation						
6	Socioeconomic monitoring	Operation stage	Income levels, livelihood options	• DPs impacted due to the project components	Once a year for 5 years from completion of the project	Primary surveys and consultations	DWASA
Procurement Package 3							
1	Air quality	Construction stage	SPM $PM_{2.5}$ PM_{10} SO_2 NOx CO	• Raw water transmission mains at Rupshi junction, two construction camps/site locations	24-hour monitoring once in a season (except monsoons) for the construction period	Bangladesh Standards for Ambient Air Quality Schedule 2; Rule 12, Environment Conservation Rules, 1997	Contractor
2	Noise and vibration levels	Construction stage	Equivalent day and nighttime noise levels	• Raw water transmission mains at Rupshi junction, two construction camps/site locations	Once in a season (except monsoons) for the construction period	Bangladesh Standards for Noise, Schedule 4; Rule 12, Environment Conservation Rules, 1997	Contractor
3	Fish diversity	Construction stage	Yield and impacts on fish /shrimp species	• Sitalakhya River (Taraboo), Demra Bridge	Once a year during construction	Interviews and consultations, including with fisheries department	PMU with support from SC
4	Water quality	Construction	TDS, TSS, pH, hardness, BOD, fecal coliform, total nitrogen, total phosphorus, heavy metals, temperature, DO, hydrocarbons, mineral oils, phenols, cyanide, temperature	• Sitalakhya River (Taraboo), Demra Bridge	Twice a year (pre-monsoon and post-monsoon) for the entire period of construction	Bangladesh Standards for Industrial and Project Effluent, Schedule 10;Rule 13, Environment Conservation Rules, 1997	Contractor
5	Survival rate of landscaping, tree plantation	Operation stage	Survival rate	• In areas where plantation proposed	Twice a year for 2 years	-	DWASA
6	Socioeconomic monitoring	Operation stage	Income levels, livelihood options	• DPs impacted due to the project components	Once a year for 5 years from the completion of the project	Primary surveys and consultations	DWASA

C. Reporting

151. The supervision consultants will submit monthly monitoring reports to PMU reflecting performance of contractors in EMP implementation. The PMU safeguards unit will then submit semi-annual environmental monitoring reports to ADB for review and disclosure on ADB's website, as per ADB's safeguards policy and public communication policies. A sample monitoring template is in Appendix 5. The report should include update and progress of compliance with ADB and government policies, and specifically on the progress of EMP implementation in relation to design and construction activities, grievances, and corrective actions.

D. Capacity Building

152. The environmental specialist of the SC 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, and monitoring methods and tools. The proposed training program, along with the frequency of sessions, is presented in Table 21 below.

Table 21: Training Modules for Environmental Management

Program	Description	Participants	Form of Training	Duration	Trainer / Agency	Cost (BDT)
Introduction and sensitization to environment issues	Sensitization on environmental concerns Environmental impacts of urban infrastructure - water supply improvement projects Government of Bangladesh environmental regulations ADB environmental regulations Coordination between departments for implementation of environmental issues	PMU/DWASA engineers/ management team, officials responsible for implementing project, and other PMU/SC staff as interested	Workshop	1-day workshop Pre-construction	SC environmental specialist	400,000
Pre-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	3 days, pre-construction	Tailor-made training programs by Industrial Safety Board of Bangladesh (ISBB), engineering staff college, etc.	1,000,000
EMP implementation	Implementation of environment EMP Identification of environment impacts Monitoring and reporting for EMP Public interactions and consultations Coordination for consents and with various departments Monitoring formats filling and review of impacts	DWASA engineers, officials responsible for implementing project, and other PMU/SC staff as interested	Lectures and field visit	2-day session, construction stage	SC environmental specialist	1,500,000
Training on environmental management, OHS systems, emergency and risk response systems	Guidance for conformance to environmental management systems	DWASA engineers, officials responsible for implementing project, and other PMU/SC staff as interested	Lectures	4-day program, lectures, site visits	Tailor-made training programs by Industrial Safety Board of Bangladesh (ISBB),	1,500,000

Program	Description	Participants	Form of Training	Duration	Trainer / Agency	Cost (BDT)
					engineering staff college, etc.	

E. Environmental Budget

153. As part of good engineering practices in the project, there have been several measures such as erosion prevention, rehabilitation of borrow areas, occupational health and safety, community safety, traffic safety during construction, signages, provision of temporary drains, etc., the costs for which will be included in the design costs of the project. The IEE costs include monitoring costs during construction and capacity building costs on environmental management. The costs for training proposed include the costs incurred for site visits, travel to the training program by the participants, printing of training materials, and other logistic arrangements. The costs involved towards preparation of training material and imparting of training are covered in the consultancy budget for the SC. The budget for the environmental management costs for the project is presented in Table 22 below.

Table 22: Cost Estimates to Implement the EMP

Sl. No.	Particulars	Stages	Unit	Total Number	Rate (BDT)	Cost (BDT)	Costs Covered By
A.	**Mitigation Measures**						
1	Compensatory plantation measures						
	Package 1	Construction	Per tree	3,000	1,500	4,500,000	Civil works contract
	Package 2	Construction	Per tree	250	1,500	375,000	Civil works contract
	Package 3	Construction	Per tree	250	1,500	375,000	EMP costs
2	Enhancement measures at the Manikpur ferry *ghat*	Construction	LS			4,000,000	Civil works contract
	Subtotal (A)					**9,250,000**	
B.	**Monitoring Measures**						
	Package 1						
	Air quality monitoring	Construction	Per location	36	30,000	1,080,000	Civil works contract
	Noise levels monitoring	Construction	Per location	36	10,000	360,000	Civil works contract
	Fish diversity monitoring	Construction	Per sample	4	250,000	100,000	Civil works contract
	Water quality – discharge to surface waters	Construction	Per sample	3	25,000	75,000	Civil works contract
	Water quality – source protection related	Construction	Per sample	96	25,000	2,400,000	Civil works contract
	Site visits to upstream locations of source	Construction	Per trip	6	50,000	300,000	
	Subtotal (B)					**4,315,000**	
	Package 2						
	Air quality monitoring	Construction	Per location	30	30,000	900,000	Civil works contract

	Noise levels monitoring	Construction	Per location	30	10,000	300,000	Civil works contract
	Water quality – discharge to surface waters	Construction	Per sample	8	25,000	200,000	Civil works contract
	Subtotal					**1,400,000**	
	Package 3						
	Air quality monitoring	Construction	Per location	21	30,000	630,000	Civil works contract
	Noise levels monitoring	Construction	Per location	21	10,000	210,000	Civil works contract
	Subtotal					**840,000**	
C	**Capacity Building**						
1	Introduction and sensitization to environment issues	Pre-construction	L.S			400,000	SC
2	Pre-project training on hazards, health, safety, and environmental issues pertaining to the project	Pre-construction	L.S			1,000,000	SC
3	EMP implementation	Construction	L.S			1,500,000	SC
4	Training on environmental management, OHS systems, emergency and risk response systems	Construction	L.S			1,500,000	SC
	Subtotal (C)					**4,400,000**	
	Total (A+B+C), Taka					**20,205,000**	

XIII. CONCLUSIONS AND RECOMMENDATIONS

154. 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. While there are no notified protected areas, environmentally sensitive areas, or features in the project area that will be impacted adversely due to the proposed interventions, the magnitude of construction-related impacts will be significant, given the scale of the project. Location-related impacts are addressed through incorporation of environmental protection measures and specific design approaches to minimize the impacts.

155. The IEE confirms that the significance of the environmental impacts will be mostly due to construction-related impacts. 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 IEE will effectively address 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.

156. The IEE carried out for the project shows that the adverse environmental impacts can be addressed through proper location, planning, and design of the components, control of construction activity, and mitigation measures. The EMP provides for mitigation of all identified impacts, and the contract clauses for the environmental provisions will be part of the civil works contracts. Further, the proposed project components have been discussed with the stakeholders, and no significant issues requiring redress in terms of environmental safeguards were identified.

APPENDIX 1: RAPID ENVIRONMENTAL ASSESSMENT (REA) CHECKLIST

Rapid Environmental Assessment (REA) Checklist

Instructions:

(i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES) for endorsement by the Director, RSES and for approval by the Chief Compliance Officer.

(ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and indigenous peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.

(iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title:	BAN: Dhaka Environmentally Sustainable Water Supply Project
Sector Division:	SAUW

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area…			
▪ Densely populated?	√		While the intake and the portions of the transmission mains are through rural areas, the transmission mains from the WTP to Dhaka City are proposed within the boundaries of the Dhaka urban areas. In addition, the transmission mains along the highways pass through settlements which are densely populated, including Bhulta and Demra, apart from few industrial areas.
▪ Heavy with development activities?	√		
▪ Adjacent to or within any environmentally sensitive areas?			
• Cultural heritage site		√	There are no sensitive ecological and cultural sites in the project area. Though not notified or recognized as a wetland of significance, the project components are located in the low-lying areas of eastern Dhaka, which were recognized for their function as a water retention zone for the city.
• Protected area		√	
• Wetland	√		
• Mangrove		√	
• Estuarine		√	

Screening Questions	Yes	No	Remarks
• 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?		√	The project includes mechanisms for source protection through interagency coordination and active involvement of the Department of Environment, the authority mandated to control pollution in rivers.
▪ impairment of historical/cultural monuments/areas and loss/damage to these sites?		√	
▪ hazard of land subsidence caused by excessive groundwater pumping?		√	Not applicable, as the source of water supply is the Meghna River and not groundwater sources. Current high levels of groundwater pumping, and the drastic reduction in the groundwater levels in Dhaka urban areas, will be arrested with the proposed project.
▪ social conflicts arising from displacement of communities?	√		The resettlement impacts are being addressed through a resettlement plan prepared in accordance with the provisions of the SPS, 2009.
▪ conflicts in abstraction of raw water for water supply with other beneficial water uses for surface and groundwaters?		√	Extraction rates have been under extensive study in relation to the Meghna River's flow. The proposed abstraction accounts for 0.6% of the lean flow for 2035, and these are within the acceptable safe limits and shall not impact downstream uses. Consultations with other government departments on these abstraction rates confirmed that there shall be no conflicts with other water uses/users.
▪ unsatisfactory raw water supply (e.g. excessive pathogens or mineral constituents)?		√	
▪ delivery of unsafe water to distribution system?		√	The proposed water treatment plant shall comply with the National Drinking Water Quality Standards.
▪ inadequate protection of intake works or wells, leading to pollution of water supply?		√	Proper design of the intake will minimize these problems.

Screening Questions	Yes	No	Remarks
▪ overpumping of groundwater, leading to salinization and ground subsidence?		√	Not applicable, as groundwater abstraction is not envisaged
▪ excessive algal growth in storage reservoir?		√	The storage reservoirs are covered, and proper treatment like chlorination of water will not allow algal growth in the reservoirs
▪ increase in production of sewage beyond capabilities of community facilities?	√		Two of the four zones proposed to be covered for distribution from the Gandharbpur WTP have committed projects for sewerage systems. The coverage of the other two zones is part of DWASA's priority projects in the master plan for sewerage, and will be taken up at an early date.
▪ inadequate disposal of sludge from water treatment plants?		√	Sludge management is included in the design, and monitoring of the same is laid down in the EMP.
▪ inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities?		√	While no sensitive receivers exist around the pumping stations, an adequate green buffer shall be provided around the intake and treatment plant locations to minimize noise and other nuisances.
▪ impairments associated with transmission lines and access roads?	√		Impacts are likely, given the size of the transmission pipes, and the size of trenches required. Adoption of good engineering practices during construction, and the measures suggested in the EMP, shall effectively address the impacts.
▪ health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals?		√	Design of facilities will integrate concerns of health hazards due to handling of chemicals. Occupational health and safety plan to be worked out by the DWASA during the operation of the facilities
▪ health and safety hazards to workers from handling and management of chlorine used for disinfection, other contaminants, and biological and physical hazards during project construction and operation?		√	
▪ dislocation or involuntary resettlement of people?	√		Land acquisition impacts are significant. A resettlement plan to address the land acquisition and resettlement impacts of the project has been prepared.
▪ disproportionate impacts on the poor, women and children, indigenous peoples, or other vulnerable groups?		√	
▪ noise and dust from construction activities?	√		During civil work, noise and dust will be generated, but it will be localized and short-term in nature. Proper measure as suggested in EMP will minimize the problem.
▪ increased road traffic due to interference of construction activities?	√		Effective implementation of the traffic management plan during construction shall address

Screening Questions	Yes	No	Remarks
			potential impacts during construction.
▪ continuing soil erosion/silt runoff from construction operations?	√		Soil erosion, runoff is not likely in the event of proper management of spoil and debris generated, and conformance to the measures suggested in the EMP.
▪ delivery of unsafe water due to poor O&M treatment processes (especially mud accumulations in filters) and inadequate chlorination due to lack of adequate monitoring of chlorine residuals in distribution systems?		√	O&M manual will be prepared , training will be given to the staff operating the plant, and water samples will be collected from time to time to be analyzed, to ensure the quality of the supplied water.
▪ delivery of water to distribution system, which is corrosive due to inadequate attention to feeding of corrective chemicals?		√	
▪ accidental leakage of chlorine gas?		√	Emergency action plan for accidental leakage of chlorine gas will be prepared.
▪ excessive abstraction of water affecting downstream water users?		√	Not likely, as the flow of Meghna River even during the lean season is significant, and the design intake of 2,000 mld accounts for only 0.6% of the lean flow.
▪ competing uses of water?		√	
▪ increased sewage flow due to increased water supply?	√		This is being addressed by DWASA through implementation of the sewerage master plan.
▪ increased volume of sullage (wastewater from cooking and washing) and sludge from wastewater treatment plant?		√	
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	All construction related impacts will be mitigated through good construction practices specified in the EMP.
▪ social conflicts if workers from other regions or countries are hired?		√	
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel, and other chemicals during operation and construction?		√	
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community, or where their failure could result in injury to the community throughout project construction, operation, and decommissioning?		√	

Climate Change and Disaster Risk Questions The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.	Yes	No	Remarks
▪ Is the project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges,	√		The project area is located in seismic zone II, referred to as a

Climate Change and Disaster Risk Questions The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.	**Yes**	**No**	**Remarks**
tsunami, or volcanic eruptions and climate changes (see Appendix I)?			medium risk zone for earthquakes. To address potential risks, provisions of the national building code, BNBC 2006, and seismic vulnerability have been considered in the specifications for design and construction of project components, including choice of pipe materials.
▪ Could changes in temperature, precipitation, or extreme events patterns over the project lifespan affect technical or financial sustainability (e.g., changes in rainfall patterns disrupt reliability of water supply; sea level rise creates salinity intrusion into proposed water supply source)?	√		Though a possibility, there are no current records or data to suggest that there is salinity intrusion up to 30 km downstream of the proposed intake. A report by IWM states that sea-based salinity does not intrude beyond the confluence of Meghna and Padma Rivers, which is about 100 km downstream of the proposed intake.
▪ Are there any demographic or socioeconomic aspects of the project area that are already vulnerable (e.g., high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		√	
▪ Could the project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., by using water from a vulnerable source that is relied upon by many user groups, or encouraging settlement in earthquake zones)?		√	

* Hazards are potentially damaging physical events.

APPENDIX 2:LIST OF RED CATEGORY PROJECT TYPES IDENTIFIED IN THE ECR, 1997, DOE

1. Tannery
2. Formaldehyde
3. Urea fertilizer
4. T.S.P. fertilizer
5. Chemical dyes, polish, varnish, enamel
6. Power plant
7. All mining projects (coal, limestone, hard rock, natural gas, mineral oil, etc.)
8. Cement
9. Fuel oil refinery
10. Artificial rubber
11. Paper and pulp
12. Sugar
13. Distillery
14. Fabric dyeing and chemical processing
15. Caustic soda, potash
16. Other alkalis
17. Production of iron and steel
18. Raw materials of medicines and basic drugs
19. Electroplating
20. Photo films, photo papers, and photo chemicals
21. Various products made from petroleum and coal
22. Explosives
23. Acids and their salts (organic or inorganic)
24. Nitrogen compounds (cyanide, cyanamid, etc.)
25. Production of plastic raw materials (PVC, PP/Iron, polyesterin, etc.)
26. Asbestos
27. Fiberglass
28. Pesticides, fungicides and herbicides
29. Phosphorus and its compounds/derivatives
30. Chlorine, fluorine, bromine, iodine, and their compounds/derivatives
31. Industry (excluding nitrogen, oxygen and carbon dioxide)
32. Waste incinerator
33. Other chemicals
34. Ordnance
35. Nuclear power
36. Wine
37. Non-metallic chemicals not listed elsewhere
38. Non-metals not listed elsewhere
39. Industrial estate
40. Basic industrial chemicals
41. Non-iron basic metals
42. Detergent
43. Land-filling by industrial, household, and commercial wastes
44. Sewage treatment plant
45. Life-saving drugs
46. Animal glue
47. Rodenticide

48. Refractories
49. Industrial gas (oxygen, nitrogen, and carbon dioxide)
50. Battery
51. Hospital
52. Ship manufacturing
53. Tobacco (processing/cigarette/*biri*-making)
54. Metallic boat manufacturing
55. Wooden boat manufacturing
56. Refrigerator/air-conditioner/air-cooler manufacturing
57. Tire and tube
58. Board mills, E.C.R. ’97 203
59. Carpets
60. Engineering works: capital above Tk 10,000
61. Repairing of motor vehicles: capital above Tk 10,000
62. Water treatment plant
63. Sewerage pipeline laying/relaying/extension
64. Water, power, and gas distribution line laying/relaying/extension
65. Exploration/extraction/distribution of mineral resources
66. Construction/reconstruction/expansion of flood control embankment, polder, dike, etc.
67. Construction/reconstruction/expansion of road (regional, national, and international)
68. Construction/reconstruction/expansion of bridge (length of 100 m and above)
69. Murate of potash (manufacturing)

APPENDIX 3:NATIONAL ENVIRONMENT QUALITY STANDARDS

At present, there are environmental standards in operation in Bangladesh also promulgated under the Environment Conservation Rules of 1997. There are standards prescribed for varying water sources, ambient air, noise, odor, industrial effluent and emission discharges, vehicular emissions, etc. The standards, commonly known as Environmental Quality Standards (EQS), are legally binding. The Bangladesh standards for ambient air, noise, odor, sewage, industrial effluent, and emission are furnished here. These are all in an authentic translation from original Bengali, citing the specific source.

National Standard for Inland Surface Water

Best Practice-Based Classification	pH	BOD (mg/l)	DO (mg/l)	Total Coliform Number/100
a. Source of drinking water for supply only after disinfecting	6.5-8.5	2 or less	6 or above	50 or less
b. Water usable for recreational activity	6.5–8.5	3 or less	5 of more	200 or less
c. Source of drinking water for supply after conventional treatment	6.5–8.5	6 or less	6 or more	5,000 or less
d. Water usable by fisheries	6.5–8.5	6 or less	5 or more	---
e. Water usable by various process and cooling industries	6.5–8.5	10 or less	5 or more	5,000 or less
f. Water usable for irrigation	6.5–8.5	10 or less	5 or more	1,000 or less

Notes: 1. In water used for pisiculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l.
2. Electrical conductivity for irrigation water – 2250 µmhoms/cm (at a temperature of 25°C); sodium less than 26%; boron less than 0.2%.
Source: Department of Environment (DOE)

National Standard of Drinking Water

Parameter	Unit	Standards	Parameter	Unit	Standards
1. Aluminum	mg/l	0.2	26. Hardness (as CaCO3)	mg/l	200 – 500
2. Ammonia (NH3)	mg/l	0.5	27. Iron	mg/l	0.3 – 1.0
3. Arsenic	mg/l	0.05	28. Kjeldahl nitrogen (total)	mg/l	1
4. Balium	mg/l	0.01	29. Lead	mg/l	0.05
5. Benzene	mg/l	0.01	30. Magnesium	mg/l	30 – 35
6. BOD5 20°C	mg/l	0.2	31. Manganese	mg/l	0.1
7. Boron	mg/	1.0	32. Mercury	mg/l	0.001
8. Cadmium	mg/l	0.005	31. Manganese	mg/l	0.1
9. Calcium	mg/l	75	32. Mercury	mg/l	0.001
10. Chloride	mg/l	150 – 600*	33. Nickel	mg/l	0.1
11. Chlorinated alkanes			34. Nitrate	mg/l	10
carbontetrachloride	mg/l	0.01	35. Nitrite	mg/l	<1
1.1 dichloroethylene	mg/l	0.001	36. Odor	mg/l	Odorless
1.2 dichloroethylene	mg/l	0.03	37. Oil and grease	mg/l	0.01
tetrachloroethylene		0.03	38. pH	--	6.5 – 8.5
trichloroethylene		0.09	39. Phenolic compounds	mg/l	0.002
12. Chlorinated phenols			40. Phosphate	mg/l	6
pentachlorophenol	mg/l	0.03	41. Phosphorus	mg/l	0
2.4.6	mg/l	0.03	42. Potassium	mg/l	12

trichlorophenol					
13. Chlorine (residual)	mg/l	0.2	43. Radioactive materials (gross alpha activity)	Bq/l	0.01
14. Chloroform	mg/l	0.09	44. Radioactive materials (gross beta activity)	Bq/l	0.1
15.Chromium (hexavalent)	mg/l	0.05	45. Selenium	mg/l	0.01
16. Chromium (total)	mg/l	0.05	46. Silver	mg/l	0.02
17. COD	mg/l	,, 4	47. Sodium	mg/l	200
18. Coliform (fecal)	n/100 ml	0	48. Suspended particulate matters	mg/l	10
19. Coliform (total)	n/100 ml	0	49. Sulfide	mg/l	0
20. Color	Hazen unit	15	50. Sulfate	mg/l	400
21. Copper	mg/l	1	51. Total dissolved solids	mg/l	1,000
22. Cyanide	Mg/l	0.1	52. Temperature	°C	20-30
23. Detergents	mg/l	0.2	53. Tin	mg/l	2
24. DO	mg/l	6	54. Turbidity	NTU	10[19]
25. Fluoride	mg/l	1	55. Zinc	mg/l	5

*In coastal area 1000. Reference: Bangladesh Gazette, Addendum, August 28, 1997
Source: Department of Environment (DOE)

Bangladesh Standards for Ambient Air Quality Schedule-2, Rule 12, Environment Conservation Rules of 1997 (Micrograms /Cubic Meter)

Sl. No.	Area	Suspended Particulate Matter (SPM)	Sulfur Dioxide (SO_2)	Carbon Monoxide (CO)	Oxides of Nitrogen (NOx)
Ka	Industrial and mixed	500	120	5000	100
Kha	Commercial and mixed	400	100	5000	100
Ga	Residential and rural	200	80	2000	80
Gha	Sensitive	100	30	1000	30

Source: Schedule-2, Rule 12, Environment Conservation Rules of 1997 (Page 3123, Bangladesh Gazette, 28 August 1997) (Own authentic translation from original Bengali).

Note : 1. Sensitive area includes national monuments, health resorts, hospitals, archaeological sites, educational institutions and other government designated areas (if any).

2. Any industrial unit located not in a designated industrial area will not discharge such pollutants, which may contribute to exceed the ambient air quality above in the surrounding areas of category 'Ga' and 'Gha'.

3. Suspended particulate matters mean airborne particles of diameter of 10 micron or less.

Source: Department of Environment (DoE)

[19] The FS advises producing treated water that conforms to WHO guidelines and Bangladesh drinking water quality ECR 1997. One of the two most important parameters reduced by the WTP is turbidity (the other is microbiological matter, by providing a multi-stage barrier). In Section 10.3, the FS quotes WHO and Bangladesh standards of 10 and 5 NTU respectively. We recommend that the turbidity in the treated water leaving the WTP should never exceed 1.0 NTU and that the operational guideline should be set at 0.5 NTU, to be achieved 95% of the time. The design of the process units and their controls should accommodate these recommendations. Operational procedures must be devised to achieve these recommendations. Computerized monitoring equipment must be provided and staff trained in its use to display real-time trends and record events. Laboratory staff must monitor, record, and report treated water quality parameters to review past trends and predict operational changes, if required.

Bangladesh Standards for Noise

Sl. No.	Area Category	Standards Values (All Values in dBA)	
		Day	Night
Ka	Silent zone	45	30
Kha	Residential area	50	40
Ga	Mixed area (basically residential and together used for commercial and industrial purposes)	60	50
Gha	Commercial area	70	60
Umma	Industrial area	75	70

Source : Schedule 4, Rule-12, Environment Conservation Rules, 1997. (Page 3127, Bangladesh Gazette, 28 August 1997). Own authentic translation from original Bengali

Note : 1. Daytime is reckoned as the time between 6 a.m. and 9 p.m.
2. Nighttime is reckoned as the time between 9 p.m. and 6 a.m.
3. Silent zones are areas up to a radius of 100 m around hospitals, educational institutions, or special establishments declared or to be declared as such by the government. Use of vehicular horn, other signals, and loudspeakers is prohibited in silent zones.

Source: Department of Environment (DOE)

B**angladesh Standards for Odor**

Parameters	Unit	Values
Acetaldehyde	PPM	0.5-5
Ammonia	PPM	1-5
Hydrogen Sulfide	PPM	0.02-0.2
Methyl Disulfide	PPM	0.009-0.1
Methyl Mercaptan	PPM	0.02-0.2
Methyl Sulfide	PPM	0.01-0.2
Styrene	PPM	0.4-2.0
Trimethylamine	PPM	0.005-0.07

Source: Schedule 8, Rule 12, Environment Conservation Rules, 1997. (Page 3130, Bangladesh Gazette, 28 August 1997). Own authentic translation from original Bengali

Note :1. Regulatory standards at emission/discharge outlets (apply to those outlets which are higher than 5 meters) :
Q = 0.108 x He2 cm, Where Q – gas emission rate (Nm3/hour), He – effective height of the outlet (m), Cm – above mentioned standard (ppm)
2. Where there is a range given for a parameter, the lower value will be used for warning and the higher value for initiation of legal procedure or punitive measures.

Source: Department of Environment (DOE)

Bangladesh Standards for Sewage Discharge

Parameters	Unit	Values
BOD	mg/l	40
Nitrate	mg/l	250
Phosphate	mg/l	35
Suspended Solids (SS)	mg/l	100
Temperature	^{o}C	30
Coliforms	number/100ml	1,000

Source: Schedule- 9, Rule-13, Environment Conservation Rules, 1997. (Page-3131 of Bangladesh Gazette of 28 August 1997) (Own authentic translation from original Bengali)

Note :1. These standards are applicable for discharge into surface and inland water bodies. 2. Chlorination is to be done before final discharge.

Source: Department of Environment (DOE)

Bangladesh Standards for Industrial and Project Effluent

Sl. No.	Parameters	Unit	Discharge To		
			Inland Surface Water	Public Sewer to Secondary Treatment Plant	Irrigable Land
1	Ammonical nitrogen (as elementary N)	mg/l	50	75	75
2	Ammonia (as free ammonia)	mg/l	5	5	15
3	Arsenic (as As)	mg/l	0.2	0.05	0.2
4	BOD5 at 20oC	mg/l	50	250	100
5	Boron	mg/l	2	2	2
6	Cadmium (as Cd)	mg/l	0.05	0.5	0.5
7	Chloride	mg/l	600	600	600
8	Chromium (as total Cr)	mg/l	0.5	1.0	1.0
9	COD	mg/l	200	400	400
10	Chromium (as hexavalent Cr)	mg/l	0.1	1.0	1.0
11	Copper (as Cu)	mg/l	0.5	3.0	3.0
12	Dissolved oxygen (DO)	mg/l	4.5-8	4.5-8	4.5-8
13	Electro-conductivity (EC)	µsiemens/cm	1,200	1,200	1,200
14	Total dissolved solids	mg/l	2,100	2,100	2,100
15	Fluoride (as F)	mg/l	2	15	10
16	Sulfide (as S)	mg/l	1	2	2
17	Iron (as Fe)	mg/l	2	2	2
18	Total kjeldahl nitrogen (as N)	mg/l	100	100	100
19	Lead (as Pb)	mg/l	0.1	1	0.1
20	Manganese (as Mn)	mg/l	5	5	5
21	Mercury (as Hg)	mg/l	0.01	0.01	0.01
22	Nickel (as Ni)	mg/l	1.0	2.0	1.0
23	Nitrate (as elementary N)	mg/l	10.0	Not yet set	10
24	Oil and grease	mg/l	10	20	10
25	Phenolic compounds (as C6H5OH)	mg/l	1.0	5	1
26	Dissolved phosphorus (as P)	mg/l	8	8	15
27	Radioactive substance	(to be specified by Bangladesh Atomic Energy Commission)			
28	PH		6-9	6-9	6-9
29	Selenium (as Se)	mg/l	0.05	0.05	0.05
30	Zinc (as Zn)	mg/l	5	10	10
31	Total dissolved solids	mg/	2,100	2,100	2,100
32	Temperature	^{o}C (summer) ^{o}C (winter)	40 45	40 45	40 45
33	Suspended solids	mg/l	150	500	200
34	Cyanide	mg/l	0.1	2.0	0.2

Source: Schedule -10, Rule-13, Environment Conservation Rules, 1997 (Page 3132 - 3134 of Bangladesh Gazette of 28 August 1997) (Own authentic translation from original Bengali).

Note:

These standards will be applicable for all industries other than those which are specified under “industrial sector specific standards.”

These standards will have to be complied with from the moment of trial production in case of industries and from the very beginning in case of projects.

These standards will have to be met at any point of time and any sampling. In case of need for ambient environment condition, these standards may be made stringent.

Inland surface water will include drains, ponds, tanks, water bodies, ditches, canals, rivers, streams, and estuaries.

Public sewer means leading to full-fledged joint treatment facility comprising primary and secondary treatment.

Land for irrigation means organized irrigation of selected crops on adequate land determined on the basis of quantum and characteristics of wastewater.

If any discharge is made into public sewer or on land which does not meet the respective definitions in notes 5 and 6 above, then the inland surface water standards will apply.

Bangladesh Standards for Industrial and Project Emissions

Sn. No.	Parameters	Values (in mg/Nm3)
1	Particulates (ka) Power station of capacity of 200 MW or more (kha) Power station of capacity of less than 200 MW	 150 350
2	Chlorine	150
3	Hydrochloric acid vapor and mist	350
4	Total fluoride (as F)	25
5	Sulfuric acid mist	50
6	Lead particulates	50
7	Mercury particulates	10
8	Sulfur dioxide (ka) Sulfuric acid production (DCDA* process) (kha) Sulfuric acid production (SCSA* process) (* DCDA : Double conversion, double absorption, SCSA : Single conversion, single absorption) Lowest height of stack for sulfur dioxide dispersion: (ka) Coal based power plant 500 MW or more 200 MW – 500 MW Less than 200 MW (kha) Boiler Steam per hour – up to 15 tons Steam per hour – more than 15 tons (Q = SO_2 emission in kg/hour)	kg/ton acid 4 100 275 m 220m 14(Q)0.3 11m 14(Q)0.3
9	Oxides of nitrogen (ka) Nitric acid production (kha) Gas based power stations 500 MW or more 200 – 500 MW Less than 200 MW (Ga) Metallurgical oven	 3 kg/ton acid 50 ppm 50 ppm 40 ppm 30 ppm 200 ppm
10	Kiln soot and dust (ka) Blast furnace (kha) Brick kiln (Ga) Coke oven (Gha) Lime kiln	Mg/Nm3 500 1000 500 250

Source : Schedule 11, Rule 13, Environment Conservation Rules, 1997 (Page 3135, 3136, Bangladesh Gazette, 28 August 1997) (Own authentic translation from original Bengali)
Source: Department of Environment (DOE)

APPENDIX 4: CHECKLIST FOR CONSTRUCTION SAFETY

Sl. No.	Safety Issues	Yes	No	Non-Compliance	Corrective Action	Penalty	Remarks
1	Appointment of qualified construction safety officers						
2	Approval for construction safety management plan by the SC						
3	Approval for traffic management/control plan in accordance with IRC: SP: 55-2001						
4	Maintenance of the existing road stretches handed over to the contractor.						
5	Provision of temporary traffic barriers/barricades/caution tapes in construction zones						
6	Provision of traffic signboards						
7	Provision for flags and warning lights						
9	Providing plastic crash barrier						
10	Provision of adequate staging, form work, and access (ladders with handrail) for works at a height of more than 3 m						
11	Provision of adequate shoring/ bracing/barricading/lighting for all deep excavations of more than 3 m depth.						
12	Demarcations (fencing, guarding, and watching) at construction sites						
13	Provision for sufficient lighting, especially for nighttime work						
14	Arrangements for controlled access and entry to construction zones						
15	Safety arrangements for road users/pedestrians						
16	Arrangements for detouring traffic to alternate facilities						
17	Regular inspection of work zone traffic control devices by authorized contractor personnel						
18	Construction workers' safety - Provision of personnel protective equipment						
19	A. Helmets						
	B. Safety shoes						
	C. Dust masks						
	D. Hand gloves						
	E. Safety belts						
	F. Reflective jackets						
	G. Earplugs for labor						
20	Workers employed on bituminous works, stone crushers, concrete batching plants, etc. provided with protective goggles, gloves,						

Sl. No.	Safety Issues	Yes	No	Non-Compliance	Corrective Action	Penalty	Remarks
	gumboots, etc.						
21	Workers engaged in welding work shall be provided with welder protective shields						
22	All vehicles are provided with reverse horns.						
23	All scaffolds, ladders, and other safety devices shall be maintained in safe and sound condition.						
24	Regular health checkup for labor/ contractor's personnel						
25	Ensuring sanitary conditions and all waste disposal procedures and methods in the camps.						
26	The contractor shall provide adequate circuit for traffic flow around construction areas, control speed of construction vehicles through road safety and training of drivers, provide adequate signage, barriers, and flag persons for traffic control						
27	Provision of insurance coverage for the contractor's personnel						

Contractor

Consultant

APPENDIX 5:SAMPLE SEMIANNUAL ENVIRONMENTAL MONITORING REPORT TEMPLATE

This template must be included as an appendix in the EIA/IEE that will be prepared for the project. It can be adapted to the specific project as necessary.

I. Introduction

Overall project description and objectives

Description of subprojects

Environmental category of the subprojects

Details of site personnel and/or consultants responsible for environmental monitoring

Overall project and subproject progress and status

No.	Subproject Name	Status of Subproject				List of Works	Progress of Works
		Design	Pre-Construction	Construction	Operational Phase		
		☐	☐	☐	☐		
		☐	☐	☐	☐		
		☐	☐	☐	☐		

II. Compliance Status with National/State/Local Statutory Environmental Requirements

No.	Subproject Name	Statutory Environmental Requirements	Status of Compliance	Action Required

III. Compliance Status with Environmental Loan Covenants

No. (List Schedule and Paragraph Number of Loan Agreement)	Covenant	Status of Compliance	Action Required

IV. Compliance Status with the Environmental Management and Monitoring Plan

Provide the monitoring results as per the parameters outlined in the EMP. Append supporting documents where applicable, including environmental site inspection reports.

There should be reporting on the following items which can be incorporated in the checklist of routine environmental site inspection report, followed by a summary in the semiannual report sent to ADB. Visual assessment and review of relevant site documentation during routine site inspection need to noted, and recording the following:

i) the dust suppression techniques followed for site, and if any dust was noted to escape the site boundaries;

ii) if muddy water was escaping site boundaries or muddy tracks were seen on adjacent roads;

iii) adequacy of type of erosion and sediment control measures installed onsite, condition of erosion and sediment control measures, including if these were intact following heavy rain;

iv) are their designated areas for concrete works, and refueling;

v) are their spill kits on site, and if there are site procedure for handling emergencies;

vi) is there any chemical stored onsite and what is the storage condition;

vii) are there any dewatering activities; if yes, where is the water being discharged;

viii) how are the stockpiles being managed;

ix) how is solid and liquid waste being handled onsite;

x) review of the complaint management system; and

xi) checking if there are any activities being undertaken out of working hours, and how those is being managed.

Summary Monitoring Table

Impacts (List from IEE)	Mitigation Measures (List from IEE)	Parameters Monitored (As a minimum, those identified in the IEE should be monitored)	Method of Monitoring	Location of Monitoring	Date of Monitoring Conducted	Name of Person Who Conducted the Monitoring
Design Phase						
Pre-Construction Phase						
Construction Phase						
Operational Phase						

Overall Compliance with CEMP/ EMP

No.	Subproject Name	EMP/CEMP Part of Contract Documents (Y/N)	CEMP/EMP Being Implemented (Y/N)	Status of Implementation (Excellent/ Satisfactory/ Partially Satisfactory/Below Satisfactory)	Action Proposed and Additional Measures Required

V. Approach and Methodology for Environmental Monitoring of the Project

Brief description on the approach and methodology used for environmental monitoring of each subproject

VI. Monitoring of Environmental Impacts on Project Surroundings (Ambient Air, Water Quality, and Noise Levels)

Brief discussion on the basis for monitoring

Indicate type and location of environmental parameters to be monitored

Indicate the method of monitoring and equipment to be used

Provide monitoring results and an analysis of results in relation to baseline data and statutory requirements

As a minimum, the results should be presented as per the tables below.

Air Quality Results

Site No.	Date of Testing	Site Location	Parameters (Government Standards)		
			PM_{10} µg/m3	SO_2 µg/m3	NO_2 µg/m3

Site No.	Date of Testing	Site Location	Parameters (Monitoring Results)		
			PM_{10} µg/m3	SO_2 µg/m3	NO_2 µg/m3

Water Quality Results

Site No.	Date of Sampling	Site Location	Parameters (Government Standards)					
			pH	Conductivity µS/cm	BOD mg/l	TSS mg/l	TN mg/l	TP mg/l

Site No.	Date of Sampling	Site Location	Parameters (Monitoring Results)					
			pH	Conductivity µS/cm	BOD mg/l	TSS mg/l	TN mg/l	TP mg/l

Noise Quality Results

Site No.	Date of Testing	Site Location	LA_{eq} (dBA) (Government Standard)	
			Day Time	Nighttime

Site No.	Date of Testing	Site Location	LA_{eq} (dBA) (Monitoring Results)	
			Day Time	Nighttime

VII. SUMMARY OF KEY ISSUES AND REMEDIAL ACTIONS

Summary of follow-up time-bound actions to be taken within a set timeframe

APPENDIXES

Photos

Summary of consultations

Copies of environmental clearances and permits

Sample of environmental site inspection report

Other

SAMPLE ENVIRONMENTAL SITE INSPECTION REPORT

Project Name
Contract Number

NAME: _____ DATE: _____
TITLE: _____ DMA: _____
LOCATION: _____ GROUP: _____

WEATHER CONDITION:
_____

INITIAL SITE CONDITION: _____

CONCLUDING SITE CONDITION:

Satisfactory _____ Unsatisfactory _____ Incident _____ Resolved _____ Unresolved _____

INCIDENT:
Nature of incident:
_____

Intervention steps:
_____

Incident issues

Resolution

Project Activity Stage	**A.** Survey	
	Design	
	Implementation	
	Pre-Commissioning	
	Guarantee Period	

Inspection

Emissions	Waste minimization
Air quality	Reuse and recycling
Noise pollution	Dust and litter control
Hazardous substances	Trees and vegetation

Site restored to original condition Yes

Signature
_____

Sign off

_____ _____
Name **Name**
Position **Position**