

**Government of The People's Republic of Bangladesh
Local Government Engineering Department**

Technical Assistance on Integrated Solid Waste Management Improvement Project

Preparation and Design Consultancy Services

Environment and Social Impact Assessment (ESIA) RAJSHAHI CITY CORPORATION



**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF RAJSHAHI
CITY CORPORATION SUBPROJECT**

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List of Abbreviations

ADB	-	Asian Development Bank
AH	-	Affected Household
AIE	-	Assessment of Impact on Environment
AP	-	Affected Person
AQG	-	Air Quality Guideline
ASIE	-	Assessment of Social Impact on Environment
BECA	-	Bangladesh Environment Conservation Act
BOD ₅	-	5-day Biochemical Oxygen Demand
CAPEX	-	Capital Expenditure
COD	-	Chemical Oxygen Demand
CPC	-	Commune People's Committee
CSSWM	-	Common System for Solid Waste Management
DCA	-	Double Cropped Area
DCARC	-	District Compensation Assistance and Resettlement Committee
DCS	-	Distributed Control System
DEI	-	Division of Economy and Infrastructure
DENR	-	Division of Environmental and Natural Resource
DHPS	-	Department of Housing and Public Services
DHPU	-	Department of Housing and Public Utilities
DMS	-	Detailed Measurement Survey
DO	-	Dissolved Oxygen
DoE	-	Department of Environment
DONRE	-	Department of Natural Resources and Environment
DPC	-	District People's Committee
DPHE	-	Department of Public Health Engineering
EARF	-	Environmental Assessment and Review Framework
ECA	-	Environmental Conservation Act
ECC	-	Environmental Clearance Certificate
ECR	-	Environmental Conservation Rules
EE	-	Ecological Expertise
EHS	-	Environmental, Health and Safety
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
EP	-	Executive Power
EPSM	-	Environment and Plan of Social Management
ESIA	-	Environment and Social Impact Assessment
ESMS	-	Environmental and Social Management Systems
ETP	-	Effluent Treatment Plant
EU	-	European Union
FS and CD	-	Feasibility Study and Conceptual Design
GE	-	Gender Equality
GHG	-	Greenhouse Gas
GIS	-	Geographic Information System
GRC	-	Grievance Redressal Cell
GRM	-	Grievance Redress Mechanism
HDPE	-	High Density Poly Ethylene

ICPMU	-	Investment and Construction Project Management Unit
IEE	-	Initial Environmental Examination
IL	-	Integrated Landfill
LCC	-	Location Clearance Certificate
LFG	-	Landfill Gases
LGED	-	Local Government Engineering Department
MED	-	Ministry of Economic Development
MENR	-	Ministry of Ecology and Natural Resources
MEQ	-	Milliequivalent
MLGRDC	-	Ministry of Local Government, Rural Development, and Cooperatives
NCA	-	Net Cropped Area
NGO	-	Non-Government Organization
O&M	-	Operations and Maintenance
OFID	-	OPEC Fund for International Development
OI	-	Operational Instructions
PMU	-	Project Management Unit
PPTA	-	Project Preparatory Technical Assistance
QCA	-	Quadruple cropped Area
REA	-	Rapid Environmental Assessment
RP	-	Resettlement Plan
RRF	-	Resource Recovery Facility
SEA	-	Sexual Exploitation and Abuse
SH	-	Sexual Harrasment
SEP	-	State Ecological Programme
SIA	-	Social Impact Assessment
SPS	-	Safeguard Policy Statement
TSS	-	Total Suspended Solids
SCA	-	Single Cropped Area
SH	-	Sexual Harassment
SWM	-	Solid Waste Management
SWMC	-	Solid Waste Management Company
TCA	-	Triple Cropped Area
TECG	-	Thermal Effect Creating Gases
TOR	-	Terms of Reference
TSP	-	Total Suspended Particles
UEIP	-	Urgent Ecological Investment Project
USEPA	-	United States Environmental Protection Agency
WB	-	World Bank
WHO	-	World Health Organization
WTE	-	Waste to Energy
XEN	-	Executive Engineer

GLOSSARY

Adverse impact: An impact that is considered undesirable.

Ambient air: Surrounding air.

Aquatic: Growing or living in or near water.

Arsenic: Arsenic is a chemical element with symbol As and its atomic number is 33. Arsenic occurs in many minerals, usually in conjunction with sulfur and metals, and also as a pure elemental crystal. Arsenic is a metalloid.

Bangla: Bengali language.

Baseline (or Existing) Conditions: The 'baseline' essentially comprises the factual understanding and interpretation of existing environmental, social and health conditions of where the business activity is proposed. Understanding the baseline shall also include those trends present within it, and especially how changes could occur regardless of the presence of the project, i.e. the 'No-development Option'.

Bazar: Market

Beel: A "back swamp" or depression. It can be either perennial or seasonal.

Beneficial impacts: Impacts, which are considered to be desirable and useful.

Biological diversity: The variety of life forms, the different plants, animals and micro-Organisms, genes they contain and the ecosystems they form. It is usually considered at three levels: genetic diversity, species diversity and ecological diversity

Biological Oxygen Demand (BOD): The amount of dissolved oxygen, consumed in a biological process, which degrades the organic matter in water.

Consultation: the process of seeking the views of interested or affected stakeholders and engaging them in constructive two-way dialogue.

Crore: 10 million (=100 lakh)

Ecology: Science, which studies relationships and interaction between organisms and their environment.

Ecological factor: Any part or condition of the environment that influences the life of one or more organisms.

Ecosystem: A dynamic complex of plant, animal, fungal and microorganism communities and associated non-living environment interacting as an ecological unit.

Emission: The total amount of solid, liquid or gaseous pollutant emitted into the atmosphere from a given source within a given time, as indicated, for e.g., in grams per cubic meter of gas or by a relative measure, upon discharge from the source.

Endangered species: Species in danger of extinction and whose survival is unlikely if the existing conditions continue to operate. Included among those are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to suffer from immediate danger of extinction.

Environmental effects: The measurable changes, in the natural system of productivity and environmental quality, resulting from a development activity.

Environmental enhancement: An intentional change, which amplifies the anticipated positive impact of the project on an environmental component.

Environmental impact assessment (EIA)/Environmental assessment: The systematic, reproducible and interdisciplinary identification, prediction and evaluation, mitigation and management of impacts from a proposed development and its reasonable alternatives, sometimes known as environmental assessment.

Environmental Impact: An estimate or judgment of the significance and value of environmental effects for natural, socio-economic and human receptors.

Environmental Management Plan (EMP): A plan to undertake an array of follow-up activities which provide for the sound environmental management of a project/intervention so that adverse environmental impacts are minimized and mitigated; beneficial environmental effects are maximized; and sustainable development is ensured.

Environmental management: Managing the productive use of natural resources without reducing their productivity and quality.

Erosion: Process in which wind and water removes materials from their original place; for instance, soil washed away from an agricultural field.

Evaluation: The process of looking back at what has been really done or accomplished.

Fauna: A collective term denoting the animals occurring in a particular region or period.

Field Reconnaissance: A field activity that confirms the information gathered through secondary sources. This field study is essentially a rapid appraisal.

Flora: All of the plants found in a given area.

Flood Plain: Areas of relatively low-lying land seasonally inundated by overspill from adjacent rivers, lakes and natural depressions.

Habitat: The natural home or environment for a plant or animal.

Household: A household is defined as a dwelling unit where one or more persons live and eat together with common cooking arrangement. Persons living in the same dwelling unit by having separate cooking arrangements constitute separate households.

Important Environmental Component (IEC): These are environmental components of biophysical or socio-economic importance to one or more interested parties. The use of important environmental components helps to focus on the environmental assessment.

Initial Environmental Assessment/ Evaluation: Preliminary analysis undertaken to ascertain whether there are sufficient likely significant adverse impacts to warrant a "full" EIA. In some countries, use of initial assessment forms a meaning of "screening" proposed projects.

Katcha: Poor quality, poorly built

Khal: Small Channel, Canal.

Khas, Khash: Belongs to government (e.g., land)

Land use: Types include agriculture, horticulture, settlement, pisciculture and industries.

Mauza: A Bangla word for the smallest government administrative area corresponding to a village revenue unit.

Madrasah: Islamic college

Magnitude: The degree of change in an important environmental component that results from a project activity. It refers to the size of the impacts and could be either beneficial or adverse.

Mitigation: An action, which may prevent or minimize adverse impacts and enhance beneficial impacts.

Mouza: Government-recognized land area

Natural Gas: Flammable gas, consisting largely of methane and other hydrocarbons, occurring naturally underground (often in association with petroleum) and used as fuel.

Negative Impact: Negative Change from the existing situation due to the project.

pH: pH is a measure of how acidic/basic water is. The range goes from 0 - 14, with 7 being neutral. pH of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base. pH is really a measure of the relative amount of free hydrogen and hydroxyl ions in the water.

Public involvement/ Public consultation: A range of techniques that can be used to inform, consult, or interact with stakeholders affected/to be affected by a proposal.

Pucca: Good quality, well built, solid.

Reversible impact: An environmental impact that recovers either through natural process or with human assistance (e.g. cutting off fish migration by an embankment might be reversible at a later stage if a proper regulator is built).

Risk analysis: A technique used to determine the likelihood or chance of hazardous events occurring (such as the release of a certain quantity of a toxic gas) and the likely consequences.

Stakeholders: Those who may be potentially affected by a proposal e.g., local people, the proponent, government agencies, NGOs, donors and others, all parties who may be affected by the project or take an interest in it.

Social impact assessment: The component of EIA concerned with changes in the structure and functioning of social orderings. In particular the changes that a development would create in: social relationship; community (population, structure, stability etc.); people's quality and way of life; language; ritual; political/economic processes; attitudes/values.

Socio-economic: The human environment, which includes social and economic components that are not termed biophysical.

Sustainability: Applied to positive impacts only and could be of three different types sustainable, sustainable with mitigation and non-sustainable.

Taka: Unit of Bangladeshi currency.

Terrestrial: Living on land.

Thana: Sub-district level of government administration, comprising several unions under a district.

Union: Smallest unit of local self-government comprising several villages.

Upazila: Sub-district name. Upazila introduced in 1982.

Wildlife: Organism that can survive without any artificial help. The four general types are: mammals, amphibians, reptiles and birds.

Wildlife Habitat: An area maintained as an undisturbed breeding ground for wild fauna. The habitat is protected for the continued well-being of the resident and migratory fauna.

Zila: Bengali word for district.

WEIGHTS AND MEASURES

Ha	-	Hectare
Km	-	Kilometre
M	-	Meter
Mm	-	Millimetre

NOTES

- (i) In this report, "\$" refers to US dollars.
- (ii) BDT refers to Bangladeshi Taka

EXECUTIVE SUMMARY

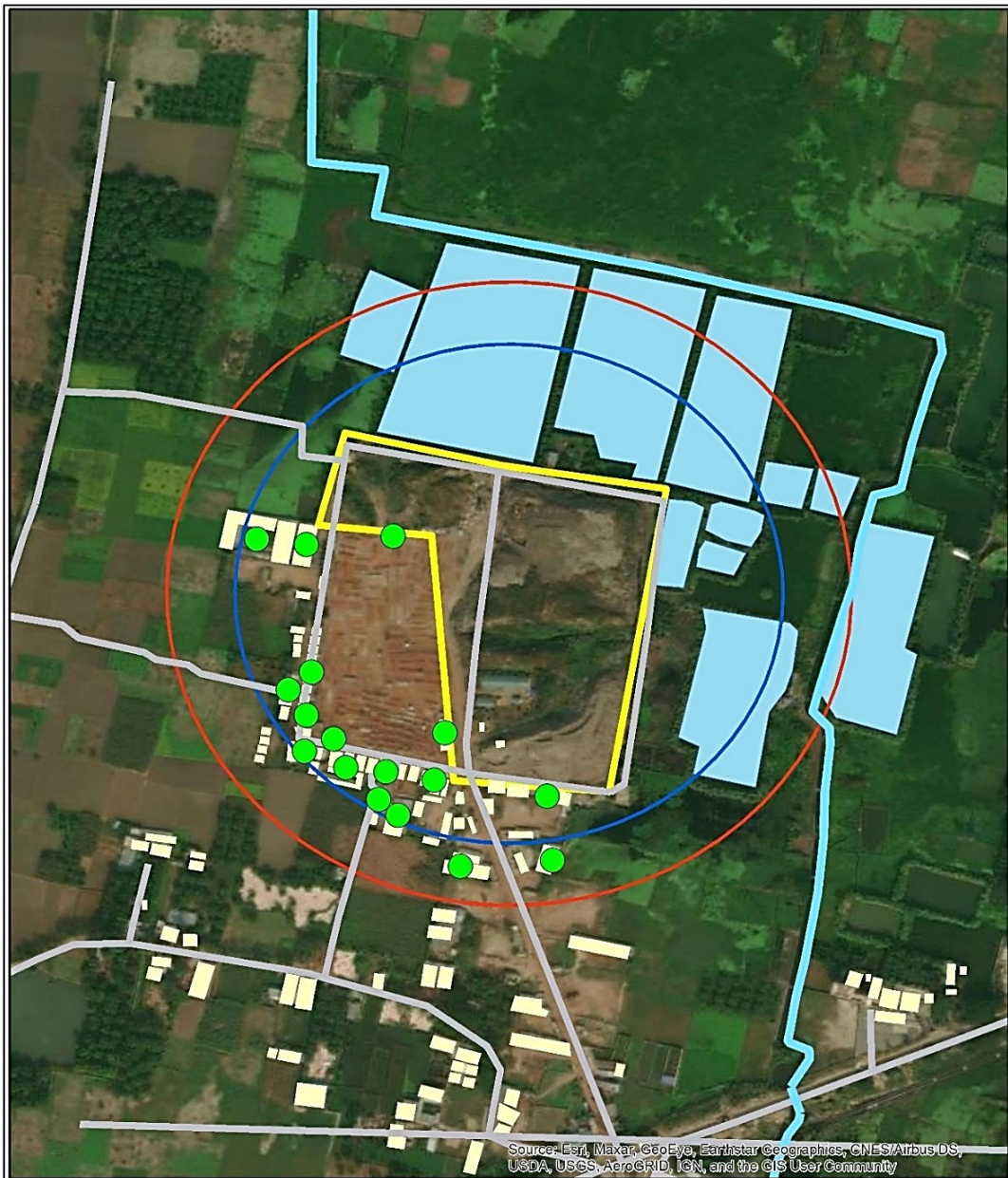
The current Integrated Solid Waste Management Improvement Project (ISWMIP), supported by the AIIB, will improve the SWM system in the selected municipal areas. This will help: (i) improve public health and quality of life by reducing exposure to pollutants and disease vectors associated with solid waste; (ii) strengthen the government's capacity to plan for and implement effective waste management services; and (iii) improve SWM practices in the country, encouraging waste minimization, recycling, and segregation at source. The project is aligned with the Government of Bangladesh (GoB)'s priorities for providing sustainable urban infrastructure. The country is, in particular, facing an immense challenge in its solid waste management. The project would directly contribute to one of the key objectives of the 8th Five-Year Plan and the long-term Perspective Plan for 2021-2041, improving the urban environment and quality of life.

The subproject aims to establish an integrated landfill and resource recovery facility, improve secondary storage of waste by introducing containerized storage system, and improve two existing roads in Rajshahi City Corporation (RCC) connecting the landfill site. The land for establishing the integrated landfill and resource recovery facility is owned by the city corporation. Currently, the land is free from any unauthorized occupancy. Two existing roads (The road from Kristan Para to Paba and Road from Dabtola Mor to Bohorampur Nagar Nursing College More) of 5.460 km which are vital for the transportation of waste of the subproject area will be improved without any widening. These roads are also free from any unauthorized occupancy. No new STS will be constructed in RCC under the subproject. Only improvement of the existing STSs has been proposed.

According to AIIB guidelines, the Rajshahi City Corporation subproject will require a comprehensive ESIA following the ESMPF addressing the Environmental and Social Standards to ensure that the subproject is environmentally sound and sustainable. As part of the AIIB funding guidelines, an Environmental and Social Impact Assessment (ESIA) should be carried out to address the environmental and social issues of the subproject following operational procedures, policies, guidelines, and statements set by the AIIB. According to the Environmental Conservation Rules (ECR), 2023 of the Department of Environment (DoE), Bangladesh, the subproject will fall under the "**Red Category**" and it on the Red list in ECR'23 (Schedule-I, SI-66 of Red Category: Municipality Landfill Site).

Subproject Categorization			
Sl. No.	SWM Components	Category (ECR'2023)	Overall Assessment
1	Landfill of Municipality	Red	Red category subproject
2	Compost Plant (>5MTs)	Orange	
3	Pyrolysis	Orange	
4	Material Recovery Facilities (MRF)	-	
5	Secondary Transfer Station (STS) of the Municipality	Yellow	
6	Medical Waste Treatment Facility	Orange	

The subproject is located at the Landfill Site of the Rajshahi City Corporation, which is in Ward no 17. Geographically it is located between 24.3635886° north and 88.6241351° east. The below satellite image depicts the location of landfill site and compliance with environment rules, and the location of the landfill site and alignment of the connecting roads proposed for improvement for the landfill site of the RCC subproject.



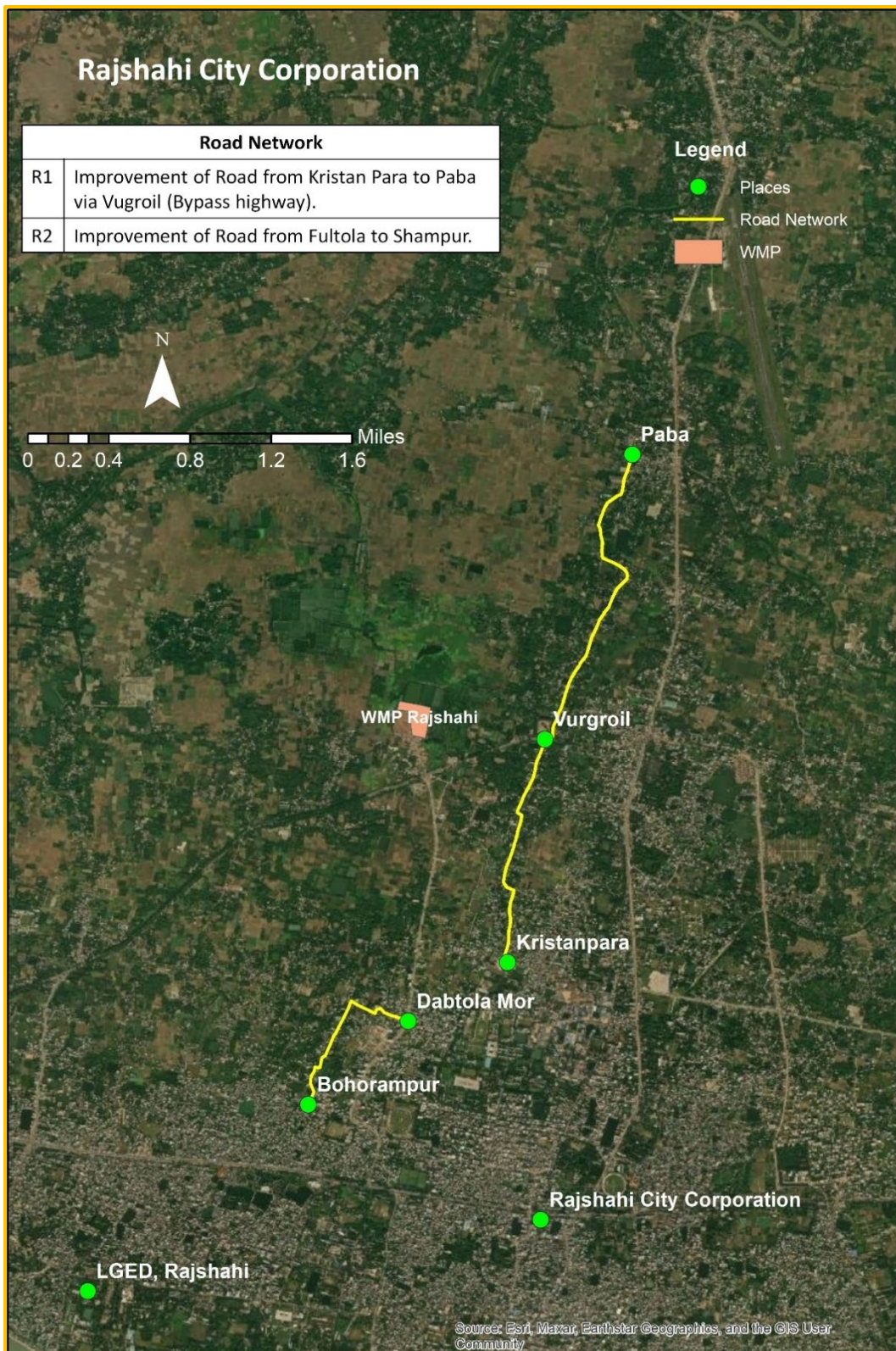
200m & 250m Buffer Map of Rajshahi Landfill Site

Legend	
Landfill Site	Affected Ponds
200m Buffer	Waterway
250m Buffer	Roads
Settlements	Temporary Shops /Restaurants

Technical Assistance on Integrated Solid Waste Management Improvement Project Preparation & Design Consultancy Services



Location Map of Landfill Site and Compliance with Environment Rules



Landfill Site Location and Alignment of the Connecting Roads Proposed for Improvement

To improve the solid waste management situation of Rajshahi City Corporation following interventions have been planned:

- Compost and Biogas Plant,
- Material Recovery Facility,
- Landfill Cells and Leachate Treatment Facility,
- Pyrolysis Plant

The contractor and operator will be primarily responsible for preparing the Site-Specific Environmental Management Plan (SEMP) following the risks associated with the subproject's preconstruction, construction & operation stages. During construction, the contractor will be guided by the SEM. This shall be based on the subproject's ESMP with details on staff, resources, implementation schedules, and monitoring procedures. The table below shows the Environmental and Social Risks associated with the Integrated Solid Waste Management Improvement Project of Rajshahi City Corporation.

Subproject Activities	Environmental and Social Risk
Preconstruction Stage	
1.1 Location impacts of the plant	Nearby communities may be affected due to increased pollution during construction and operation.
1.2 Incorporation of all mitigation measures in the design	The efficiency of the plant operation.
1.3 Natural calamities	There is a threat of inundation due to flooding during monsoon due to excessive rain.
1.4 Sources of Materials	Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution.
1.5 Permits, clearances, no objection certificate (NOC), etc.	Failure to obtain environmental clearance and NOCs, etc., can result in design revisions and/or stoppage of works.
1.6 Preparation of SEM	Expect minor impacts during the construction period only, and mitigation measures are addressed.
1.7 SEM implementation training	Irreversible impact on the environment, workers, and community
Construction Stage	
2.1 Physical and Cultural Heritage	Construction works will be on the existing Landfill Site, and thus risk for chance finds is very low.
2.2 Excavations	Potential erosion, dust generation, and accident. The impacts are negative but short-term, site-specific within a relatively small area, and reversible by mitigation measures.
2.3 Waste management	Oil, grease, etc., from construction machinery. Hazardous and solid waste from waste construction material and food. The impacts are negative but short-term, site-specific within a relatively small area, and reversible by mitigation measures.
2.4 Water quality (surface and groundwater)	Trenching and excavation, runoff from stockpiled materials, and chemical contamination from fuels and lubricants may result to silt-laden runoff during rainfall, which may cause siltation and reduction in the quality of adjacent bodies of water. The impacts are negative but short-term, site-specific within a relatively small area, and reversible by mitigation measures.
2.5 Soil disturbance	The construction activities may cause soil degradation problems in the areas of the plant, access road, etc.

Subproject Activities	Environmental and Social Risk
2.6 Air Quality	Air pollution due to construction activities. The impacts are negative but short-term, impacts within a relatively small area, and reversible by mitigation measures.
2.7 Noise Level	Construction activities will be nearby settlements. A temporary increase in noise level may be caused by excavation equipment and the transportation of equipment, materials, and people. The impact is short-term and within a relatively small area, and reversible by mitigation measures.
2.8 Biodiversity	<ul style="list-style-type: none"> ▪ Clearing of existing vegetation may result in the loss of associated ecological habitats and their fauna. ▪ Noise, vibrations, and intrusive activities related to construction works may scare away animals remaining onsite after vegetation clearance.
2.9 Socio-economic status	Manpower may be employed from the local community during the construction and operation stage. Thus, the potential impact is positive and long-term.
2.10 Provision of Worker Facilities	Inconvenience to the communities due to the presence of workers; solid waste and sanitary discharges from worker camps.
2.11 Occupational Health and Safety	Occupational hazards can arise during work. Potential impacts are negative and long-term but reversible by mitigation measures. Health Risk of construction workers due to COVID-19
2.12 Community Health and Safety	Construction works will impede the access of residents and businesses in limited cases. The impacts are negative but short-term, site-specific within a relatively small area, and reversible by mitigation measures.
2.13 Site reinstatement	Damage due to debris, spoils, excess construction materials
Operation Stage	
3.1 Health and Safety Risks of Workers	Risk to the health of workers working in plant operation and maintenance, workers may suffer infectious diseases due to hazardous waste Workers/ operators may have accident risks in the operation and maintenance of the landfill and resource recovery facility.
3.2 Efficient Working of Integrated Solid waste management activities	Inefficient working of integrated Solid waste management activities may cause poor quality of treatment and management of solid waste and may cause environmental, health, and safety risk to workers and the environment.
3.3 Air Quality	The ambient Air quality of the landfill Area.
3.4 Socio-economic aspect	<ul style="list-style-type: none"> ▪ Visual impacts. ▪ Impacts on community health. ▪ Employment.
3.6 Traffic management	<ul style="list-style-type: none"> ▪ Random parking of vehicles and unplanned loading/unloading areas can lead to traffic congestion for compost and recyclable transport

In order to identify households, businesses, and individuals affected due to the implementation of the sub-project have been identified through social surveys, field visits, consultation meetings, and observations. The list of the affected entities with livelihood impact due to the implementation of integrated landfill and resource recovery project along with the improvement of access roads is shown below:

Social Impact Assessment in the Construction and Operation Phase of Landfill Site							
SI No.	Affected Entities	Construction Phase			Operation and Maintenance Phase		Remarks
		No. Affected	Compensation	Engaged in work	Engaged	Work field	
1	Waste Pickers	27	√	√	√	Engage in MRF	Will be absorbed by the Municipality
2	Vangari Shop	1	√	√	√	Better Livelihood	Transfer and Reconstruction Grants will be made before the construction phase
3	Restaurants/Tea stalls/Other shops Owner in Landfill Area	16	√	√	√	Better Livelihood	Transfer and Reconstruction Grants will be made before the construction phase
4	Affected Pond	1	√	X	X	To be compensated by resettlement	Based on the decision of DOE and Municipality

Social Impact Assessment in the Construction and Operation Phase of Two Connecting Roads							
SI No.	Affected Entities	Construction Phase			Operation and Maintenance Phase		Remarks
		No. Affected	Compensation	Engaged in work	Engaged	Work field	
1	Small Shops, Mills and Business Enterprises along the connecting roads	89	√	X	X	X	Compensation payment for income loss will be made before the construction phase

For the Rajshahi City Corporation subproject, the compensation provision under Livelihood Restoration Program has been estimated at Tk. 23,959,684 (Tk. 10,315,684 for landfill site improvement and Tk. 13,644,000 for connecting road improvement). The Project Director of ISWMIIP will allocate the compensation payable, and city corporation authority will disburse the compensation to the PAPs under the supervision of the social safeguard team of the supervision consultant of the project. A social survey was conducted in December 2022 and a road survey was conducted in June 2023. The quoted numbers regarding the affected categories are currently considered an estimate, and their numbers will be updated six months before the commencement of civil works to reflect the fluidity of the waste-picking ecosystem and the change in the commercial establishments along the connecting roads. No person will be eligible for any Livelihood Restoration Compensation after the update. During the social and road survey, GPS coordinates are taken for the affected entities. This GPS location will be used to verify and update the affected persons during compensation payment for livelihood restoration. In addition to payment of compensation to the affected persons, it is recommended to arrange capacity-building training for the affected persons along with the arrangement of health camps annually. The estimated training and health camp budget is shown in the Livelihood Restoration Plan.

A copy of the ESMP shall be kept onsite during the construction period at all times. The ESMP shall be made binding on the contractor operating on the site and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set out in this document shall constitute a failure in compliance. LGED has fully endorsed the ESMP and is committed to implementing all the mitigation measures. Rajshahi City Corporation will also ensure that the work is carried out in an environmentally acceptable manner and that the monitoring and reporting are completed in a compliant and timely fashion, acceptable to DOE.

The stakeholders are involved in developing the ESIA through discussions onsite and public consultation, after which views expressed are incorporated into the ESIA. This ESIA will be made available to a wider audience via the Rajshahi City Corporation, LGED, and AIIB websites. Free printed copies of the executive summary of the ESIA document in Bangla and English will be made accessible to the general public. The consultation process will be continued and expanded during project implementation to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation. A grievance redress mechanism is described within the ESIA to ensure any public grievances are addressed quickly.

I. INTRODUCTION

I.1 Background

Bangladesh is one of the fastest urbanizing and most densely populated countries in the region, putting great pressure on basic urban services and infrastructure. Solid Waste Management (SWM) has been one of the major urban challenges in the country given its rapid urban growth. Despite the Government's efforts in improving the SWM system, waste collection and disposal capacity is still limited. Less than half of total waste generated is collected, while uncollected waste is often informally burned, buried, or illegally dumped in streets, public spaces, drainage channels, and waterways. This has resulted not only in public health hazards and the contamination of the environment, including air, water, and soil, but also the blocking of major drainage channels and sewerage networks

The current Integrated Solid Waste Management Improvement Project (ISWMIP) supported by the AIB, will improve the SWM system in the selected municipal areas. This will help: (i) improve public health and quality of life by reducing exposure to pollutants and disease vectors associated with solid waste; (ii) strengthen the government's capacity to plan for and implement effective waste management services; and (iii) improve SWM practices in the country, encouraging waste minimization, recycling, and segregation at source. The project is aligned to the Government of Bangladesh (GoB)'s priorities for providing sustainable urban infrastructure. The country is, in particular, facing an immense challenge in its solid waste management. The project would directly contribute to one of the key objectives of the 8th Five Year Plan and the long-term Perspective Plan for 2021-2041, that is to improve the urban environment and quality of life.

The GoB has received a Project Preparation Special Fund (PSF) from AIB to support the preparation of proposed ISWMIP for consideration of USD500 million AIB financing. The investment shall be undertaken in a phased manner with a likely investment size for Phase I of USD 150 million. The PSF is being implemented by the Local Government Engineering Department (LGED) under the Local Government Division (LGD), the Ministry of Local Government Rural Development and Co-operatives (MLGRDC).

The project will function under the overall guidance of a Steering Committee (SC) which will be chaired by the Secretary, Local Government Division (LGD), the Ministry of Local Government Rural Development and Co-operatives (MLGRDC). The SC will play a significant role in high-level decision making, ensure seamless coordination among the various governmental actors, and accelerate the implementation of the proposed activities under various Components. The SC will comprise representatives from various Ministries.

The LGED has adopted the ESMPF¹ findings, which lays out the requirements for the environmental and social impact assessment, environmental management plans, best management practices, and social management plans, for the ULBs where sites for ISWM are finalized and for the ULB areas once the ISWM areas are identified. This ESIA report of Rajshahi City Corporation has been prepared following the ESMPF policies, guidelines and procedures to be integrated into the design and implementation of component 1, 2, 3 & 4 respectively, under the proposed project.

¹ LGED would like to express its deepest appreciation to all those who have provided the support and cooperation in completing the ESMPF report. A special gratitude is being conveyed to the concerned officials of AIB for their invaluable cooperation and continued sharing of information. Further, it's a matter of gratefulness to put on record the services so kindly extended by Consulting Firms and others involved in the ESMPF study.

I.2 ISWMIP Components

The ISWMIP has four components as mentioned below:

- **Component 1: Waste Collection and Transportation.** This will help improve and optimize solid waste collection and transport services in selected Urban Local Bodies (ULBs), including collection containers and fleet, mechanical cleaning equipment, and transfer stations etc.
- **Component 2: Waste Processing and Disposal Systems.** This will finance prioritized waste processing and disposal infrastructure, including closure of polluted landfill sites, construction and rehabilitation of engineered sanitary landfills (standalone or regional/ clustered), and provision of facilities related to composting, resource recovery, and waste-to-energy.
- **Component 3: Project Management and Supervision Support.** This will support in the areas of project management, monitoring and evaluation, procurement, financial management, and environmental and social safeguards (including public awareness campaigns and public consultation), and provision of support with respect to supervision and maintenance of infrastructure investments.
- **Component 4: Policy Support and Capacity Building.** This will support: (i) improvement of the SWM sector policy and legal framework; (ii) policy and guideline development related to waste minimization and recycling, private sector participation, inclusion of informal workers, and multi-jurisdictional waste management; and (iii) institutional capacity strengthening for relevant central and local agencies in SWM.

I.3 Scope of the ESIA

The detailed scope of the ESIA study is as outlined below:

- Screening of the Subproject based on applicable Environmental and Social Management Planning Framework (ESMPF) based on reconnaissance survey and field-based assessment of AIIB's Environmental and Social Standards (ESSs) of the Environmental and Social Framework (ESF);
- Scoping for the ESIA study by identifying the applicable ESSs;
- Development of a regulatory, policy and administrative framework relevant to the Subproject;
- Monitoring, analysis and reporting of the environmental and social baseline data of the study area including consultation with local communities and other stakeholders;
- Assessment of the environmental impacts of the Subproject in the study area;
- Assessment of social impacts on the local community as well as subproject affected people (if any) and any other stakeholders, which have been identified during the social consultation process;
- Identification of potential risks and hazards including environmental, socio-cultural, public health hazards due to the development of Rajshahi City Corporation Subproject;
- Formulation of an Environment and Social Management Plan and associated/specific mitigation plans for identified impacts and effective risk management especially for the protection of the natural environment of the subproject area; and
- Formulation of Stakeholder Consultation and Grievance Redress Mechanism for the Subproject.

1.4 Approach and Methodology of The ESIA Study

1.4.1 Categorization of the Subproject

According to the Environmental Conservation Rules (ECR), 2023 of the Department of Environment (DoE), Bangladesh, the subproject will fall under “**Red Category**” and it on the Red list in ECR 2023 (Schedule-I, SI-66: Landfill of Municipality). Therefore, it is mandatory to conduct an Environmental Impact Assessment (ESIA) for obtaining an environmental clearance certificate. The EIA approval from the DoE has been obtained. According to AIB, this subproject will require a comprehensive ESIA following the ESMPF addressing the three Environmental and Social Standards to ensure that the subproject is environmentally sound and sustainable. There is difference in subproject categorization as per AIB ESS and GOB rules (ECR-2023).

1. Scoping

Scoping was done for:

- Categorization of the subproject according to ECR 2023 and the AIB ESSs.
- Identifying and procuring institutional information.
- Information collection through discussions/meetings with AIB, LGED, Rajshahi City Corporation etc. to define scope for the impact assessment,
- Planning and implementation of mitigation and monitoring,
- Confirmation of the applicability of the Performance Standards set forth by the AIB as requirements of the ESS.
- Confirmation whether Resettlement Action Plan (RAP) or voluntary dispossession or negotiated settlement is required.

2. Statement of Works

The environmental and social screening of Rajshahi City Corporation Subproject was performed and the basis of the screening was –

- Desk review of the relevant documents and available imagery of the subproject site and its surroundings,
- Reconnaissance survey of the site, surrounding areas, approach road and informal discussions with local stakeholders,
- Discussions with AIB, LGED, Rajshahi City Corporation, Design Consultants of the Client and Department of Environment (DoE) to update the regulatory requirements and formats/ methods, etc.

3. Reconnaissance Survey and Data Collection Scheming

- A reconnaissance survey of the site and the surrounding area was conducted in May 2022 to ascertain the extent of the study area and to identify the studies to be conducted to fulfill the requirements of the ESIA.
- Relevant information about the subproject area were gathered through detailed physical survey and measurement of environmental parameters as necessary.
- Additional information was collected from published literature and previous ESIA reports.

- In addition, data and information were also collected from different government and non-government organizations.

4. Baseline Data Collection

An environmental and social baseline survey have been carried out to gather information on the existing physicochemical, biological, and socio-economic environment of areas surrounding the proposed area. These data collection campaign was as follows:

- Identification of the monitoring locations for air, water and noise for sensitive receptors, and at key locations for water intake and outfall, etc.;
- The baseline data collection, monitoring and analysis for environmental parameters was completed during the period from end of December 2022;
- Socio-economic data collection and consultations were carried out in December 2022;
- Secondary data was also collected from different government departments, local bodies and through literature surveys etc.; and
- Stakeholder consultation was completed with the intent of collecting baseline information on the environmental and social conditions and sensitivities, developing a better understanding of the potential impacts, informing the public of the proposed subproject and to gain an understanding of the perspectives/concerns of the stakeholders;

5. Impact Assessment and Mitigation Measures

- Analysis of the baseline results and the incremental impacts of the subproject were assessed in accordance with the Bangladesh national guidelines for air, water and noise emissions; standards stipulated in the Environment Conservation Rules (ECR), 2023 and amendments thereof and with reference to the AIIB's Environmental and Social Standards, AIIB's Safeguard Policies, IFC's Environmental, Health and Safety (EHS) Guidelines, including the General Guidelines;
- The impact assessment involved the prediction and evaluation of impacts from the subproject in different phases, including site preparation, construction and operation phase, decommissioning of subproject and included consideration of mitigation measures towards the same;
- Impact prediction covered residual impacts (impacts remaining after all possible mitigations have been incorporated) and took into account control measures that are part of the subproject design (e.g. acoustic enclosures for major equipment). Additional measures aimed at further avoiding, minimizing and mitigating predicted impacts were proposed where necessary or appropriate;
- Impact assessment also involved risk assessment covering hazard identification, consequence analysis and risk reduction measures and recommendations; and
- Impacts have been further classified as insignificant, minor, moderate or major based on the criteria for rating of impacts.

6. Analysis of Alternatives

Analysis of alternative options was considered to minimize impacts of the subproject while undertaking the ESIA study. The alternative options assessed in the study ranged from technology, transportation methods, subproject site and operations, including the no subproject alternative. Alternatives are

considered in terms of their potential environmental impacts, the feasibility of mitigating these impacts alternatives for mitigation measures for high residual impact/risk, if any etc.

7. Management Plans and Grievance Redress Mechanism

- Environmental and Social Management Plan (ESMP) were developed for the mitigation measures suggested and included defined roles and responsibilities for implementation;
- A Grievance Redress Mechanism (GRM) was developed by the Consultant to address any complaints and concerns from all stakeholders;
- Based on the risk assessment, risk reduction measures and recommendations for a WMP, CMP, LMP, TMP, BMP were also developed; and
- ESMP also addressed the Institutional review, finalization of ESMP and grievances.

8. Information/Data Sources

Key relevant information sources have been summarized in Table I.1

Table I-1 Key Data Sources

Parameters	Information sources	Remarks
Subproject Background, Technical details on subproject and associated components	<ul style="list-style-type: none"> ▪ Subproject specification documents from Rajshahi City Corporation ▪ Subproject Execution milestones, Landfill layout, Solid waste management system 	Rajshahi City Corporation provided other information required during the course of the study
Study area features and sensitivities	<ul style="list-style-type: none"> ▪ Ground physical survey ▪ Satellite images ▪ National web portal of Bangladesh ▪ Primary data collection 	Details of the satellite data used is included in Baseline Chapter
Legal framework	<ul style="list-style-type: none"> ▪ Department of Environment ▪ IFC and AIB documents ▪ DOE ESIA Guidelines 	In discussion with the DOE and local Govt. departments, AIB and LGED
Land use /Land cover Details, Meteorology and climatic conditions	<ul style="list-style-type: none"> ▪ Ground Physical Survey ▪ Bangladesh Meteorological Department ▪ Observatory Surface Meteorological Data 	Details of the satellite data used is included in Baseline chapter, Pre-subproject land use data are collected from subproject personnel and local people.
Geology, Topography, Hydrology and Drainage	<ul style="list-style-type: none"> ▪ Rajshahi City Corporation Subproject Location Map, previous EIA reports of the project area ▪ Bangladesh Water Development Board ▪ Web portal of National Encyclopedia of Bangladesh (Banglapedia) 	Field Observations
Natural hazards	<ul style="list-style-type: none"> ▪ Web portal of National Encyclopedia of Bangladesh (Banglapedia) ▪ Bangladesh Meteorological Department 	Included in consultation with Locals

Parameters	Information sources	Remarks
Environmental baseline as Air quality, water quality, soil and sediment quality	<ul style="list-style-type: none"> ▪ Primary data collection ▪ Applicable Standards from DoE, Bangladesh 	Monitoring was completed from December 2022.
Ecological parameters	<ul style="list-style-type: none"> ▪ Primary and Secondary data collection, observations, surveys and local consultations ▪ Websites of birdlife international ▪ IUCN Data base 	Data collection was carried out in the month of December 2022, Endangered, critical status was checked from the website: www.iucnredlist.org
Social-economic parameters	<ul style="list-style-type: none"> ▪ Primary data collection surveys, extensive consultations, meetings and discussions held with stakeholders ▪ Bangladesh population Census for 2011 ▪ Fisheries Census data ▪ Land Regulation Policy, Bangladesh ▪ Web portal of National Encyclopedia of Bangladesh (Banglapedia) 	Primary Socio-economic Survey was carried out in month of December 2022. Details provided in baseline environmental and social conditions chapter.

1.5 Structure of the ESIA Report

The ESIA report has been prepared following the ESMPPF as well as ECR 2023. The report is divided into ten (10) chapters to cover all key issues comprehensively. The report structure is as follows:

Chapter 1 of this ESIA report describes the background and objectives of the subproject. It also presents an outline of the methodology followed for carrying out ESIA.

Chapter 2 presents an overview of policy, legal and administrative framework relevant to the subproject.

Chapter 3 presents a detail description of the subproject including the major activities to be carried out during both construction and operation phases of the subproject.

Chapter 4 presents baseline information, identification and assessment of the potential environmental, ecological and socio-economic impacts of the proposed subproject, both during construction and operation phases, as well as environmental and social audit of existing industries.

Chapter 5 presents the alternative options for the proposed subproject.

Chapter 6 presents the Potential Impacts identification and Assessment including the mitigation measures for enhancement of positive impact and reduction or elimination of negative impacts.

Chapter 7 presents the Information Disclosure along with outcome of public consultations and communications carried out as a part of the environmental assessment.

Chapter 8 presents the Environmental and Social Management System (ESMS), including the Environmental and Social Management Plan (EMP) and the Monitoring Plans for both construction and operational phases along with the GAP, OHSMP, GBV, WMP, CMP, LMP, TMP, BMP.

Chapter 9 Grievance Redress Mechanism of the subproject containing the mechanism process, intake channel, registry, referral, resolution & appeals process, GRM monitoring & reporting etc.

Chapter 10 of the ESIA report presents the conclusions of the environmental assessment of the proposed subproject.

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Introduction

The proposed Integrated Solid Waste Management Improvement Project will be implemented in compliance with applicable national environmental laws and regulations. Bangladesh has a wide range of laws and regulations related to environmental protection, natural resources conservation as well as social issues, which are mostly cross-sectoral and would be applicable to the proposed project. The Asian Infrastructure Improvement Bank (AIIB) also has certain Social and Environmental safeguard policies, which needs to be adhered to for the purpose of the implementation of this project. This section presents an overview of the major national environmental, social and Solid Waste Management laws, policies and regulations that are relevant and may apply to activities supported by the project, institutional arrangement and national and sub-national level, and AIIB safeguard policies.

2.2 National Environmental and Social Laws, Rules, Policies and Guidelines

Table 2-1: List of Applicable National E&S Laws, Rules, Policies and Guidelines

Sl. No.	Policies/Act/Rules	Key provisions and purpose	Applicability to the sub-projects/LGED
1.	Bangladesh Environmental Conservation Act (ECA), 1995	This umbrella Act includes laws for conservation of the environment, improvement of environmental standards, and control and mitigation of environmental pollution. According to this act (Section 12), no industrial unit or project shall be established or undertaken without obtaining, in a manner prescribed by the accompanying Rules, an Environmental Clearance Certificate (ECC) from the Director General of DoE.	Yes, sub-projects have to get ECC.
2.	Bangladesh Environmental Conservation Rules (ECR), 2023	The Rule 5 classifies industrial units and projects into four categories depending on environmental impact and location for the purpose of issuance of ECC. These categories are: Green, Yellow, Orange and Red. The ECR 2023 describes the procedures for obtaining Environmental Clearance Certificates (ECC) from the Department of Environment for different types of proposed units or projects.	Yes, LGED sub-projects will fall under Red category, hence require ESIA approved by the DoE and have to deposit prescribe fees according to the schedule 7 to obtain ECC.
3.	Bangladesh Environment Court Act, 2010	Bangladesh Environment Court Act, 2010 has been enacted to resolve the disputes and establishing justice over environmental and social damage raised due to any development activities.	According to this act, government can take legal actions if any environmental problem occurs due to ISWMI subproject interventions.
4.	The Protection and Conservation of Fish Act (1950)	This Act provides power to the government to: make and apply rules to protect fisheries; prohibit or regulate erection and use of fixed engines; and construction of temporary or permanent weirs, dams, bunds, embankments and other structures.	Yes, as the sub-projects includes Waste Collection and Transportation, Waste Processing and Disposal Systems etc. which has potential risk for Air and water

Sl. No.	Policies/Act/Rules	Key provisions and purpose	Applicability to the sub-projects/LGED
			pollution, habitat alternation, hinder of natural flow/migration.
5.	Protection and Conservation of Fish Rules (1985)	Section 6 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.	Yes, during construction and operation of the sub-projects.
6.	Bangladesh Wildlife (Protection and Preservation) Act 2012	The Act protects 1,307 species of plants and animals, including 32 species of amphibian, 154 species of reptile, 113 species of mammal, 52 species of fish, 32 species of coral, 137 species of mollusk, 22 species of crustacean, 24 species of insect, six species of rodent, 41 species of plant and 13 species of orchid. Of these, eight amphibian, 58 reptile, 41 bird, and 40 mammal species are listed as endangered in the IUCN Red Data Book (2000, updated in 2015).	Yes, the sub-projects area might have presence of these listed threatened animals.
7.	Biodiversity Act, 2017	It provides for the creation of the National Committee and the Biodiversity Management and Surveillance Committees at local levels (i.e. Districts, Upazilas, Municipalities, and Unions). In general, all these committees are mandated to: assist the Government in implementing the National Biodiversity Strategy and Action Plan (NBSAP) and to visit the biodiversity enriched areas in their respective territories; and, monitor the progress of implementation of the NBSAP.	Yes, all sub-projects need to include these local committees, so that they can monitor project impact on the local biodiversity.
8.	Forest Act 1927 (Amendment 2000)	The act empowers the government to regulate the felling, extraction, and transport of forest produce in the country.	Yes, sub-projects will include felling of trees and social forestry.
9.	Embankment and Drainage Act, 1952	The Act consolidates the laws relating to embankments and drainage providing provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion or other damage by water.	Yes, sub-projects will include interventions in the water bodies, construction of bridges, ghats, etc.
10.	Bangladesh Water Act, 2013	As per this Act, all forms of water (e.g., surface water, ground water, sea water, rain water and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people. Without prior permission issued by the Executive Committee, no individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources, nor they will be allowed to build any structure that impede the natural flow of rivers and creeks.	Yes, LGED is permitted to implement water projects covering impact area below 1000 hectare (<1000 ha).
11.	Bangladesh Labor Act, 2006	It provides the guidance of employer’s extent of responsibility and workmen’s extent of right to get compensation in case of injury by accident while working.	Yes, sub-projects require substantial labor from local and external areas.

Sl. No.	Policies/Act/Rules	Key provisions and purpose	Applicability to the sub-projects/LGED
12.	Bangladesh National Building Code, 2006	The BNBC clearly sets out the constructional responsibilities according to which the relevant authority of a particular construction site shall adopt some precautionary measures to ensure the safety of the workmen. The Code also clarifies the issue of safety of workmen during construction.	Yes, sub-projects will include construction of STS, Landfill Sites, etc.
13.	The Noise Pollution Control Rules, 2006	The Noise Pollution Control Rules have been established in order to manage noise generating activities which have the potential to impact the health and wellbeing of workers and the surrounding communities.	Yes, many activities of sub-projects will be performed under the densely populated areas.
14.	Road Transport Act, 2018	The new Road Transport Act 2018 has finally come into effect at the start of November. After the long-standing Motor Vehicle Ordinance of 1983, the new act introduces a myriad of updated laws and adds new definitions for what constitutes an offence, with most of the fines and punishments receiving major bumps.	Yes, sub-projects will use heavy vehicles, deploy drivers and operators of machineries.
15.	Solid Waste Management Rules 2021	These rules require (i) source segregation of waste into dry and wet waste, (ii) standards for composting, (iii) an-aerobic digestion and waste-to-energy projects, (iv) guidelines for landfilling, and (v) standards for the placement of secondary storage bins, and primary and secondary collection of waste. Promotion of 3Rs, site selection criteria for landfills, recycling plants, and applicable environmental standards are typically articulated by MoEF&CC. For landfill site selection and construction of large-scale organic waste recycling plants, an environmental impact assessment would also be overseen by the environmental agency. MoEF&CC also monitors the local government's performance for compliance of such rules and environmental regulations.	Yes, Subproject will be well guided by the SWM rules.
16.	Rules for Removal of Wrecks and Obstructions in inland Navigable Water Ways (1973)	Rules for removal of wrecks and obstructions	Yes, if obstruct natural canals/rivers or any other natural water ways (includes seasonal water bodies).
17.	The Water Supply and Sanitation Act (1996)	Regulates the management and control of water supply and sanitation in urban areas.	Yes, sub-projects will include construction of water supply and sanitation facilities
18.	The Ground Water Management Ordinance (1985)	Describes the management of ground water resources and licensing of tube wells	Yes, construction sites of the sub-projects may require deep tube wells for meeting up water use.
19.	The Antiquities Act (1968)	Describes the preservation of cultural heritage, historic monuments and protected sites	Yes, sub-projects areas may have elements of

Sl. No.	Policies/Act/Rules	Key provisions and purpose	Applicability to the sub-projects/LGED
			cultural, historic and protected value.
20.	Acquisition and Requisition of Immovable Property Act, 2017	The principal legal instrument governing land acquisition in Bangladesh is the Acquisition and Requisition of Immovable Property.	Yes, both acquisition and requisition of land, and other properties would require by the sub-projects.

2.3 Environmental and Social Policy of AIIB

The AIIB Environmental and Social Framework (ESF), 2016 (AIIB, 2016) (Amended February 2019 and May 2021) provides an overview of the AIIB concerning (a) environmental and social sustainability; and (b) its role in meeting the challenge of sustainable development in Asia. The complete objectives of development are framed within the ESF in terms of both local impacts, and global challenges, especially in climate change. The ESF provides general specifications, standards and objectives that clients should adhere to during project preparation and implementation. Thus, the ESF attaches importance to country regulatory systems as sources of legally binding procedures and standards.

The Environmental and Social Policy (ESP) in the ESF comprises essential environmental and social requirements for each project and is accompanied by:

- (a) Three associated mandatory Environmental and Social Standards (ESSs) setting out requirements applicable to clients on, respectively,
 - i. ESS-1: Environmental and Social Assessment and Management,
 - ii. ESS-2: Land Acquisition and Involuntary Resettlement and
 - iii. ESS-3: Indigenous Peoples;
- (b) An Environmental and Social Exclusion List (ESEL); and
- (c) A Glossary of certain terms used in the ESP and ESSs.

The three ESSs mentioned in the ESP are, ESS 1: implementation of environmental and social assessment and management, ESS 2: prevent/minimize involuntary resettlement and ESS 3: protection of vulnerable/indigenous people. These standards require clients to implement structured process of impact assessment, planning, and mitigation to address the adverse effects of projects throughout the project cycle. Together, the ESP and the ESSs comprise an environmental and social management approach designed to:

- i. Ensure environmental and social screening and categorization,
- ii. Analyze future project environmental and social threats, and impacts;
- iii. Identify measures to prevent, reduce, mitigate, cover or make up for project environmental and social impacts;
- iv. Provide a process to consult the public on environmental and social risks and impacts of projects and to disclose information.

The AIIB classifies all its projects into four categories.

- The project is categorized as Category A if it is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or

unprecedented and requires the client to conduct an Environmental and Social Impact Assessment (ESIA) with Environmental and Social Management Plan (ESMP).

- A project is categorized as Category B when: it has a limited potentially adverse environmental and social impacts; the impacts are not unprecedented; few if any of them are irreversible or cumulative; they are site-specific; and can be successfully managed using good practice in an operational setting and requires clients to conduct an initial review of the environmental and social implications of the Project.
- A project is categorized C when it is likely to have minimal or no adverse environmental and social impacts and the client is required to prepare a review of the environmental and social aspects of the Project.
- A project is categorized FI if the financing structure involves the provision of funds to a financial intermediary (FI) for the project, whereby the bank delegates to the FI the decision-making on the use of the Bank funds, including the selection, appraisal, approval and monitoring of bank-financed subprojects. The bank requires the FI to develop and apply an appropriate ESMS that is proportional to the environmental and social risks associated with the bank-supported portfolio, is consistent with this ESP, excludes from bank support activities covered in the ESEL and incorporates applicable provisions of the ESSs.

AllIB requires the client to establish, in accordance with the ESP and applicable ESSs, a suitable grievance mechanism to receive and facilitate resolution of the concerns or complaints of people who believe they have been adversely affected by the project's environmental or social impacts, and to inform project-affected people of its availability. People who believe they have been or are likely to be adversely affected by a failure of the bank to implement the ESP may also submit complaints to the bank's oversight mechanism in accordance with the policies and procedures to be established by the bank for such mechanism.

ESF 2016 (amended in 2019) has also provisions for identify measures to avoid, minimize, or mitigate potentially adverse impacts on and risks to physical, biological, socioeconomic and cultural resources, safety of both workers and affected community and natural resources during the design, construction, operation, and decommissioning of the project.

All AllIB funded Investment Project Financing are required to follow the Environmental and Social Framework (ESF) consisting three (3) Environmental and Social Standards (ESS). These ESSs set out their requirement for the borrowers relating to the identification and assessment of environmental and social risks and impacts associated with any project. The ESSs supports the borrowers in achieving good international practice relating to environmental and social sustainability, assist them in fulfilling their national and international environmental and social obligations, enhance transparency and accountability and ensure sustainable development outcome through ongoing stakeholder engagement.

2.4 Environmental Clearance Process

The ECR, 2023 provides a basic framework for environmental evaluation of proposed projects in all sectors and establishes procedures. Accordingly, the project proponent should first obtain a location clearance and conduct the appropriate study to obtain environmental clearance of the project. Any project constructed in Bangladesh must obtain an Environmental Clearance Certificate (ECC) before its operation.

Similar to environmental screening process of the projects, Rule 5 of ECR has classified the projects into following four categories based on the site conditions and the impacts on the environment. The

projects are categorized under four categories they are: Green, Yellow, Orange and Red. Various industries/projects falling under each category have been listed in schedule-I of the ECR. According to the Rules of the ECC to all existing and proposed industrial units and projects, which are falling in the green category without undergoing EIA. However, for category Yellow, Orange and for Red projects require location clearance certificate and followed by issuing of ECC upon the satisfactory submission of the required documents.

For getting location and environmental clearances, the project proponent of concerned project should apply to the concerned Divisional Officer of DoE by filling Form-3 as per the rules given in the ECR. They should accompany with the following documents:

- Application through prescribed form-3 under ECR 2023
- Prescribed fee under the schedule of ECR 2023
- Report on Feasibility of the industrial unit or project
- Initial Environmental Examination (IEE) Report or EIA as per the Terms of Reference Provided by the DoE
- EMP for the proposed project
- No Objection Certificates (NOC) from the Local Authorities.
- Emergency plan relating adverse environmental impact and plan for mitigation of the effect of pollution
- Outline of Relocation and rehabilitation plan
- Other necessary information (based on the type of the project)

The environmental clearance is one-year validity for the projects which come under the Red Category. The environmental clearance process as per the DoE, Ministry of Environment and Forests, Government of Bangladesh is shown in Figure 2-1.

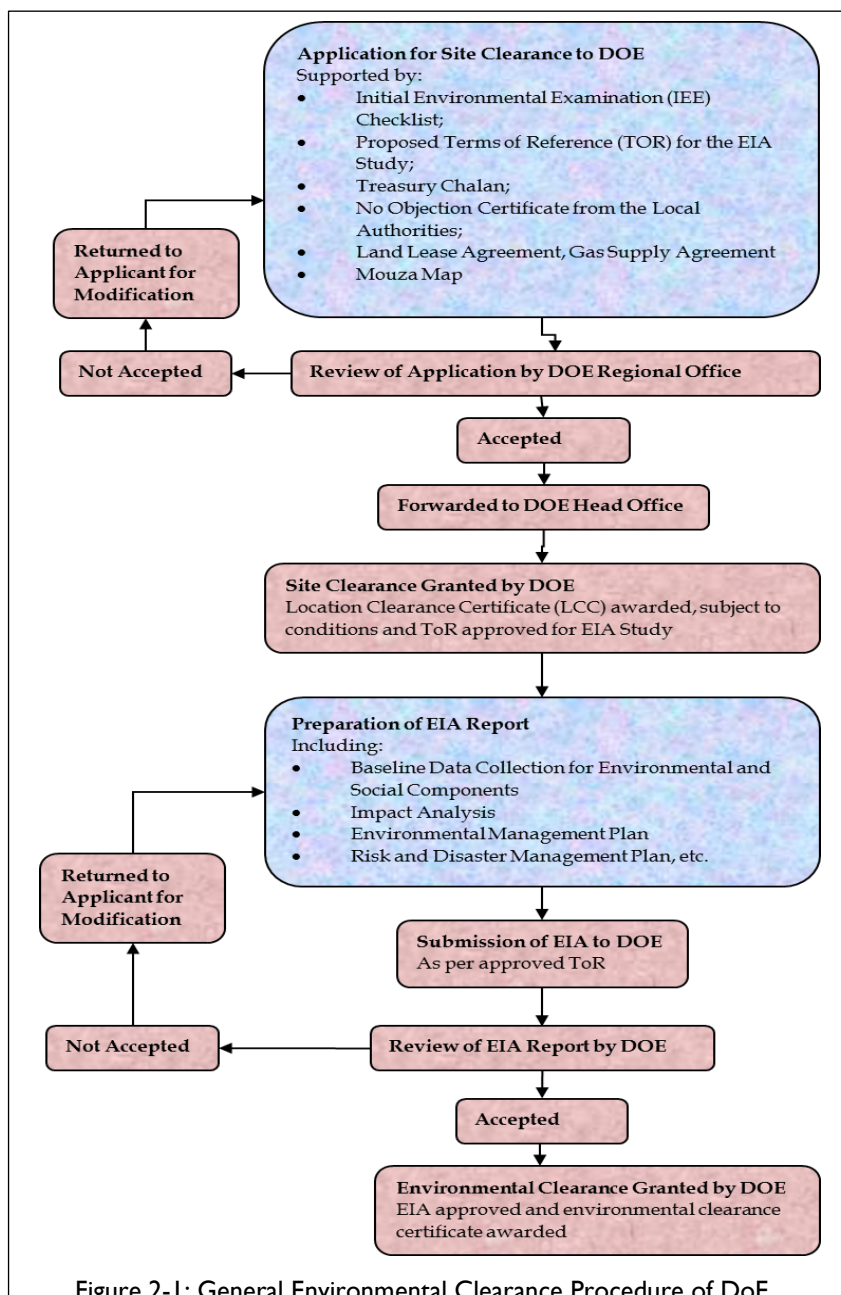


Figure 2-1: General Environmental Clearance Procedure of DoE

As part of the ECC application, a detailed IEE/ EIA with EMP satisfactory to the DoE must be prepared. The project is considered to have some negative environmental impacts. Therefore, the project requires having an EIA report along with EMP which has to be accepted by DoE as part of the LCC & ECC Issuance. Under the ECR 2023, DoE has 30 days to respond after reviewing documents from the receipt of the ECC application for a Red category project. Submission of any further materials would be carried out, as per requirement of DoE toward obtaining the LCC and ECC. Steps to be followed for obtaining the ECC for this SWM project are shown in Figure-2.1. Additionally, Detailed Flow Diagram for ECC for Red Category Projects is shown as below Figure-2.2.

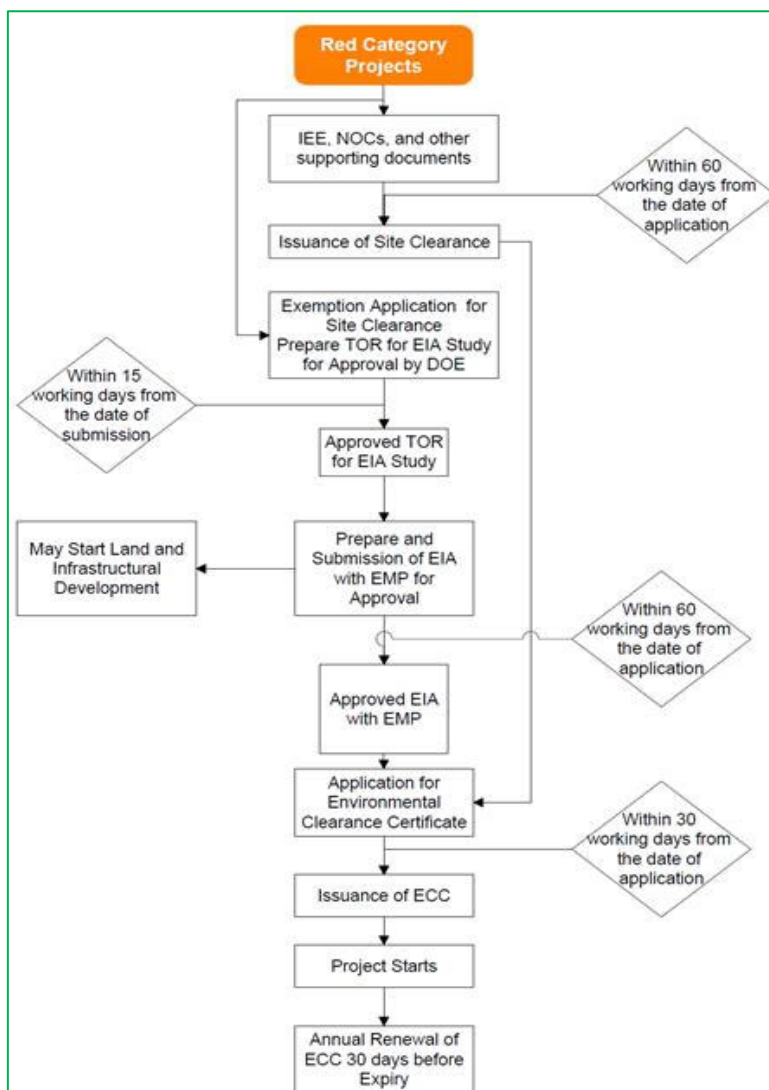


Figure 2-2: Environmental Clearance Procedure for Red Category Subproject

In addition to ECA 1995 and ECR 2023 there are a number of other policies, plans, and strategies, which need to be considered in the project. The detailed description of all these relevant legislations is provided afterward in Section 2.2 of this report.

2.5 Rajshahi City Corporation Subproject Category as per ECR 2023

In the first week of March 2023 the ECR 2023 has been gazette and published for the use of the project works Bangladesh. This Rajshahi City Corporation subproject has Landfill site; Compost Plant (>5MTs); Pyrolysis; Material Recovery Facilities (MRF); Secondary Transfer Station (STS) improvement, Medical Treatment Facility and Refuse-Derived Fuel (RDF) activities. According to the Environmental Conservation Rules (ECR), 2023 of the Department of Environment (DoE), Bangladesh, the subproject will fall under “Red Category” and it on the Red list in ECR’23 (Schedule-I, SI-66 of Red Category: Municipality Landfill Site).

Table 2-2: Categorization of the Sub-project

Subproject Categorization			
Sl. No.	SWM Components	Category (ECR’2023)	Overall Assessment
1	Landfill of Municipality	Red	Red category subproject
2	Compost Plant (>5MTs)	Orange	
3	Pyrolysis	Orange	
4	Material Recovery Facilities (MRF)	-	
5	Secondary Transfer Station (STS) of Municipality	Yellow	
6	Medical Waste Treatment Facility	Orange	

2.6 Applicable Environmental Standards and Guidelines

The following quality standard of compost mentioned in the Table 2.1 should be ensured for safe use of compost.

Table 2-3: Physical Properties of Compost

SL No.	Parameters	Standard
1	Color	Dark brown to black
2	Physical condition	Non-granular form
3	Odor	Absence of foul odor
4	Moisture Content	Maximum 20%
5	Inert materials	Maximum 1%

Table 2-4: Chemical Properties of Compost

SL No.	Parameters	Standard
1	pH	6.0 - 8.5
2	Organic Carbon	10 – 25%
3	Nitrogen, N	0.5 – 4.0%
4	Carbon and Nitrogen ratio (C:N)	Maximum 20:1
5	Phosphorus, P	0.5 – 3.0%
6	Potassium, K	0.5 – 3.0%
7	Sulfur, S	0.1 – 0.5%
8	Zinc, Zn	Maximum 0.1%
9	Copper, Cu	Maximum 0.05%
10	Chromium, Cr	Maximum 50 ppm
11	Cadmium, Cd	Maximum 5 ppm
12	Lead, Pb	Maximum 30 ppm
13	Nickel, Ni	Maximum 30 ppm

Note: Final products of compost will not be used in food grain production if the above-mentioned parameters values exceed the standard values but these products can be used in other crops.

Standard Quality of Treated Leachate

Table 2-5: Discharge Standards for processed solid waste

SL. No	Parameters	Unit	Standard (At source) (Maximum limit except pH)	
			Inland Ground Water	Sewerage drain
1	pH	-	6 - 9	6 - 9
2	BOD ₅ at 20°C	mg/l	30	250
3	COD	mg/l	250	-
4	Suspended Solids (SS)		100	600
5	Total Dissolved Solids (TDS inorganic)	mg/l	2100	2100
6	Ammoniacal Nitrogen	mg/l	50	50
7	Total Kjeldahl Nitrogen	mg/l	100	-
8	Arsenic, As	mg/l	0.2	0.2
9	Mercury, Hg	mg/l	0.01	0.01
10	Lead, Pb	mg/l	0.1	1.0
11	Cadmium, Cd	mg/l	2.0	1.0
12	Total Cr	mg/l	2.0	2.0
13	Copper, Cu	mg/l	3.0	3.0
14	Zinc, Zn	mg/l	5.0	15.0
15	Nickel, Ni	mg/l	3.0	3.0
16	Cyanide, CN	mg/l	0.2	2.0
17	Cl ⁻	mg/l	1000	1000
18	F ⁻	mg/l	2.0	1.5
19	Phenol (also called carboic acid) C ₆ H ₅ OH	mg/l	1.0	5.0

Emission Standard of Solid Waste Incinerator

Table 2-6 Stack Emission Standard from Incineration

SL. No.	Parameters	Average Time	Maximum Presence Limit (mg/Nm ³)
1	Particulate matter	1 hour	30
		24 hours	20
2	Carbon Monoxide	1 hour	100
		24 hours	80
3	Nitrogen Oxide	1 hour	300
		24 hours	250
4	Sulfur Dioxide	1 hour	100
		24 hours	80
5	HCL	1 hour	60
		24 hours	50
6	Mercury	0.5-8 hour	0.05
7	Cadmium and Thallium	0.5-8 hour	0.1
8	Antimony, As, Pb, Cr, Cobalt, Cu, Mn and Nickel	0.5-8 hour	0.5
9	Hydrogen Fluoride	0.5 hour	1.0

SL. No.	Parameters	Average Time	Maximum Presence Limit (mg/Nm ³)
10	Dioxin and Furan	6-8 hours	0.1 ng TEQ/Nm ³

Water Quality Monitoring Standard

Table 2-7 Potable Water Standard of Landfill Ground Water

SL. No.	Parameters	Unit	Standard (Maximum Presence Limit except pH)
1	Arsenic	mg/l	0.05
2	Cadmium	mg/l	0.003
3	Chromium hexavalent	mg/l	0.05
4	Copper	mg/l	1.5
5	Fluoride	mg/l	1.0
6	Lead	mg/l	0.01
7	Mercury	mg/l	0.001
8	Nitrate as NO ₃	mg/l	45.0
9	pH	mg/l	6.5 – 8.5
10	Fe	mg/l	0.3 – 1.0
11	Total Dissolved Solids	mg/l	1000
12	Chloride	mg/l	250
13	Sulfates as SO ₄	mg/l	250
14	Color	Hazen unit	15

Source: Schedule-2 (Kh) of ECR 2023

Ambient Air Quality Monitoring Standards

Table 2-8 Ambient Air Quality Standard Baseline information of the Subproject

Air Pollutants (1)	Standard Value (2)	Average time (3)
Carbon Monoxide (CO)	05 milligram/cubic meter	8 hours
	20 milligram/cubic meter	1 hour
Lead (Pb)	0.25 microgram/cubic meter	Yearly
	0.50 microgram/cubic meter	24 hours
Nitrogen Dioxide (NO ₂)	40 microgram/cubic meter	Yearly
	80 microgram/cubic meter	24 hours
Particulate Matter ₁₀ (PM ₁₀)	50 microgram/cubic meter	Yearly
	150 microgram/cubic meter	24 hours
Particulate Matter _{2.5} (PM _{2.5})	35 microgram/cubic meter	Yearly
	65 microgram/cubic meter	24 hours
Ozone (O ₃)	180 microgram/cubic meter	1 hour
	100 microgram/cubic meter	8 hours
Sulfur Dioxide (SO ₂)	250 microgram/cubic meter	1 hour
	80 microgram/cubic meter	24 hours
Ammonia (NH ₃)	100 microgram/cubic meter	Yearly
	400 microgram/cubic meter	24 hours

Source: Schedule-I of Air Pollution (Control) Rules 2022

2.7 Conventions, Treaties and Protocols

Table 2-9: International Conventions, Treaties and Protocols

International Environmental Agreement	Signed Year & Place	Details	Relevance with the project
United Nations Framework Convention on Climate Change (UNFCCC)	4-14 June 1992 (Rio de Janeiro, Brazil & New York, United States)	Parties to take precautionary measures to anticipate prevent or minimize the causes of climate change and mitigate its adverse effects.	The project is subject to the impact of climate change. Engineering designs of the subproject consider climate change impacts, such as flooding and temperature rise.
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	22 March 1989 (Basel, Switzerland)	The treaty was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries (LDCs).	In May 2019 to an amendment of the Basel Convention plastic waste is presumed as hazardous material. Recycling of plastic waste is one of the significant provisions of the project.
Convention on Biological Diversity	5 June 1992 (Rio De Janeiro, Brazil)	The Convention has three main goals: the conservation of biological diversity (or biodiversity); the sustainable use of its components; and the fair and equitable sharing of benefits arising from genetic resources.	The project will have a prominence on protection and conservation of biological diversity for the area rich with biological resources. A Biodiversity Management Plan will be prepared and implemented to comply with the provision.

3. DESCRIPTION OF THE PROJECT

3.1 Background

City corporation solid waste landfills (CSWLFs) receive household waste. MSWLFs can also receive non-hazardous sludge, industrial solid waste, and construction and demolition debris. Modern landfills are well-engineered facilities that are located, designed, operated, and monitored to ensure compliance with government regulations. Solid waste landfills must be designed to protect the environment from contaminants which may be present in the solid waste stream. The landfill siting plan prevents the siting of landfills in environmentally-sensitive areas while on-site environmental monitoring systems monitor for any sign of groundwater contamination and for landfill gas, and provides additional safeguards. In addition, many new landfills collect potentially harmful landfill gas emissions and convert the gas into energy. This chapter provides a comprehensive but brief discussion on all aspects associated with landfill design, construction and operation. Siting, regulations and other important steps that need to happen before design stage are also presented in brief. Information on monitoring and post closure requirements is discussed at the other chapter. It should be noted that discussions provided on landfill design are qualitative as they do not include detailed designs. Readers are encouraged to refer to references included for detailed information on landfill designs.

3.2 Key features of the Subproject

3.2.1 Waste Quantum and Generation rates

There is no data available regarding the total amount of solid waste generated in the city corporation. The data on waste generation has been established from a recent survey conducted by Waste Concern during 2022-2023. The survey provides waste generation rates based on size of population of the cities. The Table 3.1 below provides population size wise domestic waste and total waste generation.

Table 3.1 Population size-wise Waste Generation

Population of ULBs	Domestic Waste Kg/cap/day	Total (including non-domestic) kg/cap/day
50,000- 100,000	0.25	0.36
100,001-200,000	0.26	0.37
200,001-300,000	0.31	0.44
300,001-500,000	0.32	0.45
500,001-10,00,000	0.36	0.51
>1,000,000	0.43	0.6

Source: Waste Concern, 2022

Based on the survey it was found that for a city with a population between 500,000-10,00,000 persons, the solid waste generation rate is estimated at around 0.36 kg/cap/day for domestic waste and 0.51 kg/cap/day for total including non-domestic waste. Accordingly, the waste generation has been estimated for the city corporation for 2021 and projected till 2045. The waste generation of the city corporation projected for the year 2025, 2035 and 2045 is provided in the Figure 3.1.

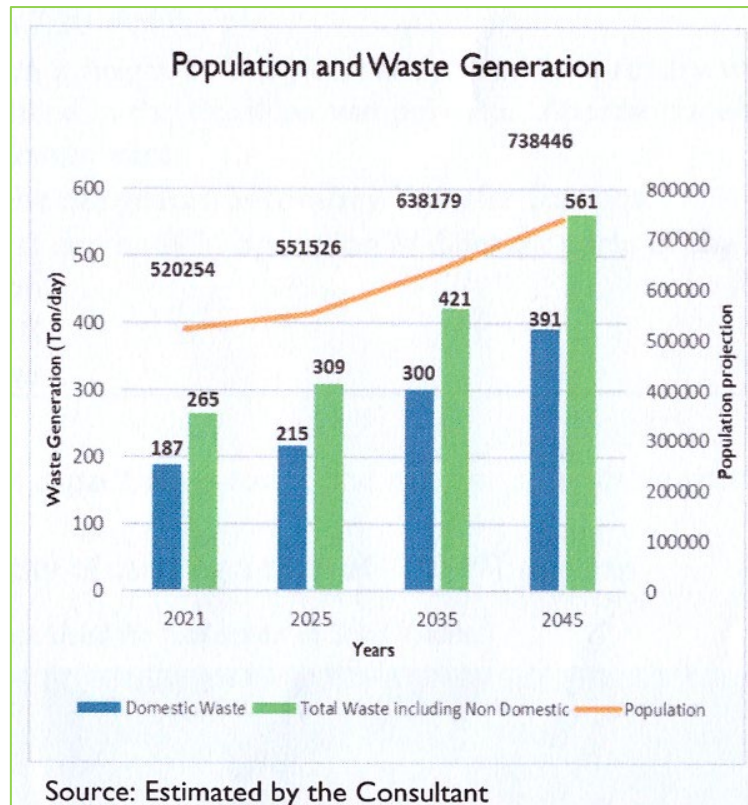


Figure 3.1 Waste Generation Projections for Rajshahi CC

Source: Estimated by the Consultant

Note: Waste generation rate: 0.44kg/person/day with 5% increase in every 5 year has been considered.

3.2.2 Physical Composition of Waste

Waste Concern study (2021) has undertaken physical composition analysis of waste by collecting samples from households, markets, and from trucks arriving at landfill sites. The following figure shows the average physical composition of solid waste for Class A City Corporation; it is representative for Rajshahi City Corporation which is a Class A City Corporation.

It is observed that the organic waste comprises of major portion (83%) of the solid waste, followed by plastics. Other category of recyclables such as paper, textiles and glass, though not in considerable amount also form a part of the overall waste composition. The large quantity of degradable organic contents indicates the necessity for frequent collection and removal. This also indicates the potential of recycling of organic waste for resource recovery, such as composting and waste to energy projects using biological process.

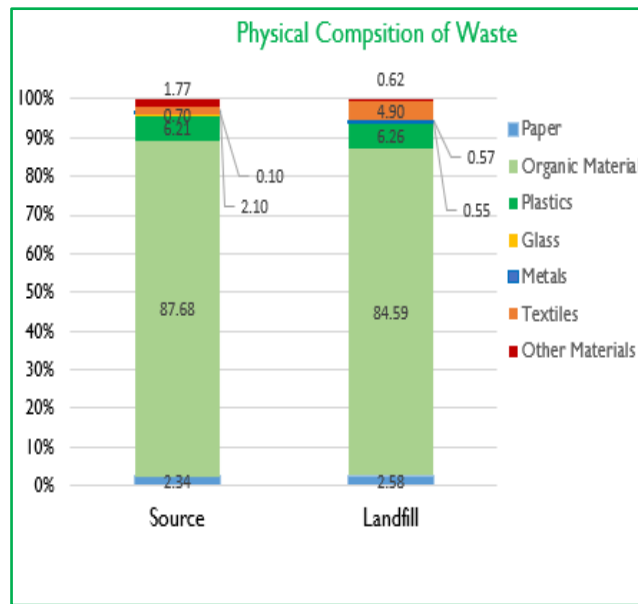


Figure 3.2 Physical Composition of Solid Waste
Source: Waste Concern, 2021

3.2.3 Existing CSW Management System

Primary Collection and Transportation

The city corporation provides primary waste collection services. It is reported that approximately 37,472 households are covered by the house to house waste collection services. The door-to-door collection of waste is almost 91%. However, it is also observed that none of the HHs follow waste segregation. Segregation of recyclable waste is generally not practiced. Most of the recyclable material is disposed of along with domestic and commercial waste. Therefore, recyclable waste is generally found mixed with garbage on the streets, into the municipal bins and at the dumpsites. Majority of the residents dispose their solid waste in vacant space and open drains. This is primarily due to lack of awareness-raising programs by the city corporation or by civil society organizations. Waste from the households is collected with the help of Primary Collection Service Providers (PCSPs) from the NGOs. Waste is collected between 3:30 PM to 7:30 PM. An average 240 tons solid of waste is collected per day by the city corporation. At present, around 270 rickshaw vans are used to collect the garbage from the HHs. The rickshaw vans (length 0.91 m x width 1.06 m x height 0.76 m) can accommodate approximately 160 kg of waste per trip. Approximately 86 tons of waste collection per day through the rickshaw vans per trip.

The

Figure 3.3 below shows the photograph of the Rickshaw Van used for primary collection of waste:



Current Door to Door Van Service for Household Waste Collection

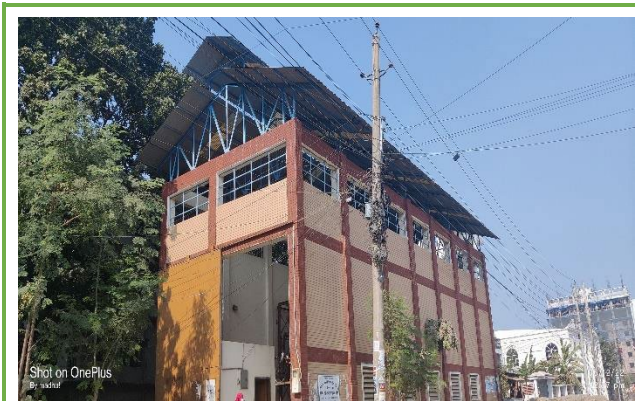
Figure 3.3 Rickshaw Van – Primary Waste Collection

Source: Consultant's Team Site Visits and Field Surveys

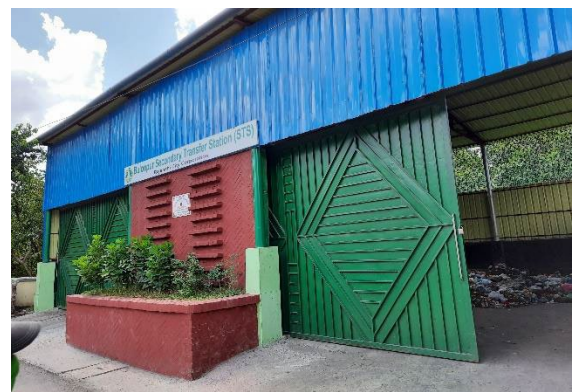
As of population census 2011 (Rajshahi District BBS 2011) the total population of the Rajshahi city is 4,49,756 and 93545 households. At present, there is no waste collection service provided by the city corporation in the slums. Slum-dwellers are currently disposing of their waste in low-lying areas or in natural drainage canals near the slums.

Secondary Collection and Transportation

The current design of the secondary storage area and collection points are not very efficient and are a source of environmental pollution. After collecting wastes from household, van drivers accumulate wastes at transfer stations or open waste collection points. There is only 1 designated Secondary Transfer Station (around 150 sq. feet with roof and walls). Waste sorting system of the authority is inefficient, as it is done manually. This makes it time consuming and not cost effective.



Secondary Transfer Station – Type 1



Secondary Transfer Station – Type 2



Figure 3.4 Example of Secondary Waste Storage for RCC
 Source: Consultant’s Team Site Visits and Field Surveys

The city corporation collects waste from these Secondary Waste Storage facilities through garbage trucks with varying capacities of 5-ton, 3-ton, 2-ton, 1.5-ton. They are 25² in number with average age varies between 20-25 years. Repair cost of the truck amounts to BDT 9,000,000 per year. The maximum waste carrying capacity of current fleet is 2-4 trips per day. This results in total carrying capacity of 240 MT per day. Total fuel consumption per day is found to be 300 liters per day.

As such, solid waste collection efficiency is estimated at 91%. A portion of the waste (9%) remains uncollected and unmanaged and is being indiscriminately disposed in low-lying areas; this results in water logging during the monsoon season. The figure below shows the collection vehicles used for transportation of waste to the landfill site.



Figure 3.5 Vehicles for Secondary Waste Transportation
 Source: Consultant’s Team Site Visits and Field Surveys

The Table 3.2 below provides an overview of the Secondary Collection Vehicles.

² Figure taken from the Questionnaire for Enhanced Institutional Assessment for 9 Phase I ULBs

Table 3.2 Existing Number and Status of Vehicles for Secondary Collection of Waste

Name of vehicles	No. of vehicles	Condition
Garbage Trucks	36	Average 20 of the trucks are more than 16 years old requiring frequent repair.

It is also observed that majority of these vehicles in possession with the Rajshahi City Corporation are more than 16 years old. The team observed that loading and unloading of waste is done manually and municipal workers involved in this activity do not use any Personal Protection Equipment's (PPEs) such as gloves and shoes for their protection.

Waste Processing and Disposal

Currently the solid waste by the city corporation is disposed of at Nawdapara situated in Ward No. 17 and 8 km from the city center. The total site area is 16 acres. The site was acquired as a landfill site in 2017 and all the due processes related to land acquisition complete. Site currently used as a waste disposal facility using crude dumping methods. An estimated 240 tons of waste disposed per day in an uncontrolled manner. The Figure 3.6 below provides a snapshot of the existing landfill site.





Figure 3.6 Existing Landfill Site of Rajshahi City Corporation
Source: Consultant's Team Site Visits and Field Surveys

3.2.4 Street Sweeping and Drain Cleaning

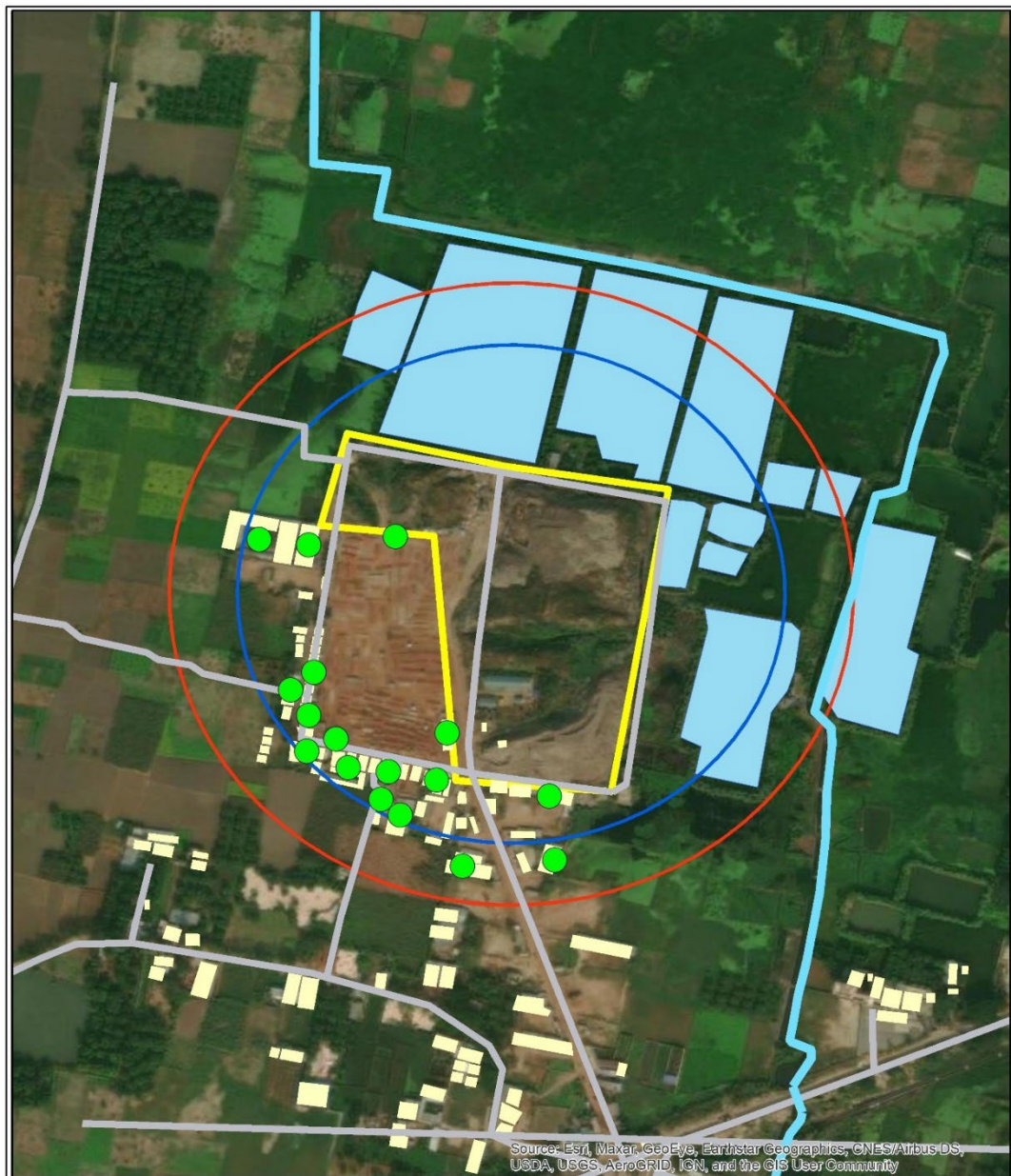
Street sweeping and drain cleaning activities also constitute major responsibilities of the conservancy section of the city corporation. At present, sweepers in the municipalities are employed for about four to six hours starting at 7 am. Each sweeper is assigned a length of road for which he or she is responsible. Street sweepers are hired on daily basis. Road sweeping operation is likely to be manual in the foreseeable

Rajshahi City Corporation Area	Total Length of Road (Km)	285
	Total Length of Drain (Km)	356.18

future and the basic equipment consists of brooms, shovels and handcarts. Drain cleaning constitutes of removing dirt material from the drains and letting the dug-up materials (mostly made up of grit, sand, and decayed organic material) dry on the roadsides, before collecting it for disposal.

3.3 Subproject Location

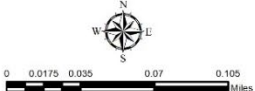
The subproject mainly located at the Landfill Site of the Rajshahi City Corporation which is in Ward no 17. Geographically it is located 24.3635886° northing and 88.6241351° easting. Below Satellite image depicted the location of the Rajshahi subproject. See Figure 3.7 for landfill site map showing the compliance with DOE Rules.



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- | | |
|---------------|------------------------------|
| Landfill Site | Affected Ponds |
| 200m Buffer | Waterway |
| 250m Buffer | Roads |
| Settlements | Temporary Shops /Restaurants |



200m & 250m Buffer Map of Rajshahi Landfill Site

Technical Assistance on Integrated Solid Waste Management Improvement Project Preparation & Design Consultancy Services



Figure 3.7 Landfill Site Map Showing the Compliance with DOE Rules

3.4 Administrative Location

Rajshahi is a Category A City Corporation in the Rajshahi division of northwestern Bangladesh. It is one of the important town in the country and also serves as the headquarters of Rajshahi district. Rajshahi City Corporation consists of 30 wards with an area of 97.18 sq. km. Figure 3.8 shows the administrative map of Rajshahi City Corporation.

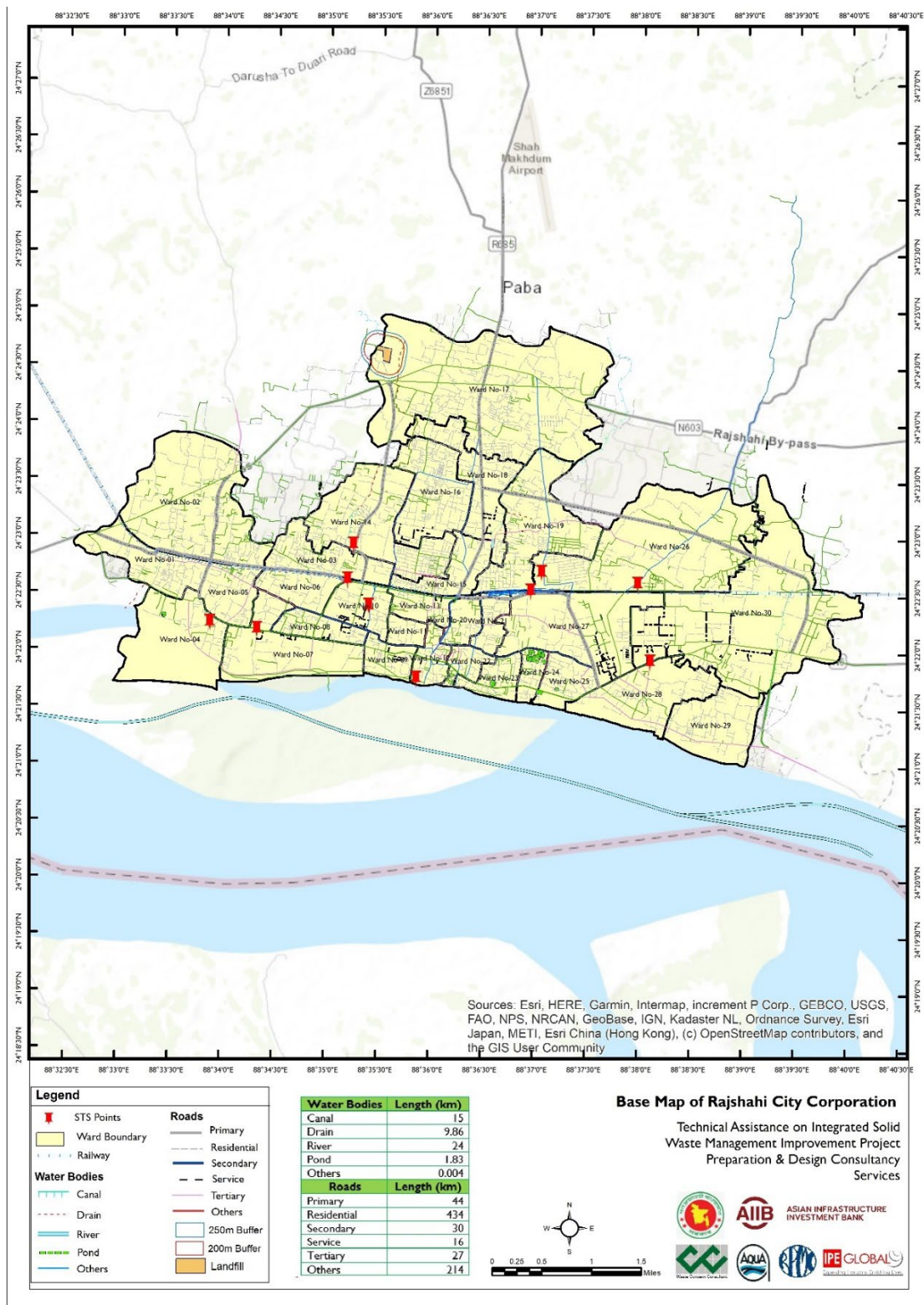


Figure 3.8 Base Map of Rajshahi City Corporation

3.5 Rajshahi City Corporation Subproject Components

To improve the solid waste management system of Rajshahi City Corporation, there is a need to address both the technical elements (source separation, collection, storage, transportation, recycling, resource recovery, and disposal), as well as the governance aspects (institutional, financial, and regulatory). Addressing both set of factors is essential for a sustainable solution as mentioned in the above sections. The following intervention measures are recommended as a way forward.

3.5.1 Improving Collection of Waste

Two types of waste collection services are found in the study area, i.e., primary, and secondary waste collection. It is customary that the primary and secondary waste collection services should be compatible so that maximum efficiency can be achieved during waste collection. Unfortunately, at present the primary and secondary collection systems in Rajshahi City Corporation are incompatible, resulting in multiple handling of waste, low collection efficiency, and environmental problems. The problem of waste collection becomes more acute during monsoon. The following section describes methods to improve the primary and secondary collection of waste.

The following improvements are recommended to improve the primary collection of waste in the city corporation area:

Promoting household level segregation- it is recommended to practice source segregation at household level irrespective of the category of urban areas. The approach involves only segregating waste at the household level in mainly three categories – organic waste (green bin); inorganic recyclable waste (yellow bin) and hazardous waste (red bin). While not a part under this project, it should be promoted by city corporation to improve the overall waste management value chain in the town.

Expansion of the house-to-house waste collection program throughout the entire town including residential, commercial buildings, and the eight slums, for a service charge. Currently, an estimated 37,472 households are covered in the house-to-house waste collection program, whereas the total number of holdings in the town is 57,959.

House-to-house waste collection is not specified in the Local Government Ordinance as a mode of waste collection. However, the Solid Waste Management Rules 2021 has recommended the collection of sources segregated waste from households. The local government ordinance instead stipulates that local government bodies shall establish a waste storage facility (community bins) at convenient locations, where the resident will be responsible for disposing of the waste as his/her responsibility. However, once the waste is disposed of in the community bins, it is the responsibility of the local government bodies to manage it. Since the house-to-house waste collection is an additional service which is preferred by the citizens, it is advisable that the city corporation should engage the private sector/NGOs/CBOs for the collection of waste from different wards; this should be done by enacting a service charge which should be fixed by the city corporation. Currently, households are paying a service charge of BDT 80-100 per month per household. Solid waste collection fees for slums should be lower than the non-slum areas.

The existing design of the rickshaw van used for the primary collection of waste is not viable since it is open and lacks a cover. During monsoon, it becomes extremely difficult to pull the rickshaw vans. Moreover, loading and unloading of waste from the rickshaw vans represents a problem. Therefore, instead of an open rickshaw van, it would be an improvement to use a modified van with six to eight

containers for the collection of waste. The containers can directly discharge the waste into the closed demountable containers for secondary collection of waste.

This type of modified rickshaw van can also be used for the collection of source-separated waste (see photographs below for the design of the van, which minimizes the multiple handling of waste).

<p>Existing waste collection Rickshaw Van without containers</p>	<p>Recommended waste collection Rickshaw Van with containers</p>

Figure 3.9 Existing waste collection van and recommended van with containers
Source: Consultant's Assessment

Recommended improved rickshaw van with containers that can directly discharge waste into covered containers and reduce multiple handling of waste. This type of van collects segregated waste easily. Green containers can be used for organic waste while bags can be used for the collection of recyclables.

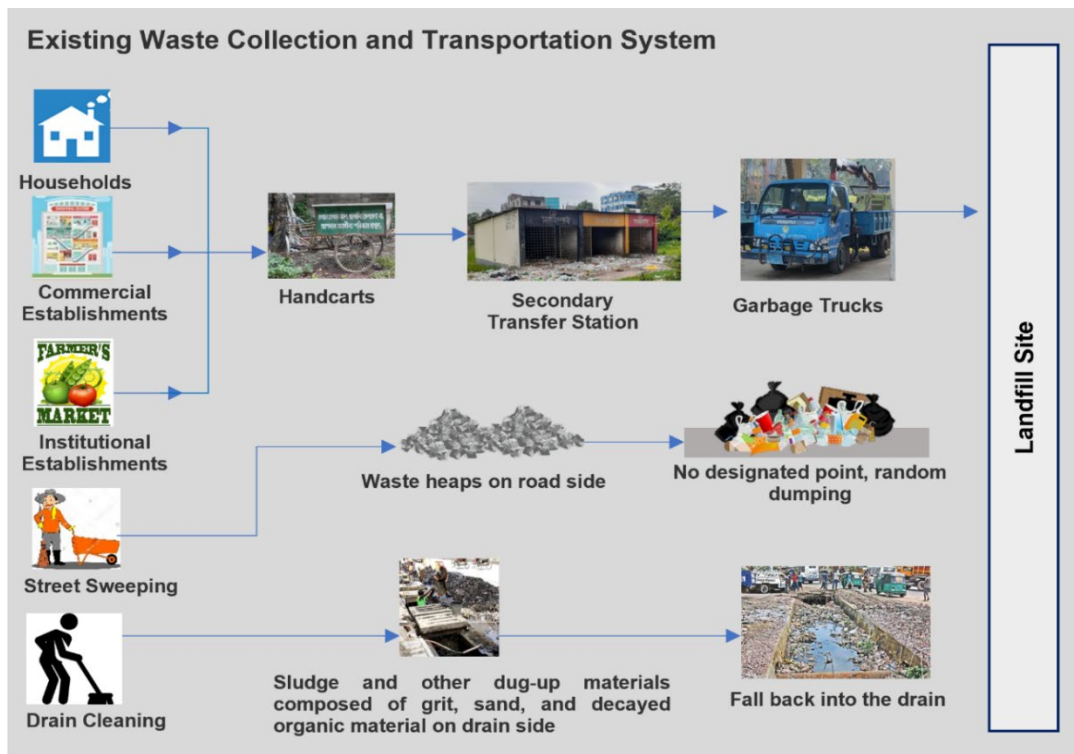


Figure 3.10 Existing Waste Collection and Transportation System in City

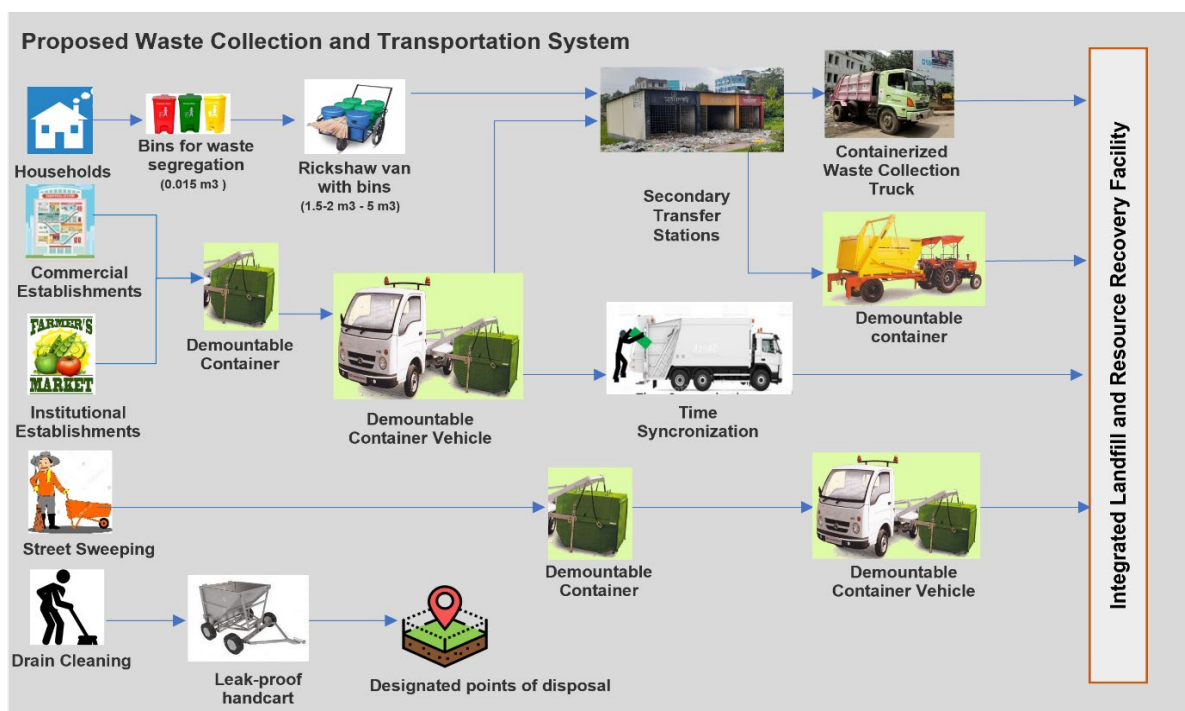


Figure 3.11 Proposed Waste Collection and Transportation System in City

3.5.2 Improving Waste Storage for Secondary Collection of Waste

Currently, the city corporation has no covered waste storage area. The current design of the secondary storage area and the open collection points are not very efficient and are a source of environmental pollution. To improve waste storage for secondary collection, small and medium size demountable containers (1.5-2m³ to 5 m³volume) are recommended for the city corporation. It has also been recommended to initiate house-to-house waste collection services in the city corporation using rickshaw vans with 6-8 containers and some motorized vans for commercial and market areas. The containers can then directly discharge the segregated waste into the closed demountable containers for secondary collection of waste; this will reduce multiple handling of waste. Depending upon the population of the wards, at least one container should be placed in each ward. The containers should be placed on a raised base of 9 to 12 inches to avoid water infiltration inside the containers in the case of waterlogging during the monsoon. Moreover, the containers should not be placed near the drains. The advantages of using a container system are as follows:

- Reduction in number of collection points;
- More efficient in terms of transportation;
- Less manpower is required and hence easy to monitor by conservancy inspectors;
- Reduce GHG emission by reduction of trips;
- Less environmental pollution compared to open concrete bins or open collection points;
- Less loading time for collection of waste and easy to unload;
- Avoid rainwater infiltration inside the storage container and hence less chance of leachate generation;
- Less chance of attracting rodents and flies since the containers are closed.



Figure 3.12 Proposed Containerized Waste Collection and Transportation System
Source: Consultant's Assessment

3.5.3 Improving Waste Transportation

In terms of total waste transportation, labor productivity, and loading time, demountable trucks with closed containers appear extremely efficient compared to open trucks in Bangladeshi conditions (see pictures below). As such, Rajshahi City Corporation should move from an open truck waste collection and transportation system to demountable container trucks. Depending upon the road width, different types of demountable container trucks can be used. Currently, open trucks are being used in the city corporation for the transportation of waste. These trucks usually make 2-4 trips per day. Instead of

using flat-bed open trucks, it is recommended to use small and medium-size demountable container trucks in the city corporation which make between 6-8 trips per day.



Figure 3.13: Proposed Waste Collection Small Truck to Carry Containers



Figure 3.14: Proposed Tractor to Carry Demountable Waste Collection Container

Source: Consultant's Assessment

3.5.4 Improving Disposal of Waste and Resource Recovery

There is one official landfill site having an area of 16 acres in the Rajshahi City Corporation which was acquired by the city corporation in 2017. All the collected waste (amounting to 240 tons per day) is disposed of in an uncontrolled manner using crude dumping methods by the city corporation. To improve the waste disposal system, this site is urgently required to be converted into an Integrated Landfill and Resource Recovery Facility. National Strategy for Water Supply and Sanitation 2014 (updated in 2021) has recommended that by 2030, 50% of the city corporation/municipalities in the country should have Integrated Landfill and Resource Recovery Facilities. These facilities should be based on 3R Principles.

The proposed site will have the following: facilities for controlled landfilling of waste (165 tons per day capacity), a composting plant (100 tons per day capacity), MRF facility (50 tons per day capacity), pyrolysis (10 tons per day capacity) leachate collection and treatment system, boundary wall, weighbridge, office facilities, RCC internal road, and an embankment along with a green belt around the site. The landfill will have a HDPE liner at the base of the landfill site since the groundwater table is high around the landfill site. It is recommended to have clay liners of at least 1m thickness along with HDPE liner. It is also recommended to raise the site up to the nearest road level which is above the flood level. In the design, space has been earmarked for hospital waste management, which may be constructed in the future by the city corporation. The proposed site will divert 45% of the waste for resource recovery. The subproject will be able to recycle and treat solid wastes to the tune of 561 tons/day by the year 2045 in an environmentally friendly manner. The subproject will also remove and cap the existing waste disposed in the landfill site using open dumping method. The existing waste will be disposed and capped in a new cell. Apart from composting and waste recycling the subproject will be able to reduce GHG emission by avoiding landfilling of significant amount of biodegradable and recyclable waste. Allocation of the incoming wastes (421 tons/day in 2035) to landfill site would be as follows:

Table 3.3 Allocation of Incoming Waste to Landfill

Landfill & Resource Recovery Facility	
300 ton/day MSW (in coming in 2035):	a) 165 ton/day to Landfill cell (Landfilling) 55%
In the coming 250 ton/day MSW calculated based on the	b) 75 tons/day to Compost plant (Compost

projected population 2025: 551,526 (with AAGR 1.47%) and waste generation rate: 0.51 kg/person/day with 5% increase in every 5yr; waste collection rate: 80% up to 2025 -2045; recycling rate: 45% up to 2030; 50% from 2031-2035; 2036-2040-60%; and 65% 2041 onward (source: estimated by consultants)	production) 25%
	c) 50 tons/day to MRF (Recyclables) 17%
	d) 10 tons/day for Pyrolysis (Plastic waste to oil) 3%

The primary objective of the proposed landfill with Resource Recovery Facility is as follows: to provide effective control measures to prevent (or reduce as far as possible) negative effects on the environment, in particular the pollution of surface water, groundwater, soil and air, as well as the resulting risks to human health arising from landfilling of waste. The fundamental objective of the proposed facility is to enhance sustainability and promote the 3Rs of waste (reduce, reuse and recycle). The proposed design has considered the diversion and conversion of bulk part of the waste into resources (compost, plastic waste to oil and inorganic waste recycling).

The project by 2025 shall be able to divert 22% of the generated waste for composting, 15% of inorganic waste shall be recycled in the MRF, and 3% for pyrolysis (single use plastic waste to oil). In all 40% will be recycled and 60% will be landfilled in 2025 and this recycling rate shall be increased to 65% by 2045. Using this percentage of waste recycling, the proposed landfill site can be used up to 2045. The total area of the landfill site is 16 acres which are currently used for waste management facility. Figure 3.16 shows the design layout plan of the proposed integrated landfill and resource recovery facility. Table 3.4 shows the distribution of space for different facilities.

Table 3.4 Land use Plan of the Proposed RpCC Landfill Facility

Sl. No.	Land Use	Area (sq.m)
1	Capped Cell for Old Waste	5127.889
2	Cell -1	3929.865
3	Cell -2	3929.865
4	Compost Plant	3961.069
5	MRF	1527.00
6	Office Building	232.062
7	Security Room	36.592
8	Vehicle Washing Ramp	42.377
9	Mechanical, Electrical, Workshop Room	65.583
10	Underground Water-tank & Pump Room	9
11	Biomedical Facility	983.832
12	Motor Room	14.823
13	Leachate Treatment Facility	947.178
14	Generator Room	62.092
15	Pyrolysis Plant	245.128
16	Internal Road	5718.742
17	Plantation	12791.856
18	Green Area	1549.491
19	Biogas Plant	851.939
Total Area		42026.383

Source: Consultant's Assessment

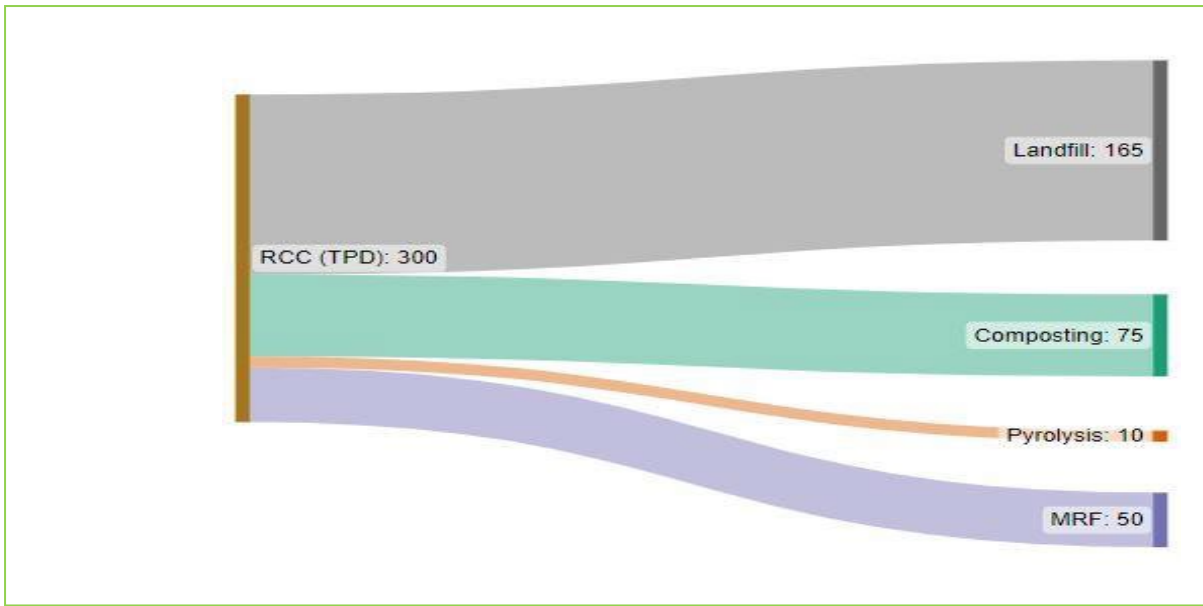


Figure 3.15 Mass Balance of Waste to be Managed in the Proposed Facility

Legacy Waste: It is estimated that currently 187 tons of solid waste is disposed per day in the landfill using open dumping method. A new cell will be made with a HDPE liner at the base of the landfill site since the groundwater table is high around the landfill site. The currently disposed waste shall be disposed in the new cell and capped.

The layout Plan of the facility is provided in the Figure 3.16 below:

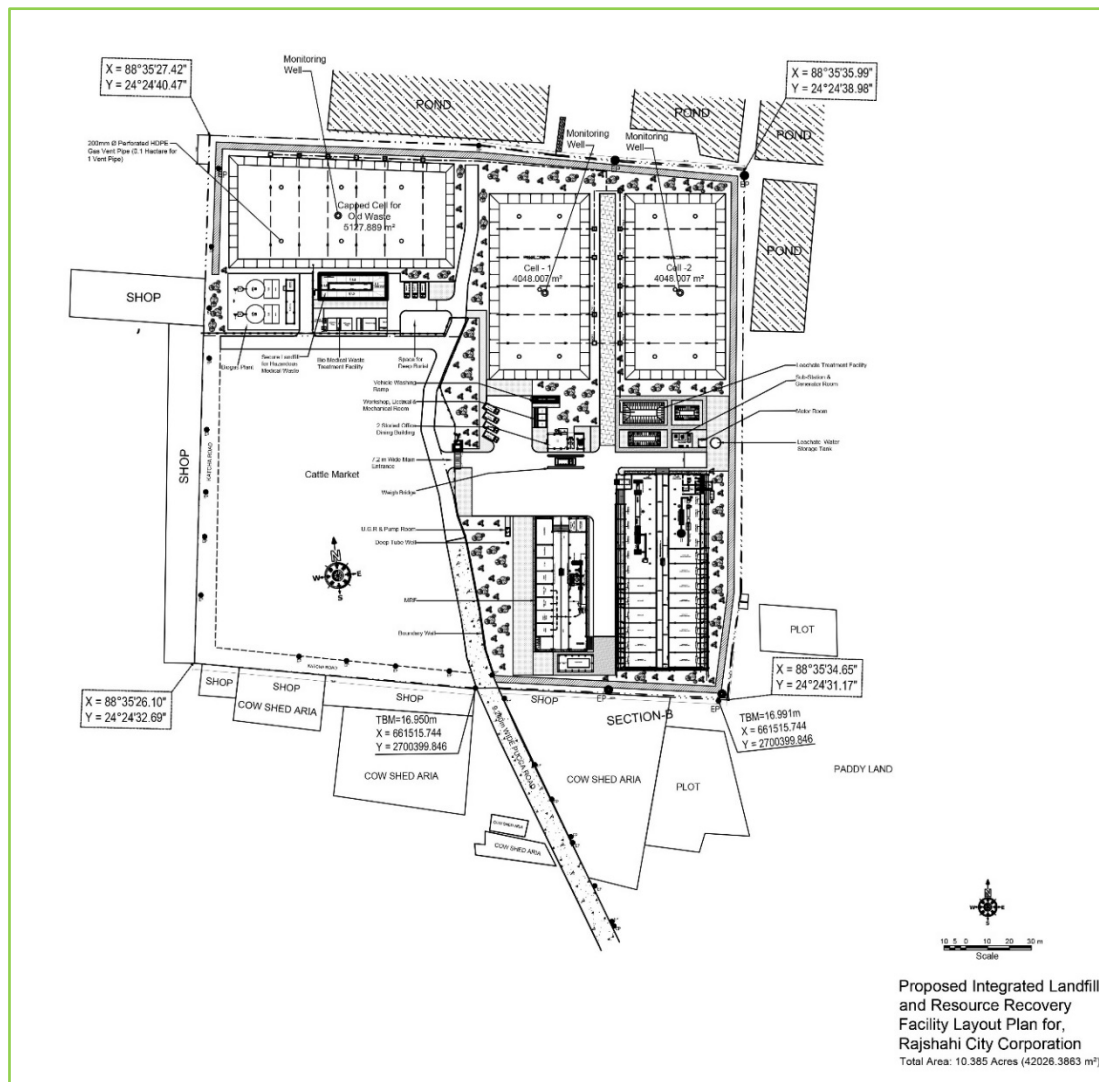


Figure 3.16 Proposed Design Layouts- IL&RRF

3.5.5 Improving Drain Cleaning and Street Sweeping

Apart from the collection and disposal of solid waste, street sweeping and drain cleaning activities constitute major responsibilities of the conservancy section of the city corporation. Street sweeping and drain cleaning are directly related to solid waste management vis-à-vis the disposal of the dirt material removed from the drains. Generally, the common practice in the city corporation is to remove the dug-up materials on the roadsides to dry for several days before collecting them for disposal. (The dug-up materials are mostly composed of grit, sand, and decayed organic material). Though it is easy and convenient to collect and dispose of the dried-up material, this practice has several shortcomings, which include:

- Sludge left on the roadside presents an unpleasant sight to the town;
- Heaps of sludge are obstructions to pedestrians and other traffic;

- Sludge is dispersed by the traffic and parts of it may fall back into the drain nullifying the cleaning effort;
- As the sludge may contain harmful bacteria and other micro-organisms, this practice may lead to the spread of diseases.

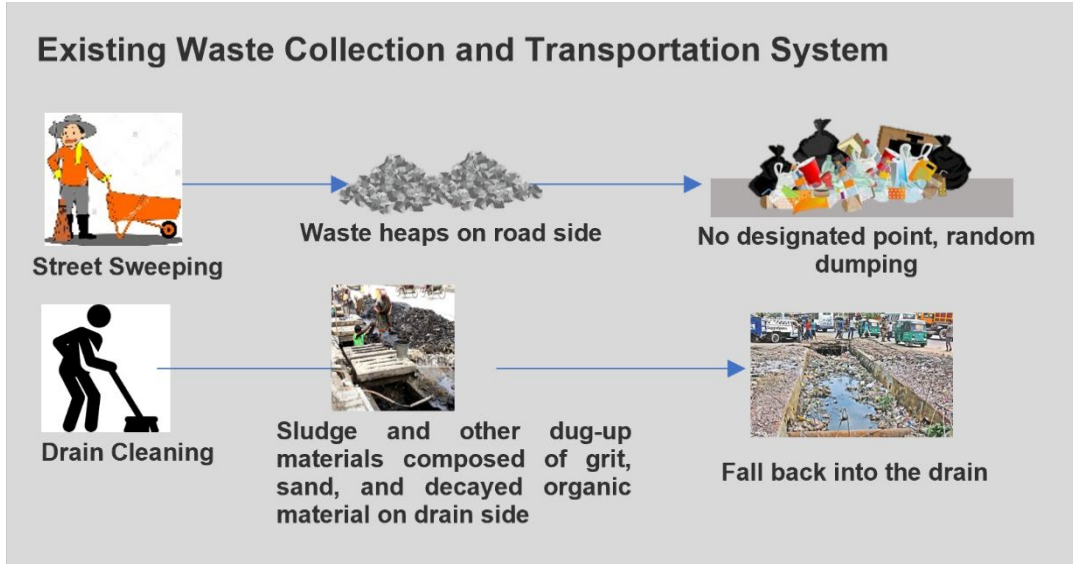


Figure 3.17 Drain Cleaning in Existing Waste Collection and Transporting System



Figure 3.18 Drain Cleaning in Proposed Waste Collection and Transporting System

Legacy Waste: It is estimated that currently, 50,000 tons of solid waste is disposed of in landfill using the open dumping method. A new cell will be made with an HDPE liner at the base of the landfill. The currently disposed waste shall be disposed of in the new cell and capped.

Bio-medical Waste Management Facility: Recently, a local NGO constructed a medical waste management facility on the landfill site. As such, the project proposes no new intervention on medical

waste management. The project proposes shifting of the location from the middle of the landfill site to a corner. Additional facilities such as space for deep burial and hazardous waste disposal have been included. The layout Plan of the facility is provided in the figure below:



Figure 3-19 Proposed Design Layouts- IL&RRF

3.5.6 Improving the Access Roads

The project will improve two existing roads (Muktijoddha Abul Hossain Road and Jugia Kadamtala Road). Total length of the two road is 2.91 km which are connected to the proposed landfill area. The improvement will be limited to resurfacing of the existing track without any widening of the road. No additional land acquisition is required for the road improvement. These roads are also free from any unauthorized occupancy.

3.5.7 Processing and Resource Recovery Facilities

3.5.7.1 Details of Composting Plant

Integrated Landfill & Resource Recovery Facility (IL&RRF)

The proposed IL&RRF site with 10.385 acres of land has several activities introduced to treat waste scientifically. The current waste generation of the municipality is estimated at 265 tons, and it is expected to reach 561 tons per day in 2045. The design of the plant considers the 2045 scenario with 10-15% extra waste considering the extreme events. The proposed facility will have the following facilities: A weighbridge and an office room, three controlled landfill cells (receive 165 tons per day), a composting plant (75 tons per day capacity), an MRF facility (50 tons per day capacity), pyrolysis plant (10 tons per day capacity), leachate collection and treatment system, boundary wall, RCC internal road, and an embankment along with a green belt around the site. The landfill cells have an HDPE liner at the base since the groundwater table is high around the landfill site. A Leachate treatment facility has been provisioned to treat leachate from the landfill cells and subsequently reuse it. No liquid will be discharged from this facility without ensuring the safe treatment of the wastewater. The IL&RRF has the following facilities to manage the incoming waste:

1. Compost Plant
2. Material Recovery Facility
3. Pyrolysis Plant
4. Landfill Cells and
5. Leachate Treatment Facility

After weighing at the weighbridge, all incoming waste will go to the compost plant, material recovery facility (MRF), pyrolysis plant, and subsequently all rejects will go to landfill cells. Leachate water generated from the landfill cells and compost plant will go to the waste water treatment facility, and treated wastewater will be re-circulated in the landfill cells. No wastewater will be released without proper treatment from the landfill facility. Figure 6-5 shows how incoming waste is converted into a resource using composting technology, material recovery facility, and pyrolysis technology. The figure below shows that waste will be segregated into two significant fractions from the sorting platform. Biodegradables will go for the composting process, which is aerobic (static pile with forced aeration). After the entire composting process, an economic output, 'compost,' is produced. A small portion of 'reject' will be generated during the initial sorting from the compost plant, and also during the composting process, these rejects will be disposed of in the landfill cells. Sorted Non-biodegradables, mainly plastic, paper and metals will be taken to the MRF adjacent to the compost plant.

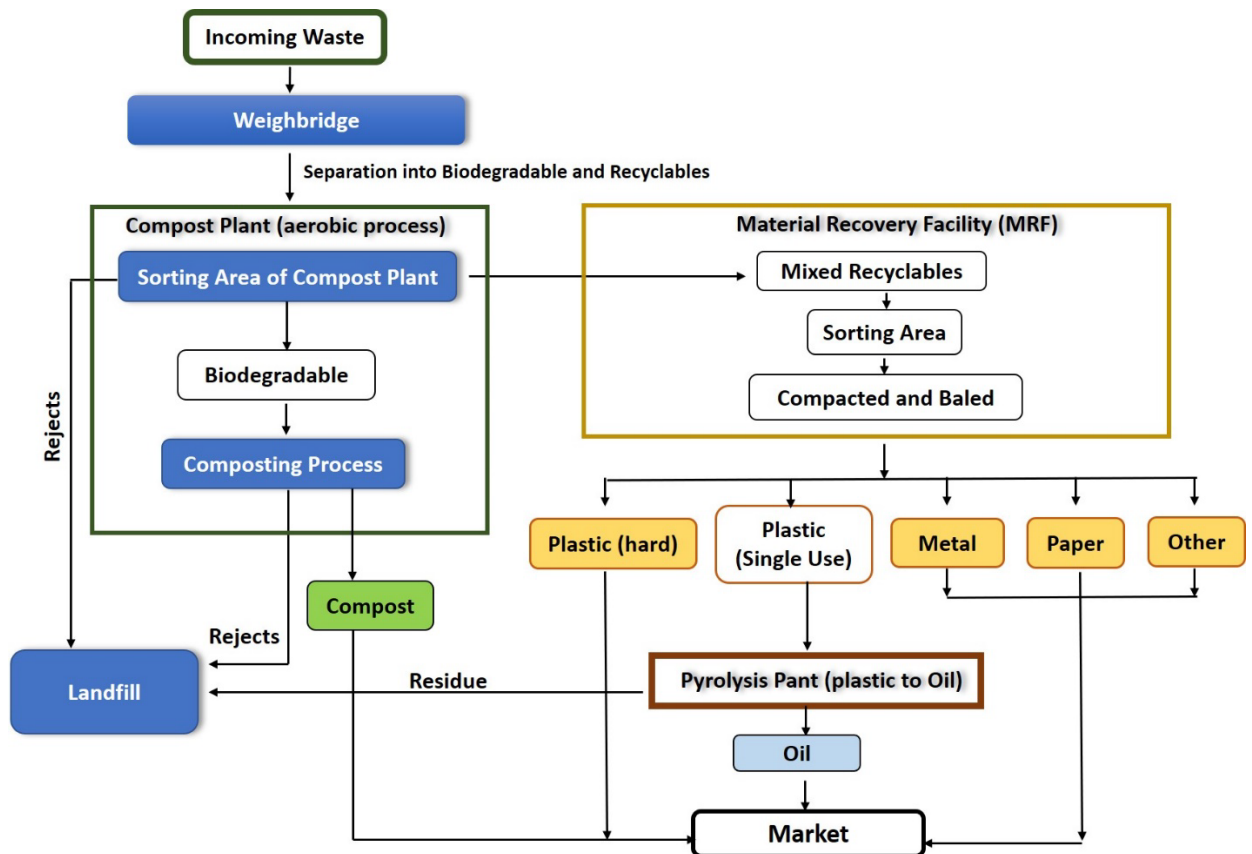


Figure 3.20 Proposed Diagram Showing the major activities (i.e., composting, material recovery facility (MRF), Pyrolysis (Plastic to oil).

In the MRF building, mixed recyclables are sorted using a mechanical conveyor belt and sorting machine. These recyclables will be sorted into Plastic (hard), Plastic (single-use), Metals, Paper, and other fractions. All the recyclable items will be compacted, baled, and stored for the market. From these, Plastic (single use), mainly soiled and with low economic value, will be taken to the pyrolysis machine to convert into oil.

3.5.7.2 Composting Process

From the weighing bridge, incoming waste is taken to the compost plant. The composting process is based on the static pile with a forced aeration system. The composting process will be carried out under a roof with a leachate collection and reuse system. The process will consist of the following steps (see Figure 3-21):

1. Receiving processing
2. Pre-composting process;
3. Intermediate process (1st screening step);
4. Maturing process; and
5. Final Screening (2nd screening step and storage);

The figure below is shown a step by step activities carried out during the composting process. The compost plant is expected to process 75 Tons/day of organic waste as an input.

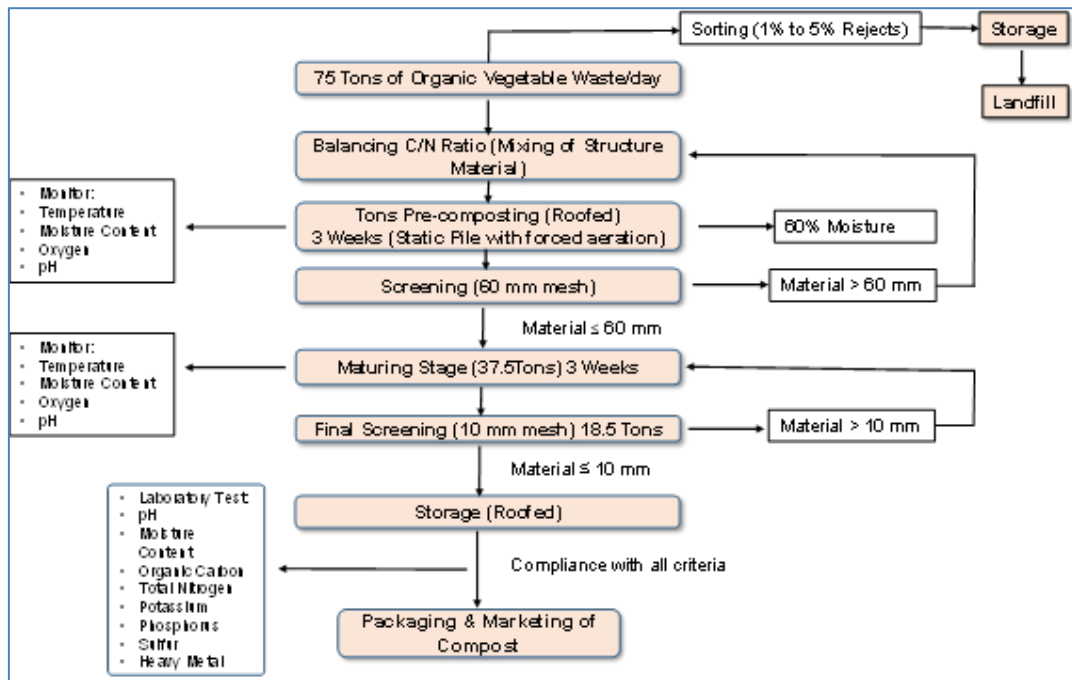


Figure 3.21 Figure showing the material flow analysis of the composting process

3.5.7.3 Receiving process

After entering the facility, incoming municipal waste first goes to the weighing bridge for record keeping. The process starts by un-loading the partially segregated municipal wastes collected from households and vegetable market areas at the reception area of the compost plant, where the wastes will be inspected. After the inspection, the wastes will be mixed with structure material, from where the mixture will be transported to the pre-composting cells.



Incoming waste taken to the weigh bridge for measurement and record keeping of waste.

Proper record keeping and data base for incoming and outgoing items in the facility.

Figure 3.22 Receiving process

3.5.7.4 Un-loading

Vehicles that collect the waste from the local market and households in Rajshahi will unload the waste at the receiving and sorting area of the compost plant. A compost plant operator staff member will guide the vehicles to the reception area where the vehicles will unload their wastes for sorting.



Figure 3.23: Unloading process

3.5.7.5 Sorting

After the vehicles unload their waste, a staff member will inspect the waste to check for inorganic substances. These substances will be removed manually and stored temporarily in a container. After initial sorting, the waste will be sorted mechanically using a trammel. The organic waste after the sorting will be used for composting, while the recyclable items will be taken to the MRF

3.5.7.6 Mixing

Depending on the composition of the fresh organic wastes, the amount of structure material will be determined by the compost plant staff. A loader will mix the fresh organic wastes with the structure material. The structure material is a residue from the 1st screening step. After mixing the fresh organic wastes with the structure material, the composition is ready for the next step in the process.

3.5.7.7 Pre-composting process

Pre-composting will be done in “pre-composting cells.” These cells are designated areas with enough space for 3-4 days daily amount is dumped, inspected, and mixed. There are 6 cells in total that all have a built-in system for forced aeration, which is regulated by butterfly valves. No turning will be required. The pre-composting process will take about 3 weeks. By monitoring the temperature daily, the compost plant operator will regulate the forced aeration system to reach an optimum pre-composting process. Controlling the forced aeration will ensure that pathogens, viruses and bacteria are neutralized according to certifying specifications before proceeding to the next step.

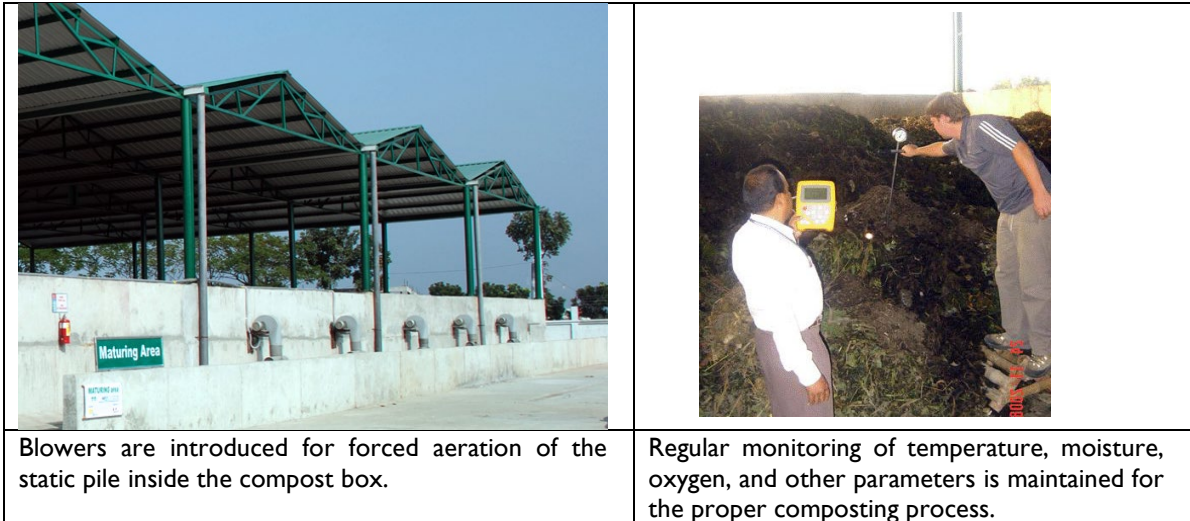


Figure 3.24: Pre composting process

3.5.7.8 Intermediate process

The intermediate process is a 1st screening step. After the 3 weeks of pre-composting, the semi-finished product will be taken out of the cells by a wheel loader. The wheel loader then drives it immediately to a fully automated drum screen. This drum screen will separate the half-fabricate into 2 fractions:

- The fraction 0–60 millimeters that will go to the maturing process;
- The fraction > 60 millimeters that will be used as structure material.

After the screening, both fractions will be processed further in the designated areas.

3.5.7.9 Maturing process

The maturing process is almost the same as the pre-composting process with the forced aeration method. The only differences are:

- The period of the process, which will take about 4-5 weeks;
- Two cells will be used for maturing of waste.
- The material's composition is < 60 millimeters and has no more structure material.



Figure 3.25: Maturing process

3.5.7.10 Final screening

The end-process will be done about 6-7 weeks after the receiving process. The product will be taken out of the windrows and screened again. This time the screening is done in the fractions 0-10 and 10-60 millimeters. The fraction:

- 0-10 millimeters is the end product, which is the compost and will be stored in cells similar to the pre-composting cells. The storage cells, however, don't have any aeration;
- 10-60 millimeters is not ready for marketing or enrichment and will go back to the maturing process, where it will be mixed with screened material from the intermediate process and stay for an additional 4-5 weeks in the maturing area.

After the processes described, we have compost (fraction 0-10 millimeters) ready for marketing or enrichment.

3.5.7.11 Packaging and Marketing

Marketing of compost will be done after laboratory analysis of the product. Analysis of compost will be done as per the Bangladesh Compost Standards. After the quality analysis of the compost product, it will be kept in a storage area for marketing. Compost will be sold in both bulk and packet. The entire composting process is shown in Figure 6-7. A layout plan of the compost plant is shown below.

The marketing of compost from an organic waste recycling facility is vital for the long-term sustainability of the facility. The following section describes key issues linked with marketing of compost.

Compost is a marketable, value-added commodity. Many composting plants have failed to deliver tangible results due to marketing problems. Marketing of compost depends on five key factors:

- (i) Quality of the compost and its compliance with standards;
- (ii) Packaging and branding of the product;
- (iii) Consistent supply of compost during the cropping seasons;
- (iv) Distribution and sales mechanism; and
- (v) Communication and promotion of the product.

Apart from the aforementioned factors, the following external factors are also vital:

- (i) Government issued compost standards and certification;
- (ii) Promotion of integrated plant nutrient systems, demonstration farming, and extension work by the department of agriculture; and
- (iii) Buy-back at fixed price by municipalities or agriculture departments.

Product quality is the most important factor in ensuring customer satisfaction and continued sales. Compost quality can be classified into visible and invisible criteria, as shown in the Table 3.5.

Table 3.5: Visible and Invisible Criteria for Compost

Visible Criteria Assessed by Customers	Invisible Criteria Assessed by Lab Analysis
<ul style="list-style-type: none"> • Color • Smell • Foreign materials (plastic, glass, wires, nails) • Degree of maturing assessed by color, smell, and moisture content 	<ul style="list-style-type: none"> • Nutrient Content (NPK) • Suitability for plants (pH, salt content) • Heavy metal content • Presence of pathogens

Source: Rouse J., Rothenberger S. and Zurbrugg C. 2008. *Marketing Compost: A Guide for Compost Producers in Low and Middle-Income Countries*.

Clearly, visible criteria are easier to control during production than invisible criteria. In order to convince the customer about invisible criteria, governmental product certification through a registration number and results from a government-approved laboratory are important. Since 2008, Bangladesh's Department of Agriculture Extension provided licenses to companies producing compost, as well as approved compost brands. One key criterion for compost registration in Bangladesh is that the compost producer must have an agreement with a government-approved laboratory for batch analysis, and the results have to be sent to the Department of Agriculture Extension prior to marketing. Registration and certification of compost by the government have resulted in increased customer demand for government-certified compost. At present there are 71 private sector organizations involved in production and marketing of compost.

It is also important to market the compost in bags as well as prominently display the product's brand name. In Bangladesh, compost is usually sold in 40-kg bags for farmers, and 5-kg bags are sold in the urban area for horticulture. It is always advantageous to sell compost in bags rather than in bulk. Packaging can be used to promote the company's product, display the logo, and provide production information. At present the market price of compost varies between Tk. 15-40 per kg.

A sales and distribution mechanism has a notable impact on compost marketing. There are three options for marketing compost (Figure 3.26):

- (i) **Direct distribution.** Producer sells directly to customer. This kind of marketing is sustainable for small-scale community-based compost plants.
- (ii) **Semi-direct distribution.** Producer engages sales agent to market the product.
- (iii) **Indirect distribution.** Producer engages a bulk buyer, such as a specialized fertilizer company with retail branches.

Since compost is an agricultural product and compost plants are located in urban areas, away from customers located mostly in rural areas, the direct marketing of compost to rural customers is very difficult. It also increases the price of compost due to transportation and storage costs. Experiences in South Asian countries have shown that when large-scale compost plants employ a direct sales approach to market the product, it inevitably fails. Farmers prefer to deal with specialized fertilizer companies with local retail branches that offer them credit instead of having them pay cash. Farmers then pay back the fertilizer companies after harvesting their crop. Box 6.1 highlights the advantages of awareness raising for IPNS,

Engaging fertilizer companies to market the compost through this form of indirect distribution has the following advantages:

- (i) Fertilizer companies already have their existing networks and distribution channels up to the village level.
- (ii) Fertilizer companies have their own storage facility.
- (iii) They have their own transportation facility.
- (iv) Compost is sold in the retail shop with chemical fertilizer.
- (v) Through their retail shops, fertilizer companies provide credit facility and undertake promotional work.

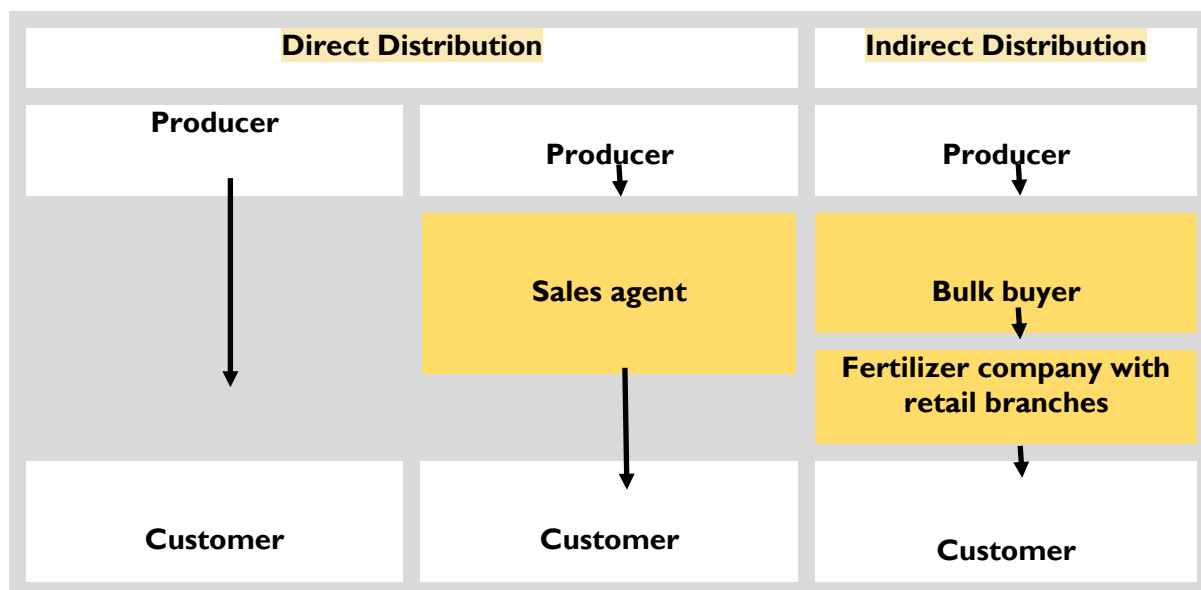


Figure 3.26: Compost Sales and Distribution Models

Source: Rouse J., Rothenberger S. and Zurbrugg C. 2008. *Marketing Compost: A Guide for Compost Producers in Low and Middle-Income Countries*.

Box I: Integrated Plant Nutrient Systems: The Way Forward for Promoting Compost

The most important aspect in marketing is communicating the right message. Compost is not an alternative to chemical fertilizers. Rather, when compost is used in conjunction with chemical fertilizers, it provides a higher yield (at least 25%–30% in the case of rice and vegetables in Bangladesh). The use of compost also results in 30% reduction in the use of chemical fertilizer. The requirement for irrigation is also reduced by 35%, since compost has high moisture-holding capacity while simultaneously acting as a medium for climate change adaptation by improving the quality of soil and increasing the soil’s organic matter content. In Bangladesh, the government is officially promoting the use of both chemical fertilizers and compost as part of their Integrated Plant Nutrient System (IPNS), to improve quality of soil and crop production. A similar approach is followed in Sri Lanka. In India, the Ministry of Agriculture requires fertilizer companies to implement a basket approach or co-marketing of both chemical and compost to farmers. The promotion of IPNS needs a large quantity of quality and certified compost.



Laboratory analysis of compost will be carried out as per the Bangladesh Compost Standards



Compost is bagged and ready for marketing

Figure 3.27: Quality Control and Bagging of Compost

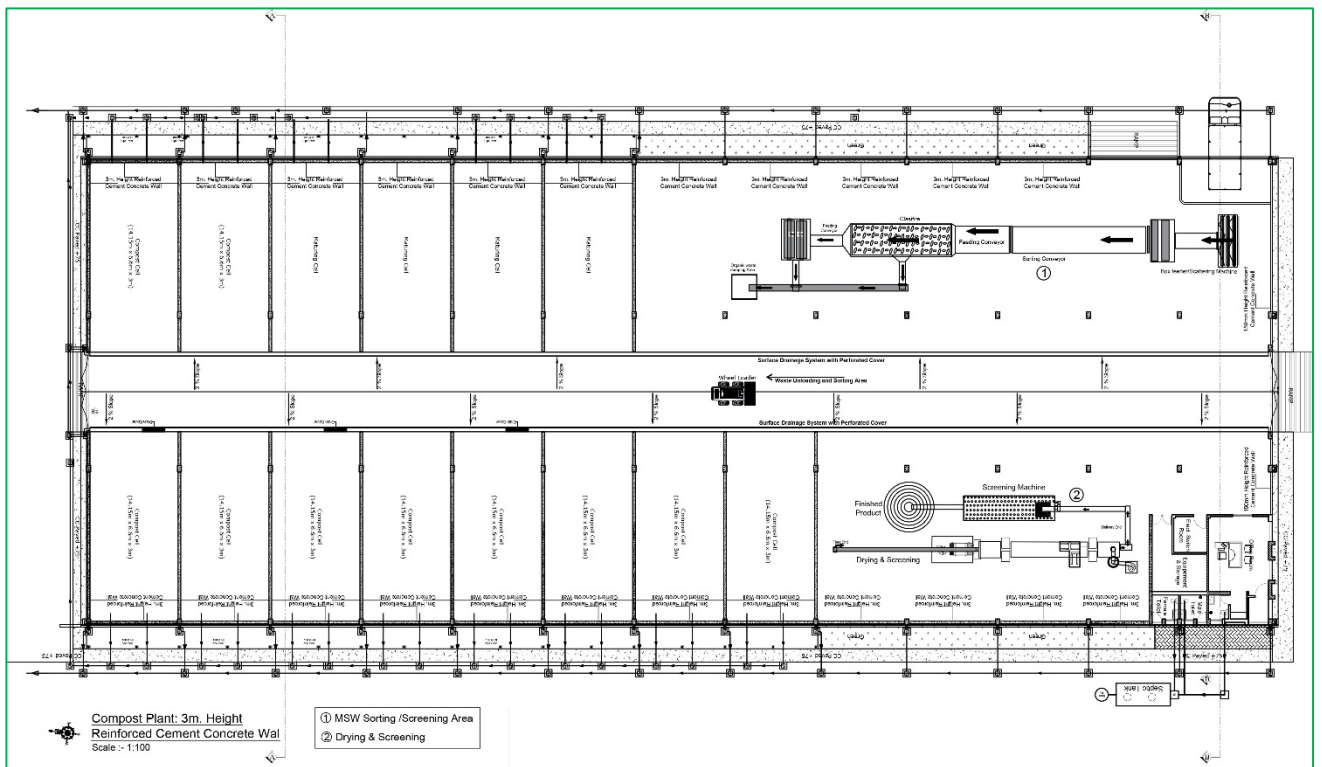


Figure 3.28: Typical layout plan of the compost plant

3.5.8 Material Recovery Facility (MRF) and Pyrolysis Plant:

This is a mechanical-type material recovery facility where a manager's office room with a toilet is provided. Workers (male and female) have separate changing rooms, and toilets are provided in the facility. In the year 2025, 250 tons of municipal waste are expected to arrive at this facility on a daily basis. Out of this total of 250 tons/day of incoming waste, 35 tons/day of recyclables (paper, plastics, carton storage, metals, and residuals) will be stored in designated compartments of this facility. The unloading and sorting area of incoming waste is kept well-ventilated by introducing exhaust fans and ventilation fans. 15 (fifteen) meter wide column-to-column space provided to allow easy access for incoming trucks in the sorting area. Recyclables with economic value will be sold in the recycling market. Space has been allocated for the baling area, where baling, shredding, and compacting of the inorganic waste will take place. Space for the storage of baled recyclables is also provided in the facility. Enough ventilation and lighting (natural from the transparent fiberglass roof and lights) are provided in the design to keep the area well-lighted for a better working environment. A corrugated GI sheet with 0.6 mm thickness is used as a roofing material. All the single-use plastic amounting 7.5 tons per day shall be used in the pyrolysis plant to produce diesel.

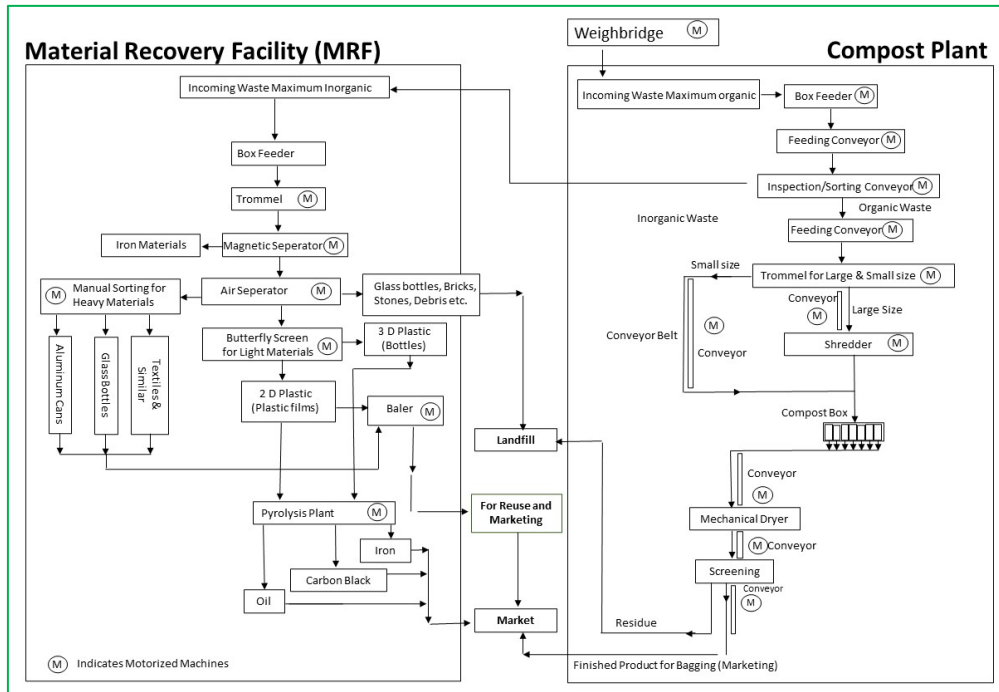
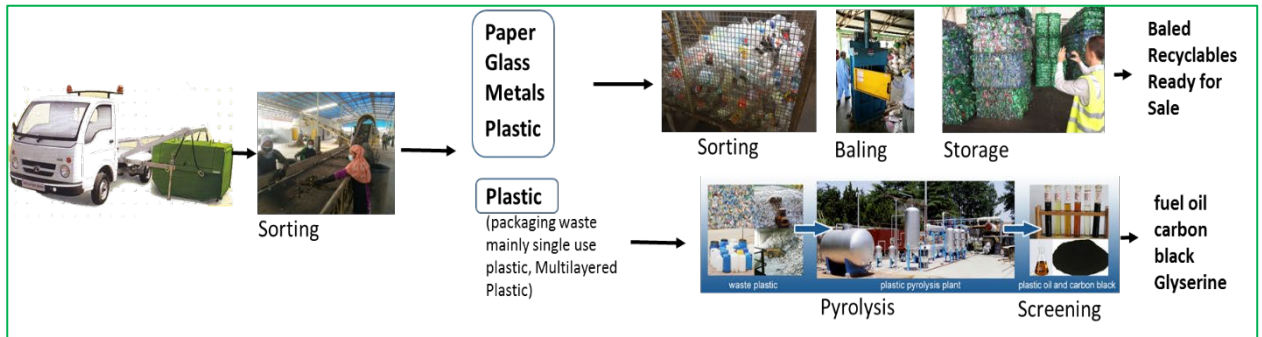


Figure 3.29: Flow diagram of Material Recovery Facilities

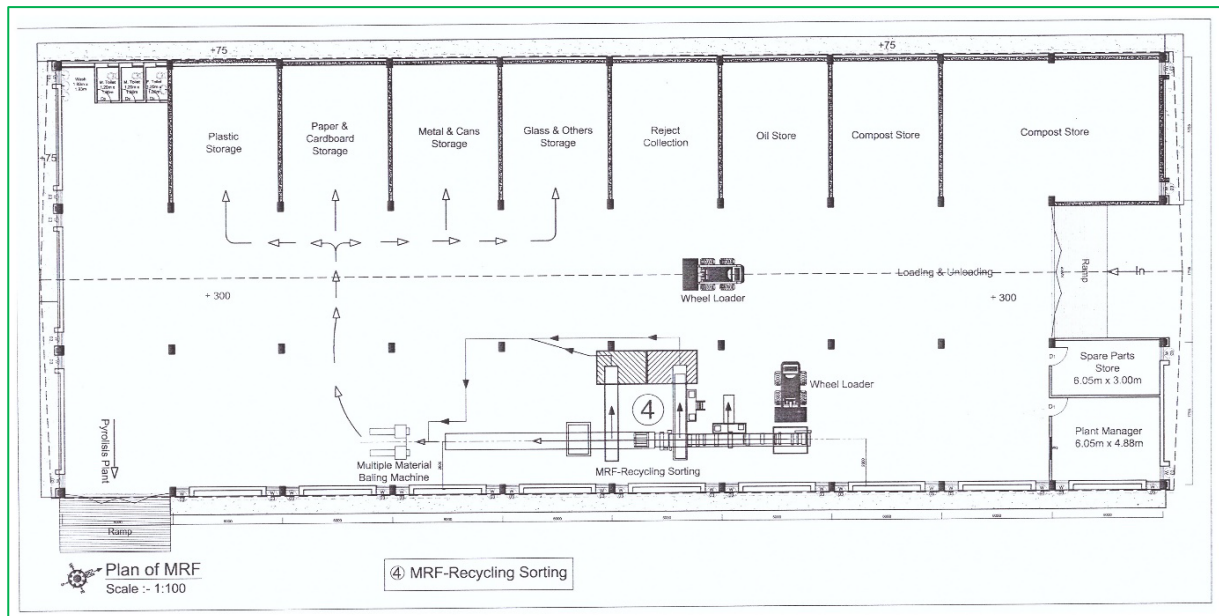


Figure 3.30: Layout Plan of the MRF

3.5.9 Landfill

3.5.9.1 Design Considerations

As regards the design consideration for the Proposed Landfill with a Resource Recovery Facility, the consultant has taken into account the following considerations:

Landfill. The landfill will be designed to provide safe waste disposal with minimal effect on the environmental components such as soil, groundwater, surface water, air, and people. The cells will maximize waste disposal quantity within the available space of the selected site. The key design considerations include the following:

Expected waste input: The current and projected amount of waste to be collected and disposed of in the landfill cells must be known. These will determine the size of the cells and the eventual lifespan of the facility that will be constructed in the selected site.

Target landfill life: Disposal facilities are usually planned for a 20-year period, with the individual cells lasting for 5 to 7 years.

Geology: The foundation for the landfill should have sufficient bearing capacity. A geotechnical survey has been conducted on the proposed landfill site. It was found from the geotechnical survey that the soil up to 19.5 meter depth is clayey silt with medium plasticity. The bearing capacity of the soil was found to be between 0.67 to 1.47 tsf.

Hydrogeology: The proximity of the groundwater to the surface affects the extent of excavation needed to generate the space for the landfill cells. As a rule, the base of the cell should be min. 2 m above the water table.

Hydrology: Surface water draining towards the landfill area could potentially increase leachate and bring about local flooding during major rain events. The design will incorporate peripheral drainage systems, diverting water from the landfill cells.

Availability of cover materials: Landfill cover will be sourced from the excavation to be made for the cells and related facilities.

Ground conditions and prevention of seepage: The ground where the landfill will be developed must be impermeable (rock without cracks or clay of min 1 m thickness to avoid leachate seeping uncontrolled into the ground and thus polluting the groundwater. If these conditions are not met, a liner must be established. SWM Rules 2021 has recommended an HDPE liner of 1.5mm or clay liner of 90 cm thickness with a permeability coefficient of 1×10^{-9} /sec.

It is recommended to use a 1.5 mm HDPE liner for the landfills. The liner must have a foundation of stable soil without any large stones. This can be achieved by compacting and leveling local soil and trimming out large rocks and stones (over 25 mm). Then a leveling layer of sand or fine gravel (0-8 mm) of min. 100 mm is added. The liner must be adequately anchored on all sides according to the manufacturer's requirements.

On top of the HDPE liner, there should be a layer of filter fabrics for protection when exposed to sunshine and weather. Usually, a drainage layer should be added on top of the filter fabrics. This may be of min. 300 mm thickness and the material must be without large stones (more than 20 mm) but can be any locally available soil with high permeability (sand, river gravel, etc.). In the drainage layer, slotted collection pipes for leachate collection should be installed at an internal distance of 20-30 m.

Leachate treatment: Leachate quantities must be minimized through strict and planned separation of clean rain surface water and polluted seepage. The treatment has the best effect on concentrated leachate. In general, Leachate has unpredictable properties compared to other waste water types, which calls for specialized design and planning. Leachate is challenging to treat adequately; many plants worldwide have problems achieving satisfactory treatment results.

Several treatment methods are available, from advanced and expensive membrane technologies to simple biological treatment. From practical experience under similar conditions, low-tech biological methods like aeration and subsequent sedimentation are suitable under local conditions.

3.5.9.2 Recommended treatment option

The treatment plant will be designed for leachate from the initial cell with 5-7 years of operation, and the input will be average rainfall in average max. Month over the last 10 years. This is because the landfill will represent a substantial retention volume, distributing the water volumes from rain over time. Observations from other landfills indicate that the retention will even flow to approx. a month's average. The following design criteria are used for the treatment of leachate:

- The water volume will be equal to the average maximum rainfall per month multiplied by the landfill cell area;
- **Aeration Pond:** The retention time in the Aeration Pond will be 1 day at the maximum flow, and it will be equipped with aerators. The depth of this pond is 2 m;
- **Facultative Pond:** The retention time in the Facultative Pond will be 4-5 days in maximum flow. The depth of this pond is 2.5 m;
- **Polishing Pond:** The retention time in the polishing pond with plants will be 1 day in maximum flow. The depth of this pond 0.8;
- The ponds have a 2 mm HDPE liner at the bottom;

Gas control: The accumulation and migration of landfill gas must be controlled. The most effective manner of managing landfill gas is to collect, treat and utilize it.

Environmental nuisances: Special consideration will be taken to minimize and control nuisances arising from the landfill's construction, operation, closure and aftercare phases. Nuisances that may occur from landfilling include: noise, odors, dust, litter, birds, vermin, and fires. However, the

protection measures suggested to control the nuisances arising from the SWM facility (i.e., noise, odors, dust, litter, birds, vermin, and fires, etc.) are as follows:

- Recover, collect, and dispose of municipal solid wastes properly at the designated landfill site;
- Handle the non-biodegradable and biodegradable municipal wastes separately at the SWM facility as quickly as possible
- Prohibit unwanted littering and unorganized discharge of wastes at the site of the SWM facility;
- Municipal solid waste is either adequately managed in a collection pit or disposed of in a municipal collection system.
- Dispose of municipal solid wastes immediately and avoid stocking for a more extended period to prevent potential nuisance and complaints;
- Haul all wastes using transport equipment such as dump trucks with proper cover (e.g., tarpaulin) to avoid accidental release along the route to the disposal site; and
- Utilize haulers that are authorized to handle and transport these kinds of wastes;
- The unloading and sorting area of incoming waste is kept well-ventilated by the introduction of exhaust fans and ventilation fans.

3.5.9.3 Landfill Layout

A landfill site will comprise of the area in which the waste will be filled as well as an additional area for support facilities. Within the area to be filled, work may proceed in phases, with only a part of the area under active operation. The following facilities must be located in the layout:

- (a) Access roads;
- (b) Equipment shelters;
- (c) Weighing scales;
- (d) Office space;
- (e) Compost plant;
- (f) Material resource recovery facility;
- (g) Waste to oil facility;
- (h) Boundary of the landfill areas and areas for stockpiling cover material and liner material;
- (i) Drainage facilities;
- (k) Leachate treatment facilities; and
- (l) Location of monitoring wells.

3.5.10 Proposed Design of Landfill & Resource Recovery Facility

3.5.10.1 Planned Infrastructure Investments to be Developed and the Design Horizon

Site plan with a design period of 20 years; the project components/facilities were planned up to the year 2045. Investment works to be implemented under the project comprise the following:

- Construction of 1 (one) controlled landfill cell out of a total of 2 (two) cells;
- Construction of 1 (one) capped cell for management of existing waste;
- Construction of 1 (one) compost plant;
- Construction of mechanical-type material recovery facility (MRF);
- Construction of biogas plant for cow manure;
- Installation of pyrolysis plant for recycling single-use plastic waste;
- Construction of leachate collection, treatment, and reuse system;
- Construction of office, workshop, electrical, and security buildings at the landfill site;
- Construction of the access road to the landfill site to be above flood levels;

- Construction of internal road and rainwater drainage system along with peripheral embankments;
- Construction of fencing and entrance gate;
- Construction of car washing facility;
- Provision of operations & maintenance equipments

The site plan showing the overall design of the proposed Integrated Landfill with Resource Recovery Facilities is shown in Figure 3-31.

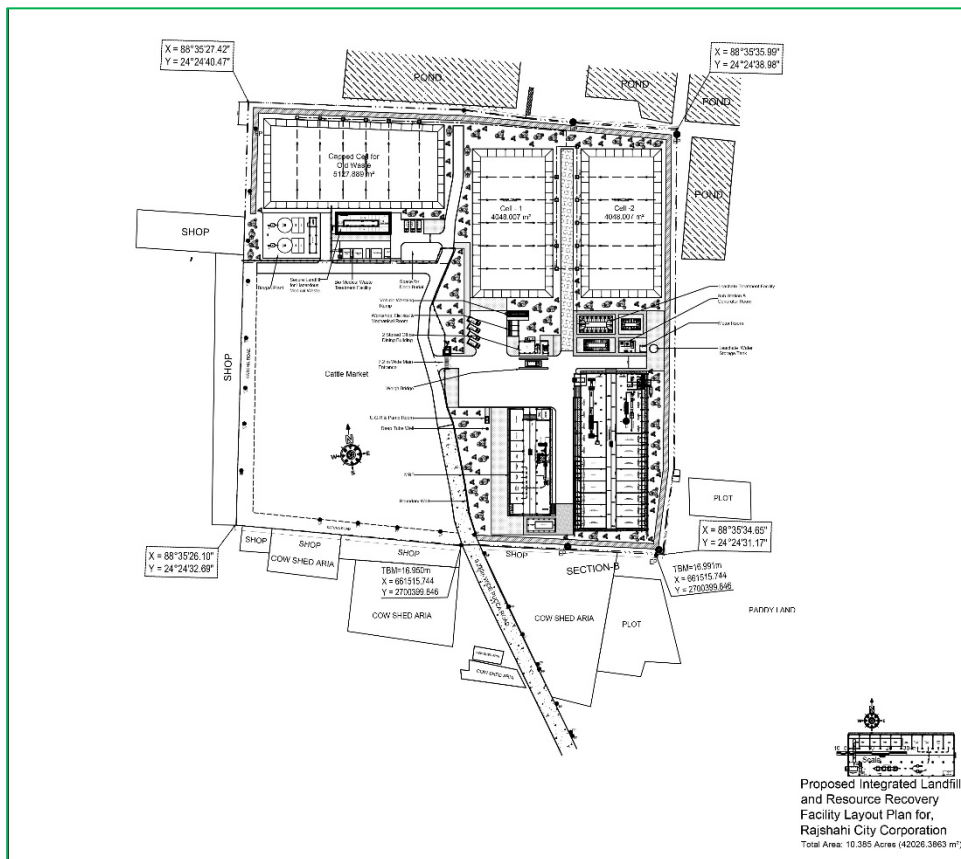


Figure 3.31: Layout plan for the proposed Integrated Landfill with Resource Recovery Facility

3.5.10.2 Incorporating Climate Resilience Measures in the Detailed Design

This project supports climate resilience by introducing the following measures:

- The finished ground level of all the construction is considered to be above the flood level;
- The plinth level of all construction is kept above flood level;
- Embankments around the landfill have been considered;
- All sidewalls and roofs are specially designed to withstand high wind velocity and storm up to 260 km/hr;
- Concrete roads are introduced to avoid waste penetration in the ground and to avoid attracting rodents and other pests to the facility;
- Concrete block roads are used along with landfill cells. Leachate collection and treatment ponds can take additional wastewater in case of extreme events.

- The highest rainfall amount in the last 10 years has been considered in the design of leachate collection and the rainwater discharge system;
- The landfill site shall have HDPE lining and clay layer to avoid percolation of leachate water into the groundwater;
- To save the landfill area, around 17% of the inorganic waste shall be recycled;
- Staff and worker restrooms with bathing and toilet facilities are provided to provide comfort to the workers during extreme weather;
- The landfill site shall have boundary walls;
- Staff and worker restrooms with bathing and toilet facilities are provided to provide comfort to the workers during extreme weather; and
- The landfill site shall have boundary walls, drainage facilities, and a drinking water facility.

3.5.10.3 Mass Balance of the Incoming Waste

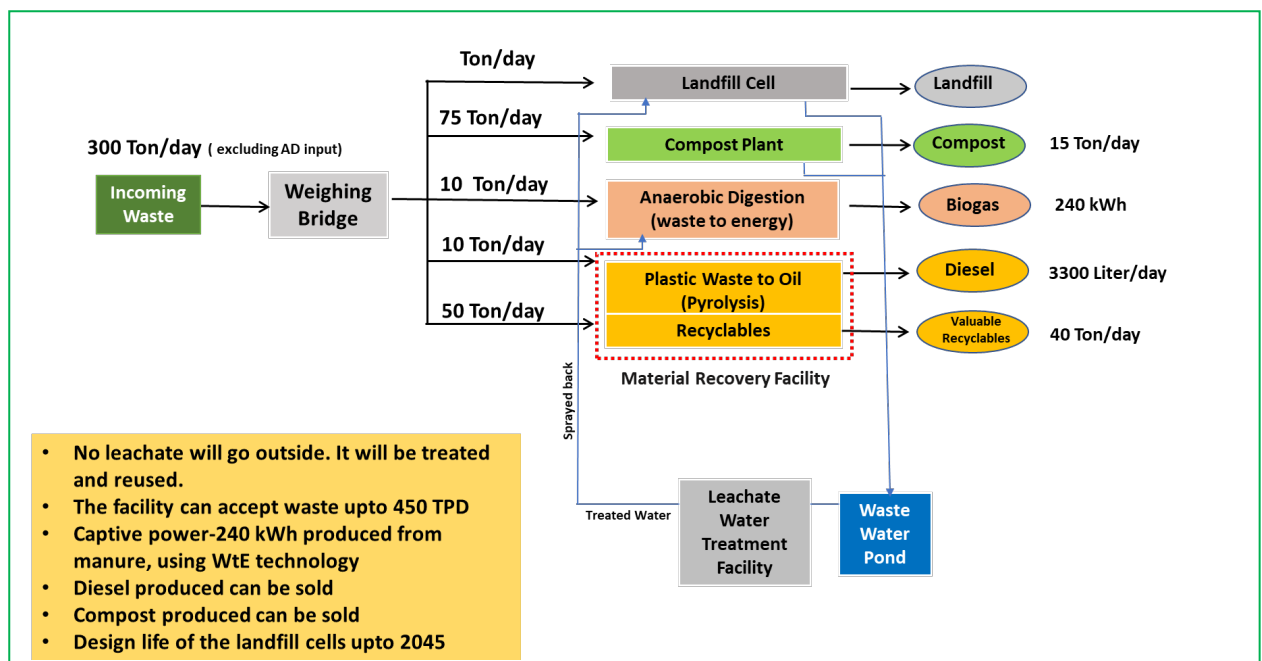


Figure 3.32 Mass Balance of the Proposed Integrated Landfill with Resource Recovery Facility (ILRRF)

The facility will accept 300 tons/day of solid waste per day, out of which 165 tons will go into the controlled landfill, 75 tons will go into the compost plant, 60 tons will go into the MRF. From the MRF, 10 tons of single-use plastic will go into the pyrolysis unit for conversion into diesel. Cow manure generated in the cattle market shall be used in the anaerobic digestion plant. The following section describes the details of each unit of the facility.

3.5.10.4 Landfill Cell Volumes and Phasing

The proposed landfill project is developed with due consideration of the local site conditions. The design is based on a topographic and geotechnical survey conducted in 2023. With a net average landfill height of 15 m, Cell-1 and capped cell are included in the bid will have to cover an area of approximately 0.5 ha, which has been the design basis. The controlled landfill will have three (2) cells. Each cell can be used for 4-5 years period. After 10 years, cell number 1 can be reused, and old waste can be used as cover material. Apart from cell numbers 1 to 2, cell number 3 will be used after 12-15 years.

The construction work of these landfill cells has a layer of compacted clay (MDD 95% hydraulic conductivity $1 \times 10^{-9} \text{ s}$), having a 2.0 m thickness at the base layer from the ground level. On the top of this compacted clay layer, an impermeable HDPE liner (1.5 mm thickness) and a protective layer of non-woven geo-textile (1.5 mm) have been introduced. A 400 mm thick drainage layer with sand and gravel (20 mm size) has been introduced on the top of this layer. Every day, the waste will be placed in the Cell with a 1- meter depth, which will be covered with a daily cover (with 150 cm thickness). A final cover (with a thickness of 300 cm) will be introduced on the top of the pile with cover vegetation with 150 mm topsoil. These cells have a slope of 1:3 ratios with a height of up to 10 meters after full completion. Within this drainage layer, leachate collection and transportation pipes are introduced in 20-meter intervals. These pipes are 200 mm \varnothing and 350 mm \varnothing HDPE collection and transport pipes, respectively. These pipes have slots/ perforation (25 mm \varnothing) to allow leachate to be collected and transported to the proposed leachate treatment facility. These cells will have daily cover, gas vent pipes, and final cover for environmentally friendly operation.

Landfill cells are planned to be constructed in stages. During the initial stage, Cell-1 will be constructed, and the life of this landfill Cell-1 is expected to be 4-5 years. During this initial stage, all the facilities and structures required for the uninterrupted operation of the proposed landfill project will be completed. These facilities are as follows, main entrance, security. Subsequently, Cell-2 will be constructed in the future for the disposal of waste. All these cells are connected to the leachate water treatment facility using HDPE pipes.

3.5.10.5 Groundwater Levels and Preventive Measures

As per the geotechnical survey report prepared in 2023, the groundwater table at the landfill site was found to be at 3m. In order to prevent any accidental seepage of leachate to the groundwater, a 0.6 m compacted clay (permeability of $1 \times 10^{-9} \text{ m/sec}$) liner has been provided in the detailed design. On top of the clay liner, a 1.5 mm HDPE liner is also provided. A Clay liner, along with a 1.5 mm HDPE liner, will secure protection against seepage of leachate into the groundwater. The HDPE liners will be appropriately anchored at all sides according to the manufacturer's requirements and the design.

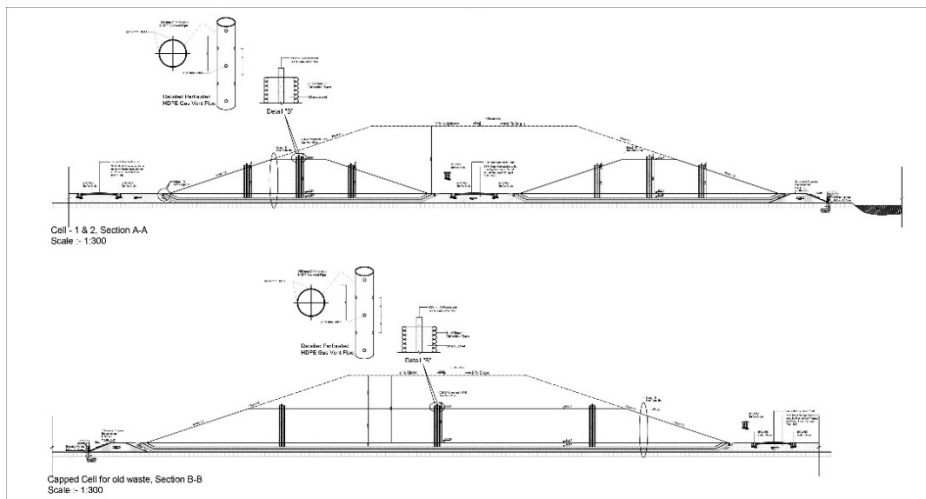


Figure 3.33 Typical section of landfill cell shows the slope, leachate collection system and landfill gas vent pipes etc.

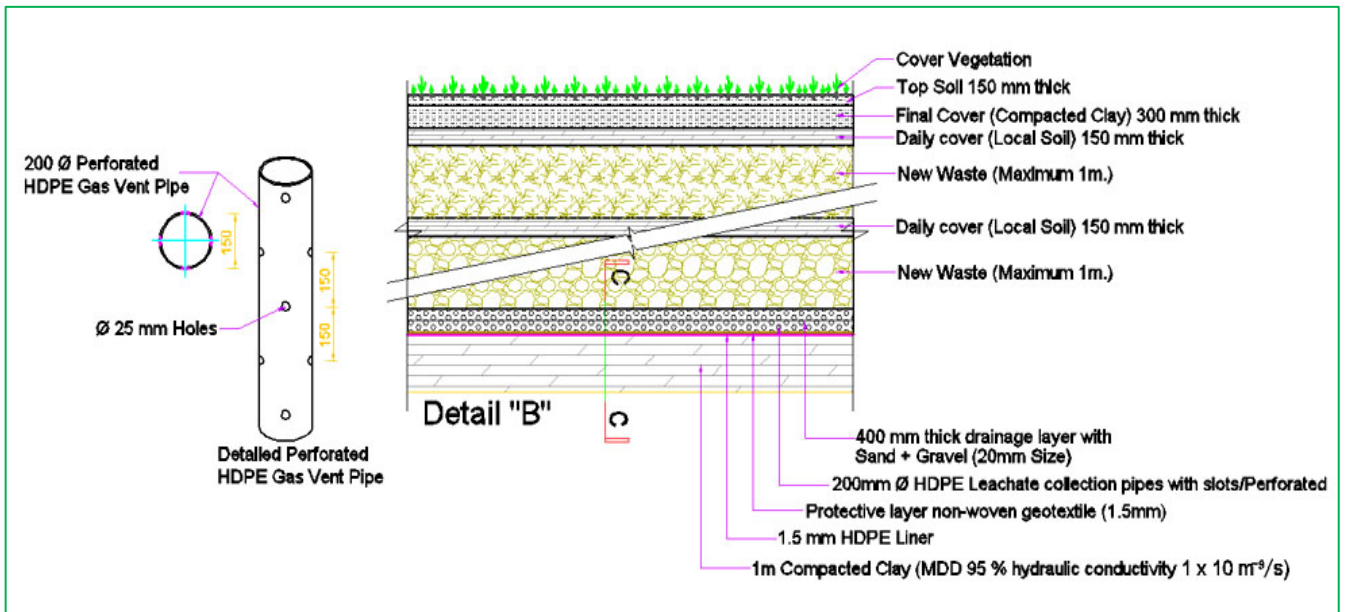


Figure 3.34 Typical Cross-Section of Landfill Cell Showing Leachate Water Drainage and Landfill Gas Vent Pipe System



Figure 3.35 1.5 mm thick HDPE Liner on top of the Clay Layer shall be used to manage leachate

3.5.10.6 Leachate Collection, Treatment & Recirculation

In addition to the impermeable bottom layer, a drainage layer has been designed on top of the impermeable layer. This is done to collect leachate and avoid water stagnation in the landfill. The drainage layer has a thickness of 400mm, which consists of sand and gravel (20 mm size). Leachate collection and transport pipes have been installed in the drainage layer to bring the leachate to the treatment plant. A 200 mm dia perforated HDPE pipe has been used for the collection of leachates from the landfill cells. Leachate collection pipes are placed 20 m apart. Leachate transport pipes are also HDPE having 350 mm dia. HDPE pipes and fittings shall conform to the standards as ISO 4427 or EN 12201, SDR 17/PN 10 with PE 100 material. The material for the drainage must be well-graded and must have good drainage properties. The sand/gravel material for the drainage layer shall have a coefficient of permeability of at least 10^{-3} m/s.

To reduce leachate generation, control measures have been considered that will minimize the quantities of precipitation, surface water, and groundwater entering landfilled waste. These control measures include soil cover and an impermeable material placed at the base. Leachate has been considered by the inclusion of a proper drainage system for the collection and in-facility treatment of leachate before recirculation in the cells. Based on the review of the following: relevant studies, the annual rainfall amount of the town, and the topography of the landfill site, a very simple treatment option has been utilized. The option uses ponds that consist of an aeration pond, followed by a facultative pond, and lastly, a wetland pond. A treated leachate water storage pond has been designed for the storage and reuse of the treated leachate. It is expected that between cubic meters/day of leachate will be generated during the period from June to October. The following design criteria are used for the treatment of leachate:

- The water volume will be equal to the average maximum rainfall per month multiplied by the landfill cell area;
- **Aeration Pond:** The retention time in the Aeration Pond will be 1 day at the maximum flow, and it will be equipped with aerators. The depth of this pond is 2 m;
- **Facultative Pond:** The retention time in the Facultative Pond will be 4-5 days in maximum flow. The depth of this pond is 2.5 m;
- **Polishing Pond:** The retention time in the polishing pond with plants will be 1 day in maximum flow. The depth of this pond 0.8;
- The ponds have a 2 mm HDPE liner at the bottom;
- Based on the rainfall data and area of the cell, the following parameters have been used:
 - Average maximum monthly rainfall: 301 mm
 - Evaporation in wet months: 31 mm
 - Net volume of rain per month: 270 mm
 - Area of cell-1: 4000 sq.m
 - Average maximum daily rainwater infiltration volume 34.83 cu.m/day say 35 cu.m during peak

Leachate Water Recirculation: Treated leachate water from the waste treatment plant (lined polishing pond) will be conveyed to the treated water pond using a 160 mm dia PVC pipe. From the treated water pond, the treated leachate water will be pumped using a centrifugal pump and pressure uPVC pipe network of 50 mm dia with gate valve and detachable hose pipe attached at the outlet for spraying into cell number 1 during the dry season. Pressure uPVC pipe used for leachate water recirculation shall have the following specification: wall thickness of pressure uPVC pipe shall be 2.7 mm for 25mm & 3.40 mm for 50mm dia., class E, 15 bar (15.30 kg/cm², PN16). The pipes shall conform to ASTM/BS/ISO/IS standards. A 350 sq.m treated storage tank has been designed with a 1 m depth, which will be used for the recirculation of treated leachate into the cells.

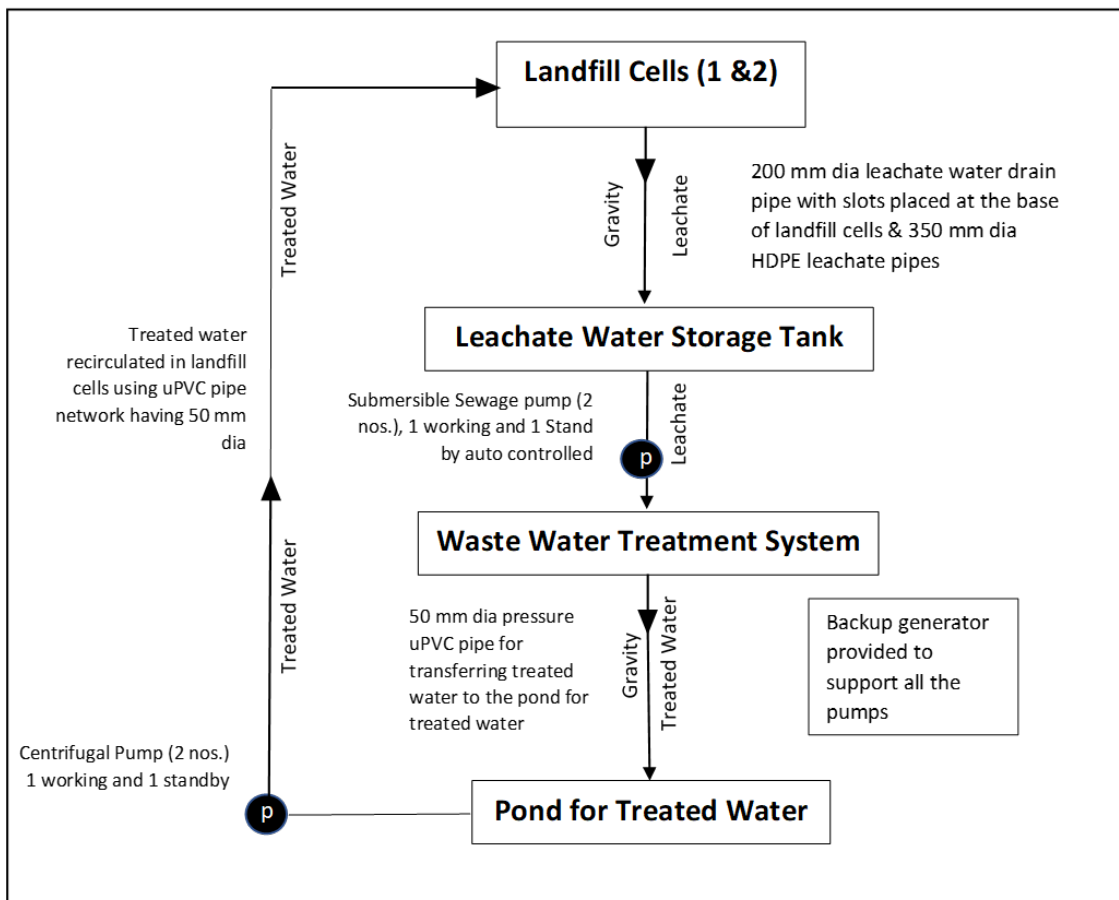


Figure 3.36 Flow diagram Showing How Leachate Water is Treated and Recirculated

3.5.10.7 Landfill Gas Control

There is no plan to flare or recover the gas. The gas ventilation has been designed as follows: (1) during site preparation, the landfill side slopes are lined with impermeable clay to curtail lateral migration of the gases and then lined with coarse rock or gravel to allow gases to escape to the atmosphere; and (2) rock-filled, wire mesh wrapped, vertical wells of about 1 m diameter are created during landfill (about one well for every 0.1 hectares). 200 mm dia perforated HDPE gas vent pipes are placed between the spacing of 30 meters apart.

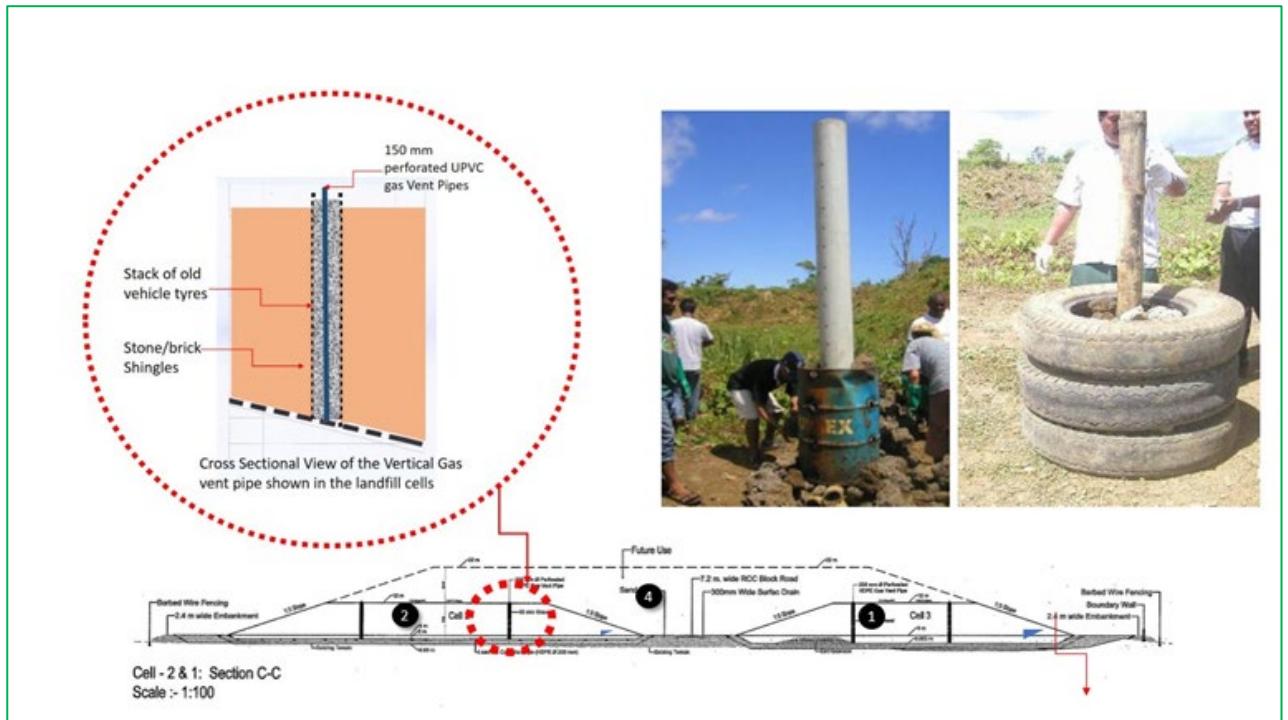


Figure 3.37 Typical Section Showing 200 mm Dia Perforated HDPE Vertical Gas Vent Pipe Introduced for Venting Landfill Gas from the Landfill Cells

3.5.10.8 Landfill Closure

As each phase is completed and as the final cover level is reached in successive phases, the following interconnectivity will be established:

- a. The leachate collection system of each phase will be sequentially connected (if so designed)
- b. The surface water drainage system at the cover of each phase will be sequentially connected (if so designed)
- c. The temporary surface water drainage system is dismantled at the base of each completed phase.
- d. The gas collection system (if provided) of each phase is sequentially connected. Upon completion of all phases, a final check will be made of the proper functioning of all interconnected systems.
- e. An access road will be provided on the landfill cover to enable an easy approach for a routine inspection.

3.6 Associated and Existing Facilities

The associated and existing facilities are defined in the AIB ESP and project ESMPF. The E&S due diligence considered project (i) associated facilities (those which are not funded by the project but whose viability and existence depend exclusively on the project and whose operation and services are essential for successful operation of the project) and; (ii) project existing facilities (those which are already established and operating, and which the project will help upgrade or rehabilitate).

Existing access roads, secondary transfer stations, container bin sites, and other waste treatment facilities linked to the landfill are considered as existing facilities. These facilities are in operation since long time following national and local regulations.

The project does not have any associated facilities.

3.7 Subproject Costing/Budget

The broad estimates for the Capital Expenditure of the sub-project in Rajshahi is given in the Table 3.6 below. The CAPEX has been broadly estimated for four key aspects a) the equipment required for collection & transportation- includes the cost of the vehicles for primary and secondary collection and the containers for secondary collection; b) construction of the Integrated Landfill and Resource facility.

Table 3.6 Capital Expenditure of Rajshahi Subproject

Item	USD
Construction of integrated landfill and resource recovery facility (cell for capping of old waste, new cell for waste disposal, compost plant, MRF, pyrolysis plant, biogas plant leachate treatment plant, boundary wall, office room, car washing ramp, workshop, guard room, an electrical system including transmission, transformer, distribution and deep tubewell with a water distribution system and shifting of medical waste plant	8,900,000
Renovation of transfer station (10)	400,000
Equipment for MRF and Compost Plant	600,000
Machinery for Pyrolysis	300,000
Weigh bridge (digital)	35,000
Excavator (2)	440,000
Bulldozer (1)	250,000
Front Loader (2)	450,000
Container Carrier Trucks (27)	1,424,000
Containers (167)	250,000
Dump truck (10)	449,074
Tractor and trailer (6)	150,000
312 Improved Rickshaw vans (with bins) for primary collection of waste	468,000
Aerators (10)	20,000
Pumps (15)	45,000
Generator (1)	40,000
Total	14,221,074

3.7.1 Operation and Maintenance Expenses

The O&M expenses are key costs required in operationalization and management of the SWM value chain including waste collection, transportation and treatment facility in the city corporation. The table below provides an overview of the various categories of O&M costs.

Table 3.7 Components included under Operating Costs

Item	USD
Operational Cost of Door to Door Waste Collection	720,000
Operational Cost of Secondary Collection of Waste	709,500
Operational Cost of Integrated Landfill and Resource Recovery Facility	617,320
Total	2046,820

3.8 Subproject Schedule

Substantial time is required for the subproject preparation, approval, survey, design & estimate, contract award and contract execution. Efforts needs to be made to meticulously follow the schedule should a timely implementation of work is aimed at. Normally the construction work season in Bangladesh runs from October through May. Construction works are sometimes impeded for the following reasons.

- Early floods in April/May,
- Late floods in September/October,
- Natural calamities (cyclone/tornado, excessive floods) occur in April/May and October/November.

A tentative time-schedule for implementation (only as an indication) is shown Table 3.8 overleaf.

Table 3.8 Proposed Implementation Schedule for the Rajshahi Sub-project

Month	2022		2023												2024												2025													
	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
Pre-feasibility Report	■																																							
Feasibility Report	■																																							
Preparation of the bid documents			■																																					
Tendering of the sub-project and the work order						■																																		
Execution of the physical work										■																														
Final inspection and certification																																							■	

4. DESCRIPTION OF BASELINE ENVIRONMENT

4.1 Introduction

The city Rajshahi is located in the north western part of Bangladesh. Rajshahi is one of the major cities in Bangladesh and Rajshahi division. The foundation of the Rajshahi city dates to 1634, according to epigraphic records at the mausoleum of Sufi saint Shah Makhdum. Rajshahi district was established in 1772. The Rajshahi municipality was constituted during the British Raj on August 1, 1876, making it one of the oldest municipalities in Bangladesh. It was a divisional capital of the Bengal Presidency. It gained status as the Rajshahi Municipality Corporation on August 13, 1987, and later renamed as Rajshahi City Corporation in 1991.

Rajshahi City Corporation has an area of 95.56 sq km, located in between 24'20' and 24'24' north latitudes and in between 88'32' and 88'40' east longitudes. It is bounded by PABA upazila on all sides. The city has total Population 388811; male 208525, female 180286. Padma Ricer is the main water body.

In the month of May and November 2022 ISWMIP consultant team visited Rajshahi City Corporation as part of the ESIA study investigating the assessment of environmental impacts. The waste dumping site of Rajshahi City Corporation is in a low-lying area named "Nawdapara" about 3 kilometers from the corporation area. This disposal site does not follow the principle of sanitary landfills. In this disposal site, waste spreads all over the site. There is no proper system to maintain the landfill area. With the blowing of wind there is an unpleasant odour spread all over the disposal area. Compaction, leveling of waste and final covering by the earth is rarely observed at a Nawdapara disposal site in Rajshahi city. Thus, open dumping ground at Nawdapara is unscientific and contributing to pollution.

4.1.1 Primary Data Collection

ISWMIP team visited the subproject sites toward assessing the existing environment (physical, biological, and socioeconomic) and gathering information in respect of the proposed sites and scale of the proposed subproject. In addition to environmental survey, a separate socio-economic study was conducted to determine the demographic information, archaeological and religious places, densely populated pockets, and settlements. The methods used for primary data collection were transecting walk, field GPS measurement, photographic records, need basis environmental survey, and observations.

4.1.2 Secondary Data Collection

For comprehensive study secondary data were also collected during the mentioned site visits and were analysed based upon which interpretations were made to assess the physical, biological, and socioeconomic features of the subproject area. The relevant information is presented in the subsequent paragraphs. Data for this study has been firstly collected through comprehensive literature survey, discussion with stakeholder agencies, and field visits to the proposed subproject site. The literature survey broadly covered the following:

- Subproject details, reports, maps, and other documents available with the Waste Concern Consultants (WCC), IPE Global, RPMC, AQUA Consultants, LGED, and Rajshahi City Corporation information available at websites;
- Relevant acts and extraordinary gazettes, and guidelines issued by Government of Bangladesh agencies; and
- Literature review on land use, soil, geology, hydrology, climate, socioeconomic profiles, and environmental planning documents collected from Government of Bangladesh agencies and websites;

- Web search for literature.

4.2 Topography of Rajshahi

Geographically Rajshahi is situated within Barind Tract, 23 m (75 ft) above sea level, and lies at 24°22'26"N 88°36'04"E. The city is located on the alluvial plains of the Padma River, which runs through southern side of the city. It is bounded on the east, north and west by Paba upazila (subdivision of a district) of the district. Rajshahi district is bounded by Naogaon district to the north, Natore district to the east, and Chapai Nababganj district and the river Padma & Kushtia district to the south. The mean elevation of the city area is 14.58m, where almost 80% of the area is above or equal to the mean elevation level. The core city area is also closer to the Padma River, and the adjacent area is relatively in high elevation than the northern part of the city area. Mainly, parts of wards 14, 16, 17, 18, and 4 have an average lower elevation, which is below the mean elevation (Kafy et al., 2020).

Rajshahi is one of the major metropolitan cities in the northwestern part of Bangladesh. It has become a metropolitan city in 1876 with a population of almost 16000000. The population of the Rajshahi city Corporation as of 2022 is 9,42,000, with male 5,05,208 (53.63%), female 4,36,792 (46.37%), and the literacy rate is 74.1% (BBS 2015). For the purposes of this report, the geographical coordinates of Rajshahi are 24.3635886° latitude, 88.6241351° longitude, and 23m (75ft) elevation.

The topography within 8 kilometers of Rajshahi is essentially flat, with a maximum elevation change of 75 feet and an average elevation above sea level of 75 feet. Within 10 miles is also essentially flat (85 feet). Within 50 miles is essentially flat (650 feet). The area within 8 miles of Rajshahi is covered by grassland (36%), cropland (36%), and artificial surfaces (29%), within 10 miles by grassland (49%) and cropland (47%), and within 50 miles by cropland (55%) and grassland (36%).

Rapid urbanization and population increase are transforming Rajshahi city, Bangladesh. Rapid expansion and environmental changes make communities more vulnerable to floods, earthquakes, fires, and waterlogging. Recent years have seen a rise in urban flooding. It disrupts everyday activity, clogs highways, and damages infrastructure. Urbanites suffer during monsoon season. Unplanned land usage causes waterlogging. The research project ("Exploring the Reasons of Waterlogging in Rajshahi City and Develop Community Based Proposals to Mitigate the Increasing Waterlogging Problem through Participatory Approach.") examines the impacts of waterlogging on residents of Rajshahi City Corporation.

In the RCC region, ward-25, ward-8, ward23, 54.5% of ward-6, and 53.9% of ward-27 experience water logging concerns. Unplanned drainage systems, blockages, and improper cleaning cause waterlogging. A long-term phased development program and urgent drainage facility upgrading with adequate environmental sanitation management are needed to reduce drainage concerns. Enforcement, cleaning, and upkeep should be consistent. Drains should be cleaned once every three months to supply enough dustbins in the RCC area. The elements that cause frequent natural and man-made water logging situations in the Rajshahi City Corporation region include rapid unplanned urbanization, land expansion through filling, a reduction in the number of water bodies, and inadequate maintenance by the relevant authorities. As a result of inadequate coverage and delivery of urban amenities, including water supply, waste disposal, and proper drainage, Rajshahi's residents are currently bearing the burden of rampant unplanned urbanization. One of the adverse effects of unplanned urbanization, which is becoming worse every day, is waterlogging in Rajshahi (Subrina & Chowdhury, 2018). Waterlogging should be considered a cautionary signal, and it is essential to consider sustainable land management in Rajshahi city to reduce the risk of future loss. Waterlogging causes damage to the crop, employment, national economy & livelihood (Papry & Ahmed, 2015). Waterlogging is a problem that has arisen since Bangladesh's commencement of the 21st century. It is increasing daily in urban areas as the porous surface is decreasing rapidly due to urbanization. It causes

overflow as the drainage capacity has remained the same compared to the past. Waterlogging is causing untold suffering to the urban poor living in the slum (Awal, 2014). Recently, Rajshahi city has observed waterlogging, which burdens city residents and disturbs the balance between the physical environment, economy, and society. As a result, regular life and traffic flow are being disturbed. The impermeable surface is expanding, and the water bodies are gradually vanishing due to uncontrolled expansion and water body invasion (Subrina & Chowdhury, 2018). A healthy and habitable city requires a functioning drainage system. When it rains, water flows over the ground, picking up faces and contaminating water supplies in regions with poor drainage and sanitation systems (Ullah et al., 2013). Solid waste management is currently one of the least researched and ignored environmental challenges in most developing nations (Ahsan et al., 2014). In many nations, solid trash is dumped in public landfills without being given the importance it deserves (Iorhemen et al., 2016). So, it is high time to study the trend of the waterlogging situation to address the problem and engage the inhabitants of the area to develop practical solutions for managing the increasing waterlogging problem.

Based on field survey data analysis, among the 30 wards of RCC, 17 wards have a waterlogging problem. In the rainy season, after a heavy downpour, places like Balia Pukur, Padma Housing Estate, Bhata Para, Kala Para, Sapura, Kadirgonj (backside of Hetem Khan Graveyard), Guri Para, Talaimari, front-side road of Rajshahi Medical College, Laxmipur Vegetable Market surrounding area, Baharampur Bank Colony Road, Dashpukur area, Terokhadia Stadium Road, Court Bazar to By-pass Road, Bilshimla Karmajibi Mahila Hostel Road and also small parts of Darga Para of Rajshahi city have become inundated.

There are 17 wards in the RCC area that are affected by waterlogging; of these, 69.7% of the households in Ward 25, 67% of the households in Ward 8, 63.6% of the households in Ward 23, 54.5% of the households in Ward-6, and 53.9% of the households in Ward-27 have been confronted with a severe water logging problem in their locality. Geographically the elevation of the main Rajshahi City is lower compared to the surrounding areas which results in water logging. The drainage system was also unplanned and defective from the beginning of the formation of Rajshahi city. Inadequate and poor drainage system, low maintenance and lack of dredging are making the condition worse. Unplanned building construction and increased population in locality has accelerated and prolonged the water inundation. Due to the up growing inhabitation, number of open lands and ponds are decreasing and moreover the poor drainage system is preventing the rainwater from draining away. The inactiveness and endangered condition of the Shyamasundari canal flowing throughout the city enhanced the acuteness of water logging. The sufferings in daily life have no bound among the residents due to water logging in the rainy season. The water bound people have no pure drinking water and food and have lost their valuable assets, furniture, houses, cattle and crops. This also causes physical damages to the roads and buildings as well as environmental damages. The study focuses on the recent scenarios of water logging and tries to find out and analyze the causes of water logging.

Significant amount of gravel, sand, and cement will be required for this sub-project. Extraction of construction materials may cause localized changes in topography and landforms. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures. Utilize readily available sources of materials. If contractor procures materials from existing burrow pits and quarries, ensure these conform to all relevant regulatory requirements. Borrow areas and quarries (If these are being opened up exclusively for the sub-project) must comply with environmental requirements, as applicable. No activity will be allowed until formal agreement is signed between PIU, landowner and contractor.

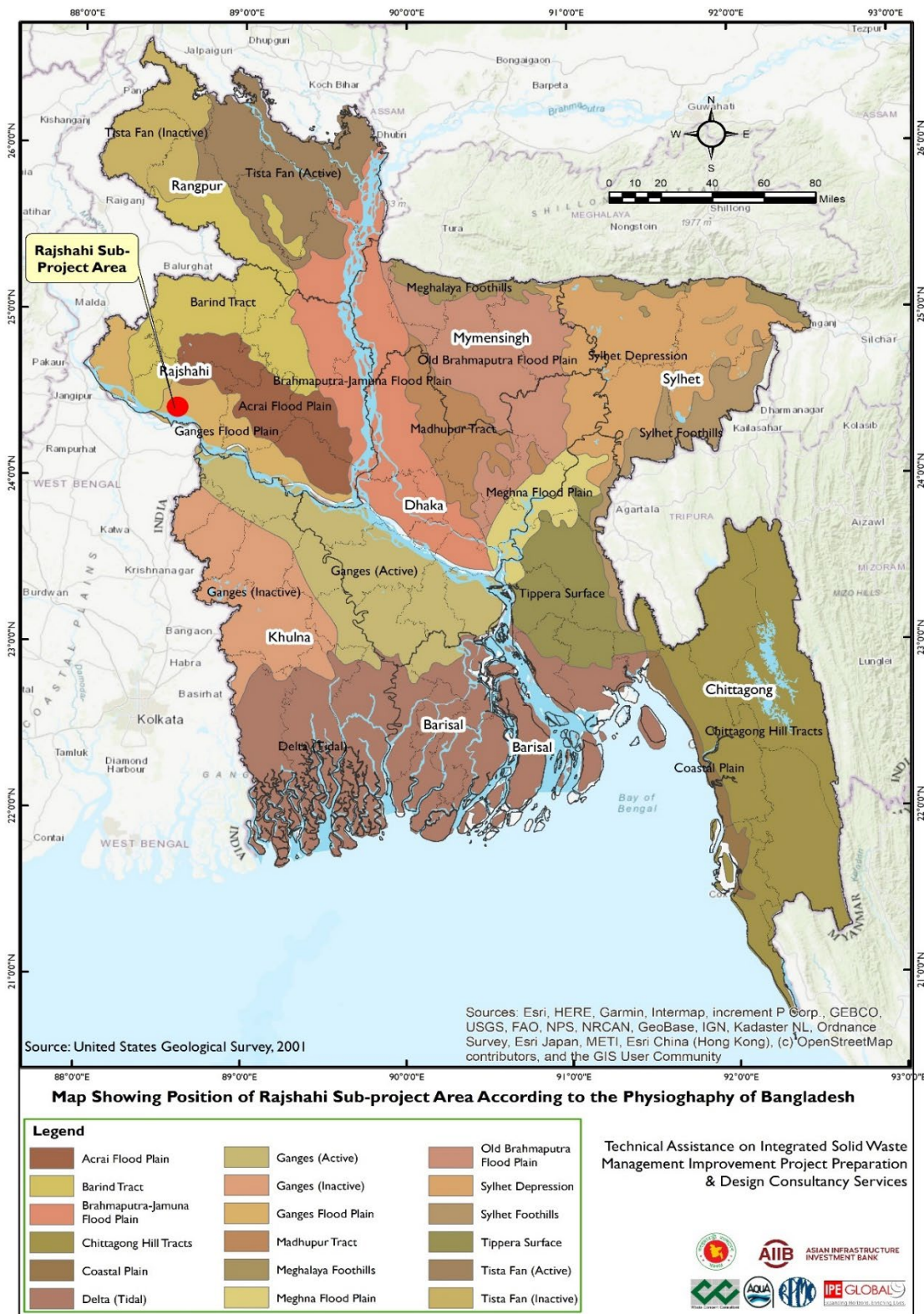


Figure 4.1 Physiography of the Rajshahi City Corporation Subproject area

4.3 Land use and land cover of the Rajshahi City Corporation Area

The land use is defined as men’s activities on land which are directly related to land. Land use has been seen as a product of interactions between a society’s cultural background, skill and its physical needs in one hand and the natural potential of land on the other hand. Land cover refers to natural vegetation, water bodies, rock/soil, artificial cover and other resulting due to land transformations. Land cover association and its temporal change is also one of the most important components of environments. Land use and its change seem to very essential for the development planning and also for a rational use of land space. To prepare land use map from any kind of image, one suitable classification system is essential. Land use classes are consisting of urban and rural areas whereas the urban areas are subjected by residential, both residential and industrial areas and the rural areas are dominated by settlements and cultivated landscapes.

Urbanization causes enormous land use and land cover (LULC) changes, which creates a significant impact on land surface temperature (LST) in rapidly growing mega-cities. The substantial increment of the LST creates urban heat island (UHI) effects in cities. This assessment first identified the pattern of the land use land cover changes, and later, investigated their impacts on land surface temperature (LST) in Rajshahi City Corporation (RCC) areas for the years of 1999, 2009 and 2019. This study explored the impact of LULC change on LST through LST distribution in different land use categories. This impact needs to be considered and evaluated immediately for ensuring sustainable urbanization and natural resource management in the RCC area. This study will be helpful for urban planners and environmental engineers to understand the impacts of LULC change (e.g., loss of vegetation cover, agricultural land and water bodies to accommodate extensive urban growth) on LST and to propose appropriate policy measures to control it.

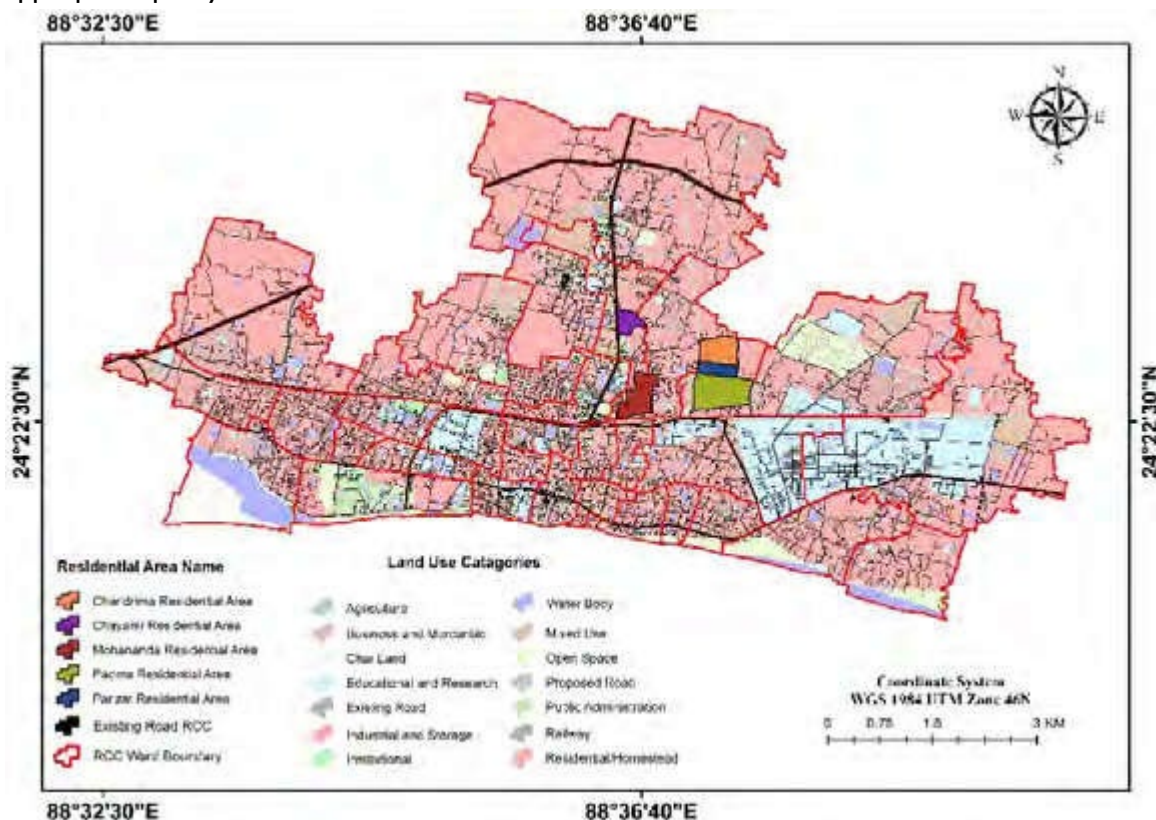


Figure 4.2 Land-use and Land-cover of Rajshahi City Corporation

Table 4.1 Land Use Categories of Rajshahi City Corporation

Category	Total area (acre)	Percentage (%)
Residential	5305.87	44.68
Agricultural	284896	23.99
Commercial	598.04	5.04
Industrial	84.14	0.71
Open Space	2636.77	22.20
Road	401.62	3.38
Total	11875.40	100

Source: Rajshahi Master Plan (2004)

Landcover Classification

The land was classified into four Land Use Land Cover (LULC) categories Urban area, Vegetation cover, Water bodies, and Bare land for the years of 2000, 2010, and 2020 (Table 4.2). Maximum Likelihood Supervised Classification (MLSC) technique used to estimate the LULC classification.

Table 4.2 Descriptions of Land Use Land Cover classes

SL. No.	LULC Classes	Description
1	Urban area	Residential, commercial and industrial services, transportation network.
2	Vegetation cover	Trees, grassland, cropland, and fallow land
3	Water Bodies	River, wetlands, lakes, ponds, and reservoirs
4	Bare Land	Vacant land, open space, sand, bare soils, and landfill sites

Land Element-1 (Agriculture, Construction Materials): This element can be used for human settlement, for the construction of roads and highways; this element is suitable for agriculture.

Land Element-2 (Settlement): This element can be used for human settlement; it is comparatively elevated than the surrounding areas. The river bank erosion, water logging and flood problems are absent or nearly absent. This zone is found in the northwestern, western and in some parts of and southeastern central region of Rajshahi area. The settlement density is high and the communication system is also very good in this element.

Land Element-3 (Agriculture, Settlement): This element is less suitable for human settlement and is moderately elevated than the surrounding areas. The soil and land configuration map show that drainage is moderately well and morphologically this element falls in the floodplain area. This area is used for cultivation. The communication system of this element is also good and settlement density is medium to high. This element is found mainly in the central and with few other areas of Rajshahi.

Land Element-4 (Pisciculture, Water Reservoir): This element is unsuitable for human settlement. Morpho-geologically this element is deeper part of flood basin and abandoned channel area. This element is highly flood affected and drainage system is poor. Water covers the areas almost throughout the year and settlement density is nil. This zone is only suitable for agriculture, surface water reservoirs and fisheries land-use.

Land Element-5 (Agriculture, Pisciculture and Water Reservoir): This element is suitable for industry because this area is highly communicated with rail, river, road etc. So, this area is suitable for industrial purpose though there is no industry in Rashahi.

Land Use/Land Cover Transformation

The transformation of one LULC to another LULC is essential to identify the most dominated LULC class in the study area. As the study aims to identify the changes of VC influence by urban development, the "combined" technique under "spatial analyst toolset" in Arc GIS 10.6 software used to estimate the transformation rate of VC (vegetation cover) pixel to the UA from 2000-2010, 2010-2020 and 2000-2020 respectively. The combined toolchains multiple rasters so that a unique output value is assigned to each unique combination of input values.

The land has had a profound effect upon the natural environment thus resulting into an observable pattern in the land use/land cover over time. The land use/land cover pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, information on land use / land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population.

Development and expansions of land use map depends on various geologic parameters. The geologic parameters include physiography, geomorphic condition, flooding, drainage system, slope elevation and geologic setting etc. It is essential to consider the geologic parameters before taking any developmental planning to avoid any unwanted events that create destruction to the lives or properties of mankind. So, decision maker should concern about the positions where does the planned project suit. The study was made to prepare a morpho-geological map of the Rajshahi City Corporation area in northern Bangladesh using remotely sensed data and field data. Physio-graphically, Rajshahi district occupy the middle part by Padma river and the land mass of the both side of the river are flood plain. Five geomorphological units were identified from the SPOT (band 4) and Lands at TM (FCC) images. These are active channel deposit, abandoned channel deposit, natural levee deposit, flood plain deposit and flood basin deposit. In consideration of the geomorphologic conditions, a preliminary land use map was prepared. The area is divided into five land elements which designated as no water reservoir, settlement, agriculture, pisciculture and industrial zone. This land use map will provide significant guideline for the better use of the land. The map will be helpful for geologist, engineers, planners, local administrator, agriculturist and farmer in their respective field. The following recommendation should be taken consideration for future development plan in the study area:

- i) It is important to integrate geological information at early stage for land use planning in order to avoid destruction or damage of properties and lives and to avoid other environmental problem and monetary loss.
- ii) The sub-soil conditions of the area should be mapped by the implementation of systematic boring program and extensive sample testing of the soil.

iii) This study work might have some lacking because of limited scope and time.

Therefore, a detailed survey should be undertaken for any further development activities in these areas.

Rajshahi district experiences rapid urban growth after 1990s and this trend still encompass present growth. Assessment of Land use/Land cover of the study area will possibly evaluate the state and rate of change in the present decades. This assessment might help the government as well as the policy makers for integrated planning and management of present landscape and also predict and design the state of future landscape. Rajshahi District area is 2370.45 sq km, located in between 24.3635886° north latitude and 88.6241351° east longitudes. Rajshahi district is bounded by Naogaon district to the north, Natore district to the east, Chapai Nababganj district to west and little part of Kushtia district & the river Padma to the south. The Rajshahi city is surrounded by the satellite towns of **Nowhata** and **Katakhali**.

In the physiographic point of view, the area falls in the alluvial plain. Geologically, the area is lies on the mid-western Bangladesh. The Padma river is the main active channel in the study area which is meandering river.

Rajshahi district experiences a significant change over the 10 years of study period. This study shows major change in settlement/build up land and barren land. Both these two land features showing an increasing trend.

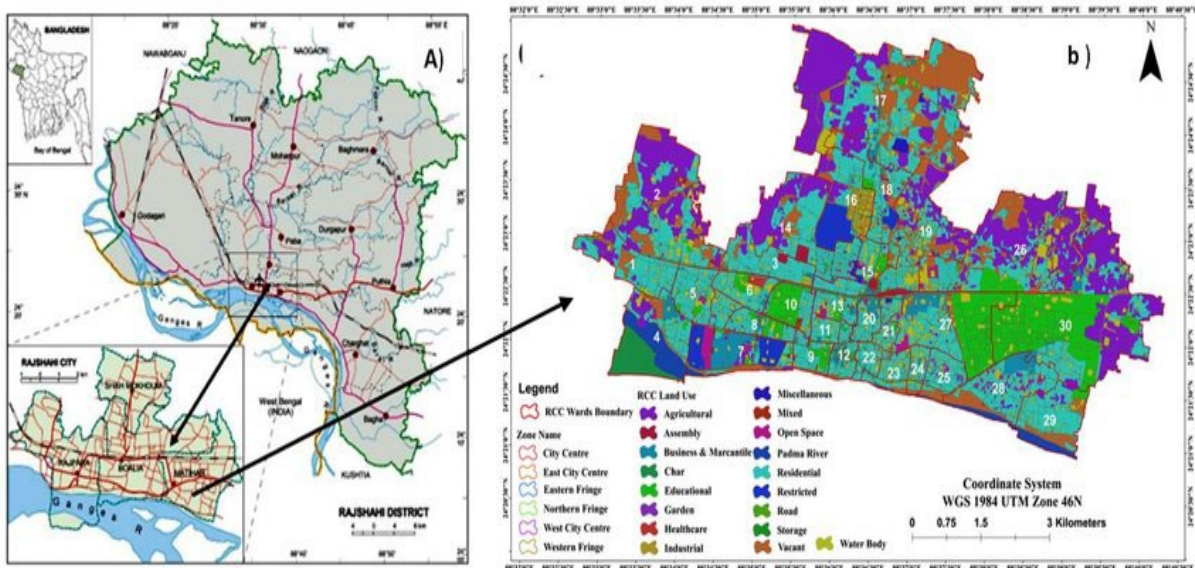


Figure 4.3 (A) Rajshahi District and (B) RCC ward boundary and LULC

Table 4.3 Showing the percentage of change from 2007 - 2017

Feature	2007 (Km ²)	2017 (Km ²)	Change %
Water Body	275	257	-0.74%
Settlement/Build up area	285	344	2.43%
Vegetation	1113	1047	-2.72%

Feature	2007 (Km ²)	2017 (Km ²)	Change %
Barren Land	755	780	1.03%
Total	2428	2428	-

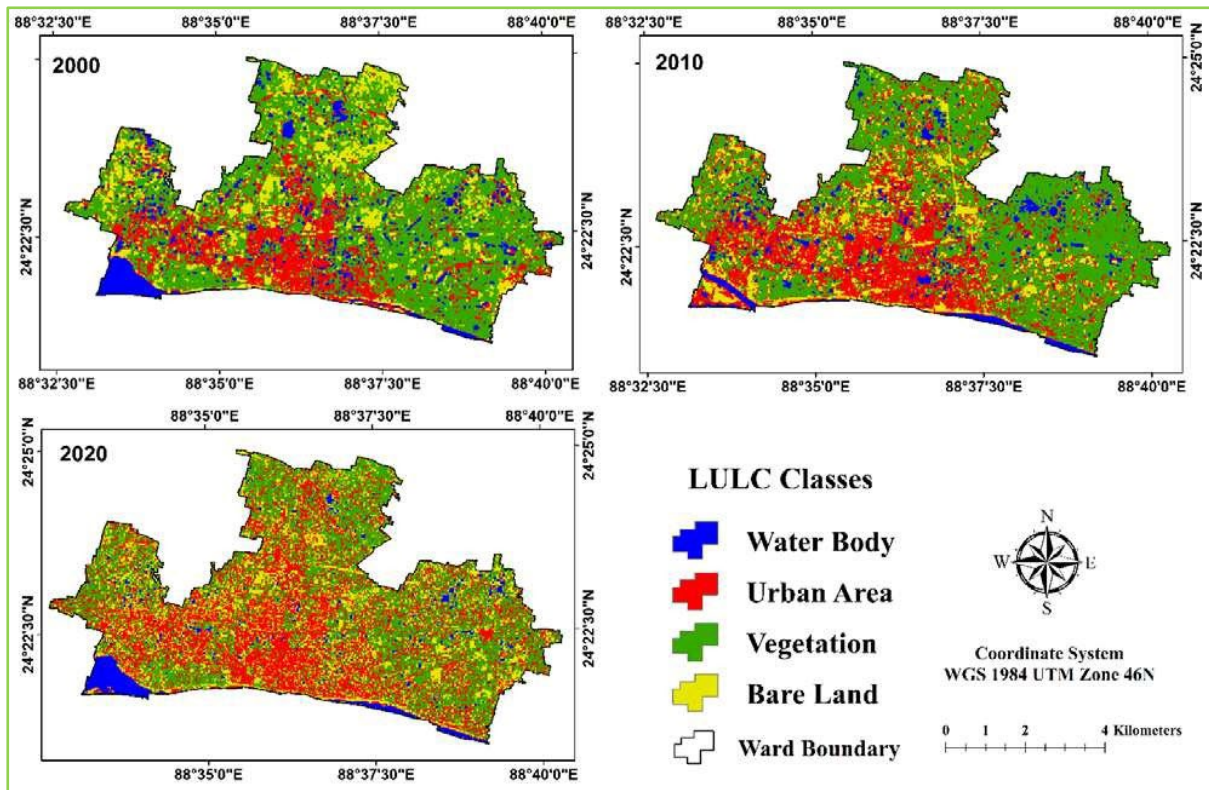


Figure 4.4 Land use/Land cover distribution in Rajshahi City Corporation area

Table 4.4 Area and Net Change Variations of Land use/Land Cover of RCC

Land Use and Land Cover (LULC)	Area (Km ²)			Net Change (%)		
	2000	2010	2020	2000-2010	2010-2020	2000-2020
Water Body	4.78	4.53	3.52	-0.51	-2.08	-2.59
Urban Area	7.77	10.59	15.34	5.79	9.76	15.55
Vegetation	25.13	20.84	15.68	-8.81	-10.60	-19.42
Bare Land	10.99	12.71	14.13	3.53	2.92	6.45
Total	48.67	48.67	48.67	-	-	-

Source: Rajshahi University Journal of Environmental Science, 8: 11-24, 2019: Reduction of Vegetation Cover in Rajshahi City Corporation of Bangladesh.

The assessment recognizes the trend of recent change of landscape from 2000-2020. The result is not a positive one for the area because of heavy percentage of landscape conversion. Decreasing trend of water body and vegetation area can be a major threat for the area. Though a certain increase in urban and bare land have shown in this study, but the conversion from barren land to urban/settlement is still very high. It means the barren lands are converting into build up area rather than cultivable land. So, there still remain a significant imbalance between vegetation and build up area.

A long-term development plan should be taken to maintain and reestablish the natural balance between vegetation and urban landscape. Integrated project plan also should be introduced and applied to maintain the water context of Padma River as well as the other water bodies. As, this study conducted with satellite images of the dry period more complicated and sophisticated study should be done using satellite images of different seasons.

4.4 Geology of Rajshahi City Corporation Area

The study area is covered by Holocene fluvial sediments with comparatively elevated Pleistocene terrace, deposited as floodplain sediments. Subsurface stratigraphy of the study area has been established on the basis of field observation, deep tube-well borelog data and published literature. On the basis of lithologic characteristics sub-surface stratigraphy of the study area is divided into four lithostratigraphic units which consist mainly of coarse sand, medium sand, fine sand and clay respectively.

The ESIA study area is the Rajshahi City Corporation landfill area. This region occupies the relatively higher parts of Holocene fluvial plain formed on sediments of the river draining into the low land catchments area. The area is mainly smooth broad ridges and basins. The area is primarily composed of raw sandy and silty alluvial deposits usually stratified either from the surface or below the cultivated topsoil. The soils are blackish to brownish gray clay with light yellow to brown silty to sandy clay. Loamy clay is also present. Some soils redish brown to brownish yellow hard and plastic clay, light yellow to yellow fine sand with redish to brownish yellow very fine sand, light gray to gray medium sand with gray medium to coarse sand and gray medium to fine sand with gravels and light gray to gray coarse sand with gravels.

The geomorphological units are identical on the basis of the fluvial features and their sedimentary characteristics formed in the areas. On the satellite image these are identical on the basis of the interpretation of the image elements such as the tonal variation, texture, size, shape, association etc. Geomorphic units are classified on the basis of differential erosion processes. Remotely sense data have capability to mapping geomorphic units. Most units are characterized by their distinct textural and sedimentological characteristics; however, some units either lack of distinct sedimentological characters or the characteristics have been modified by post depositional process such as weathering and biological activities.

Active channels have permanent water flow throughout the year. The Padma river is the main active channel in the study area which is meandering river. On the spot panchromatic imagery, the active channel deposits have been identified by their light tone, smooth texture and morphologic position. Surface deposits are clay or silty clay which underlain by silty sand to fine sand deposits. Vegetation is also present. Thick layers of organic clay and peat are common. Natural levee deposits are linear, somewhat irregular wedge-shaped ridges of silty sand and sandy silt. They are elongated deposits parallel to the channel and developed on both sides of the river. This unit is thickest near the channel margin and thinned towards the floodplain. Slope is steep towards channel and very gently towards the floodplain.

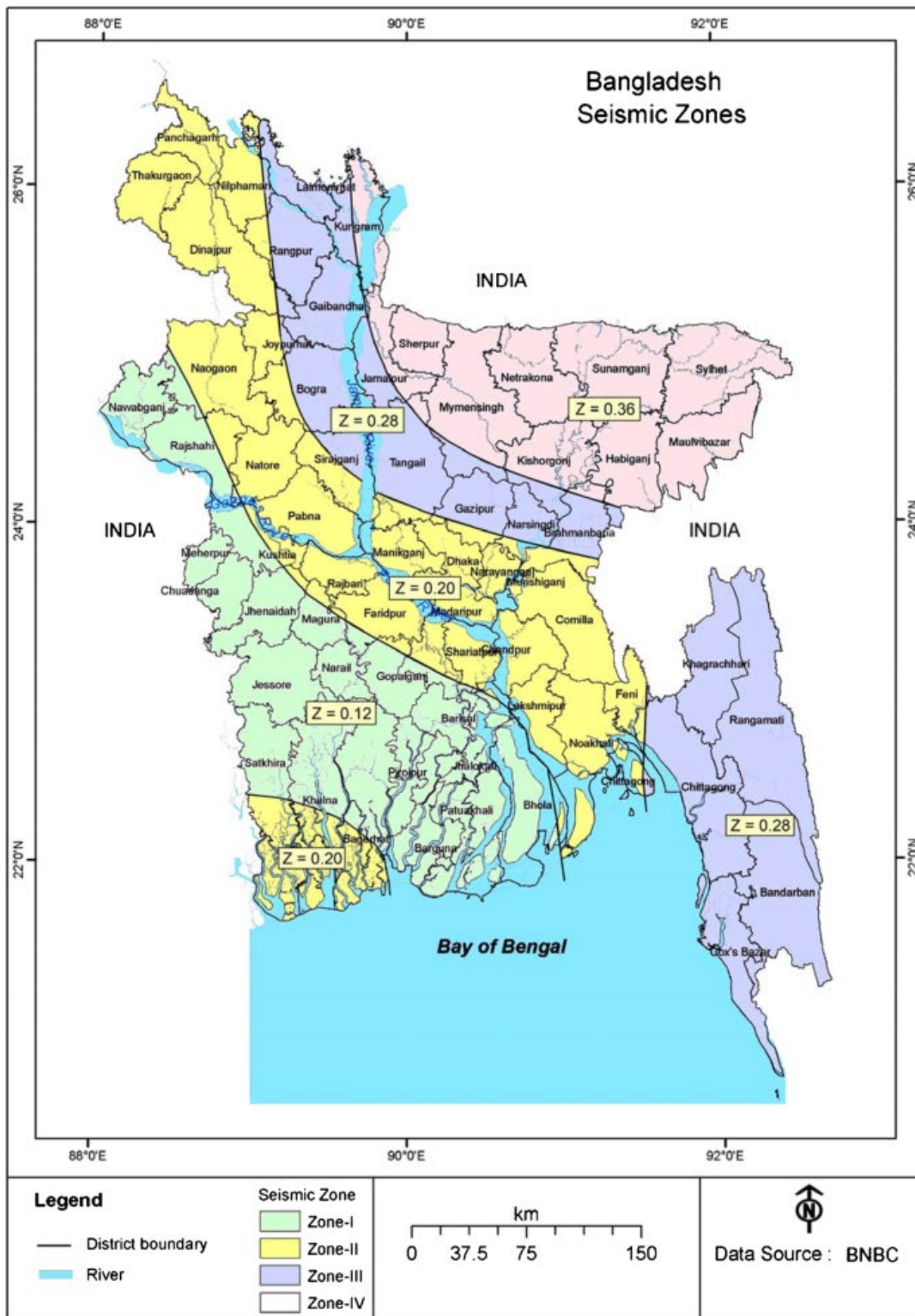


Figure 4.5 Seismic Zoning in Bangladesh (Source: National Building Code, 2015)

Along the bank of the river, these deposits are mostly silt and fine sand become clayey silt at the distal edge of the levee where it merges with the flood plain deposits. A natural levee found in the side of Padma river. This unit is mostly vegetated areas. The higher elevation of this unit in comparison to the surrounding areas results high settlement.

The floodplain lies between natural levee and flood basin and is lower in elevation than those of natural levee. This is the largest unit in the study area. Floodplains have very gently slope toward the flood basin. Floodplain deposits in the study area are composed of gray silty clay to organic rich clay. Decomposed to partially decomposed grass roots and organic remains are common in the sediments of this unit. On the spot imagery floodplains are identified by medium gray tone and smooth texture. Most parts of this unit in the study area have been converted to cultivated lands, which exhibit geometric shape and even textural distribution on the satellite imagery. In the study area these units are commonly observe on side of the Padma River.

The flood basins are featureless areas of poorly drained, flat to centrally slopping into stream depressions. Topographically flood basins are the depressed portion of the stream floodplain and oval, semi-circular or irregular in shape. These are small to large depressions in the floodplain having marshy to boggy environment. Most of the areas are usually under water round the year but few become dry during the winter. Marshes have also been mapped as flood basin. In some places of the study area the flood basins have been modified to ponds for fishery.

The flood basin deposits in the study area consists of gray to light gray organic rich clay, dark gray to blackish gray peaty clay with abundant decomposed or partially decomposed vegetal matters. Some alternations of silty layers are present in this unit. On the spot imagery the flood basins are identical by dark gray tone, no texture and irregular shape. These are monotonous featureless areas. Most flood basins are found in the eastern side of the Teesta River of the study area. However, flood basins are sparsely distributed throughout the study area.

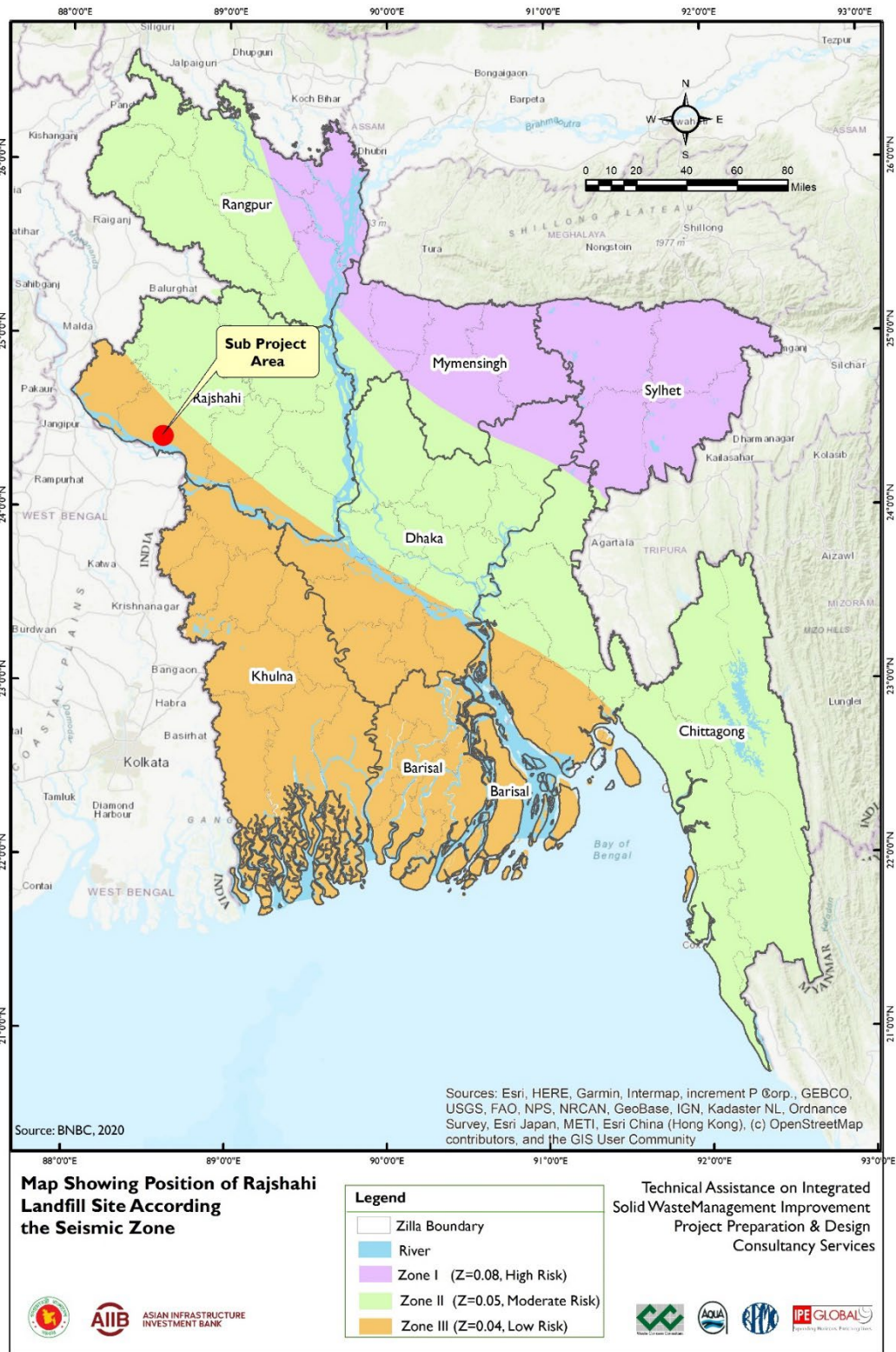


Figure 4.6 Showing Position of Rajshahi Landfill Site According to 3 Seismic Zones

4.5 Water Resources of Rajshahi

Rajshahi City Corporation (RCC) of Bangladesh, located in the north-west region of the country, is currently facing the shortages in freshwater supplies, which is being caused by the fluctuations of pressure in the water distribution networks. In 2018, the freshwater demand for RCC is estimated to be 118 million liters per day (MLD) and only 72 MLD is supplied by the Rajshahi Water Supply and Sewerage Authority (RWASA). Water shortage is estimated to be about 46 MLD, which is expected to be about 67 MLD in 2031. Every year, the groundwater table in RCC is declining by 2 to 3m. This causes the management of water supply and/or demand satisfaction more challenging since domestic or residential water demand from the system is the highest during the dry season (Ahmed et al., 1999). Therefore, an optimal water management framework is indispensable for RCC of Bangladesh. Hence, the objective of the current study is to develop an optimal water management framework for Rajshahi City Corporation of Bangladesh by considering existing water demand, supply and consumption patterns.

Rajshahi City Corporation (RCC) of Bangladesh is currently facing the shortages in freshwater supplies, which is being caused by the fluctuations of pressure in the water distribution networks. In 2018, the freshwater demand for RCC is estimated to be 118 million liters per day (MLD) and only 72 MLD is supplied by the Rajshahi Water Supply and Sewerage Authority (RWASA) authority. Water shortage is estimated to be about 46 MLD, which is expected to be about 67 MLD in 2031. Therefore, an optimal water management framework is indispensable for RCC of Bangladesh. Hence, an attempt is made in this study to develop an optimal water management framework for Rajshahi City Corporation of Bangladesh by considering existing water demand, supply and consumption patterns. The performance of the water supply network of RCC is analyzed in the ArcGIS platform. Based on the analysis, necessary improvements and/or modifications of the existing water supply network as well as the mode of operation for quantity and quality improvement are identified. It is found that there is a large variation in pressure head and the pressure supplied in the supply network and thus it is not adequate to satisfy the water demand of RCC at the consumer level. The results also indicate that a number of pipe sections and nodal points have been identified where modifications and/or improvements are required for optimum operation of the water supply network in the Rajshahi City Corporation of Bangladesh.



Figure 4.7 View of Padma River (a) in peak season; (b) in dry season

The discharge data of Padma river and Mohanonda river (shows that in the year 2007 to 2018 the highest and lowest discharge. We have seen that the rate of highest and lowest discharge is much fluctuating. But for both the Padma and Mahananda river, we have seen that the highest discharge occurs in the monsoon, when the river is filled by water where the lowest discharge occurs during the dry season. It is also seen that the highest and lowest water level of Padma and Mahananda river is decreasing in drought season and increasing a little bit in the rainy season or monsoon. For the construction of Farakka barrage the Padma is becoming desert in the drought season. So, there must be an alternative way to store the water during rainy season for the use in the drought season. It is clear that under pond project the annual crops growth is increased compared to outer parts of the areas. As the various crops are in large quantity the land owners are also happy to harvest their land under pond the project. These production of large amount of various crops are contributing to develop the national GDP. Most of the young generation are now involved to grow various crops under this pond project to reduce unemployment.

4.6 Natural Hazards in Rajshahi City Region

A disaster is a sudden calamitous event that seriously disrupts the functioning of a community or society and causes severe damage to economy and environment (“National Institute of Disaster Management” 1). Certain kinds of disaster occur suddenly, but there are disasters that take time to develop. Drought is an example of a natural disaster that builds over time. Generally, it is defined as an extended period in which available water is insufficient for human and agricultural needs.

Though Bangladesh is at a very high risk from drought enough steps are not taken to face the drought in the northern area of the country even after seeing devastating effects of drought in 1972, 1975, 1981, 1982 and so on. Those droughts affected 47 area of the land and 53 of the population (“Department of Disaster” 1). People in the northern part of the country are suffering from drought currently. They don’t get rainfall often. People are suffering from heatstroke, high temperature, lack of usable water, dehydration and a lot more. Natural hazard is a common phenomenon of Bangladesh. Rapid urbanization and multiple deprivation are making cities more prone to numerous disasters.

Drought-like situation has been prevailing in the Rajshahi region including its vast Barind tract posing a serious threat to the living and livelihood condition of the people, particularly the poor and marginalised ones. Local meteorological office recorded a temperature of 41.2 degrees Celsius at 3:00pm on Friday saying the temperature has been rising continuously for the last couple of days. The city Rajshahi is a part of huge drought affected northern area. Almost every socio economic and environmental aspect is hampered by drought; agricultural sides are affected too. Rajshahi is famous for seasonal fruits specially mangoes. But in the year 2009, there was a fall of 30% in mango production due to drought. Farmers complained that the green mangoes fell down due to lack of rain and high temperature (“India Environmental Portal” 1). This is a loss that also affects the economical side. Moreover, the annual rainfall has drastically decreased in this region. Dr. Samiran Das, an inhabitant of Rajshahi who is currently working at AUW as a professor of Environmental Science, recalls in an interview, “when I was young huge amount of rainfall used to take place in Rajshahi, but now, the amount is very low during the last few years”.

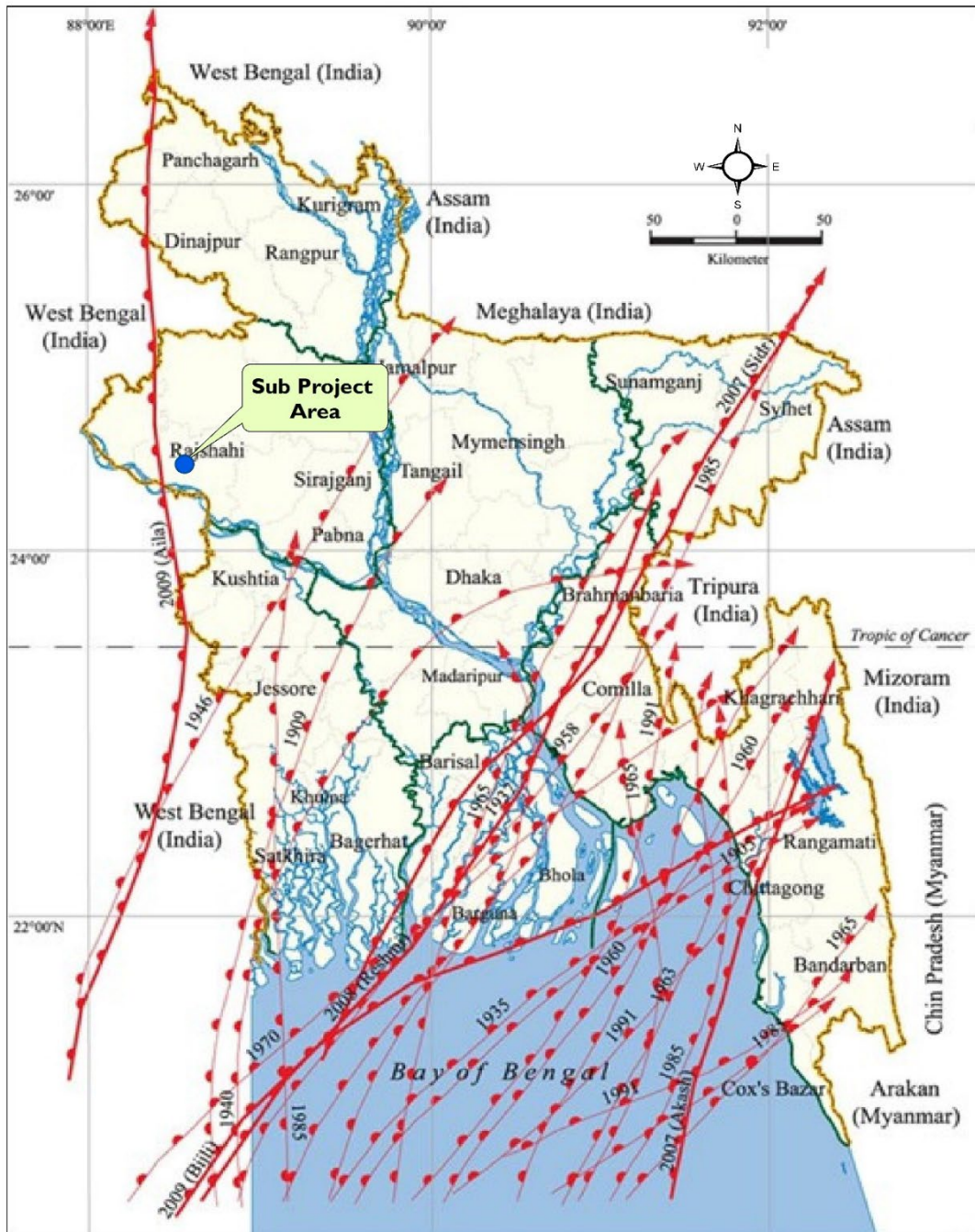
On the other hand, Rajshahi is facing shortage of water nowadays. In the dry seasons, the people of Rajshahi struggle to get water in house during afternoon. As it has appeared so far, there are no sudden effects of drought. But the effects are not less dangerous than other natural disasters. According to Dr. Das, “drought is opposite to flood, but it takes time to develop. Its effects are not less than flood or other natural disasters. It can be considered as a slow poison. Nobody can see it happening instantly, but it causes life-threatening damages”. It must be mentioned that heavy rainfall has occurred during

May to September in that region and the rest of the year remains dry. The experts come up with a lot of solutions every year. But the question is whether these are enough for facing drought. Although the nature of drought is devastating in Bangladesh, it has received much less attention from researchers than flood and cyclone. Even though the government has set up many policies and lots of experts have given many solutions on facing drought. It is still creating catastrophic effects in lives. Although the government has taken many policies to face drought, most of them are not executed. The government issued lands for planting trees and making ponds, but in reality, multistoried buildings stand on those places. The developers are filling up the remaining ponds for construction and no one prevents them from doing so. But it won't be wise to blame the government only as it is not possible to face a natural disaster just by a governing body.

Public awareness is highly needed in this regard. But sadly, most of the general people in Rajshahi don't know about drought and moreover, no steps are taken to make them aware of it. Many schools provide their pupils with knowledge of flood, tsunami, cyclone and every other disaster but drought. Many NGO's and non-profitable organizations organize competitions on facing the flood, cyclone and typhoon affected area which ultimately spread knowingsness on those disasters, but rarely, they go for drought affected area, which would have encouraged them to learn about droughts and its effects, and would ultimately create an awareness.

In order to avoid the future sufferings, it needs to start thinking about recharging the ground water. To recharge the ground water and to face drought we need more ponds, trees and grassy lands and we also need to save the existing greenery. People can also consider making tubs in their rooftops to store rainwater. Generally, cyclones and floods are considered most harmful disasters in Bangladesh. But sometimes drought can be more dangerous than these disasters and it can also hamper people in wider area. Enough precautions are not taken to face drought although it has devastating features.

Immediate steps should be taken before the situation gets worse as the next generation should not be in an environment which lacks water, an essential element to stay alive. We want them to witness the picturesque nature of Bangladesh and we want to provide them an environment enriched with every facility so that they can focus in the development of the country. Not only the government, but also the public should come forward and act in reality to meet this crisis instead of being limited just in thesis papers and unattended policies.



Source: SPARRO, 2022

Map Showing Position of Rajshahi Landfill Site According the Cyclonic Storm Tracks

Legend	
	River
	Yearwise Cyclonic Storm Tracks

Technical Assistance on Integrated Solid Waste Management Improvement Project Preparation & Design Consultancy Services



Figure 4.8 Map Showing the Position of Cyclonic Storm Tracks in Rajshahi City

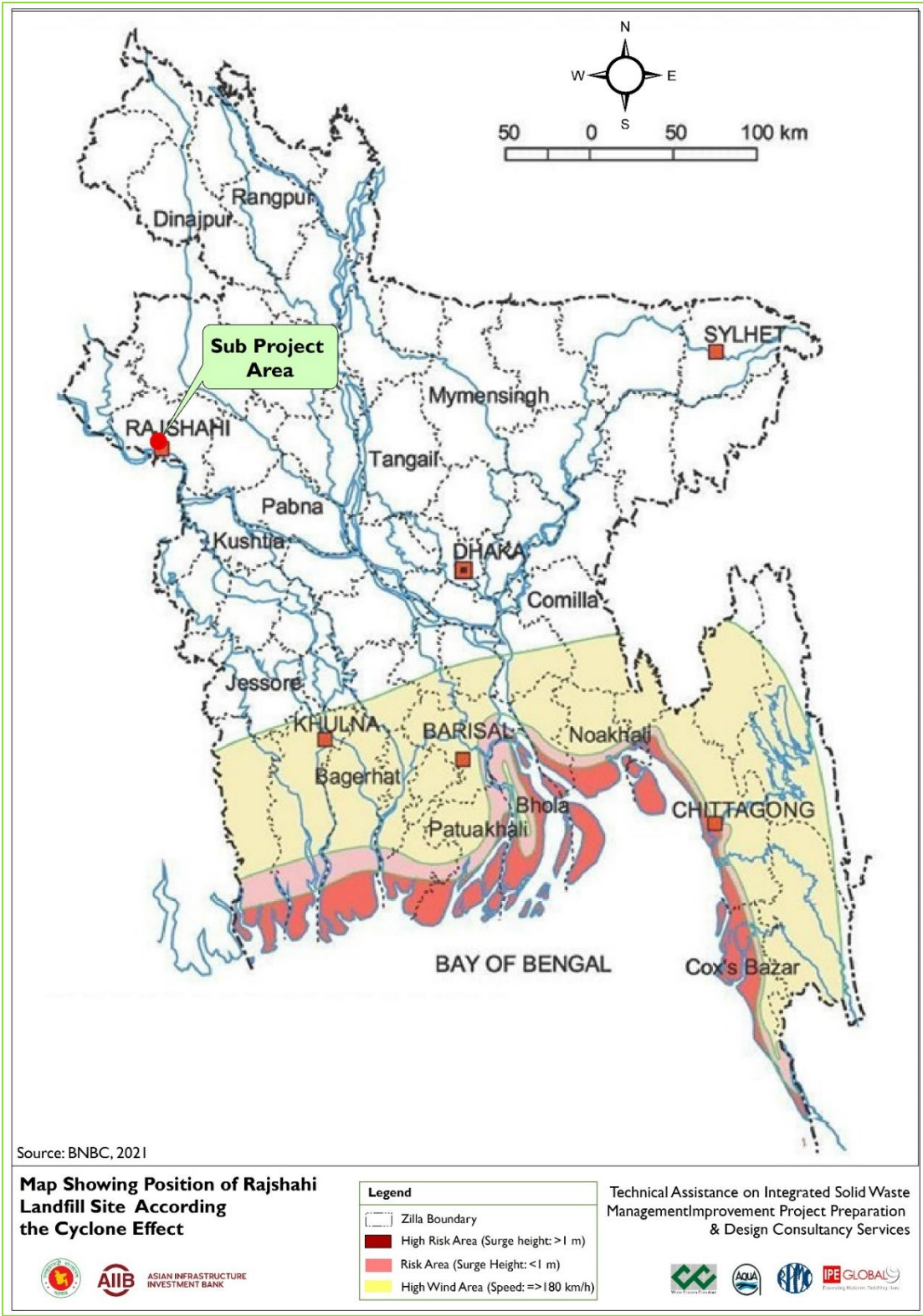


Figure 4.9 Map Showing the Position of Cyclonic Effect in Rajshahi City

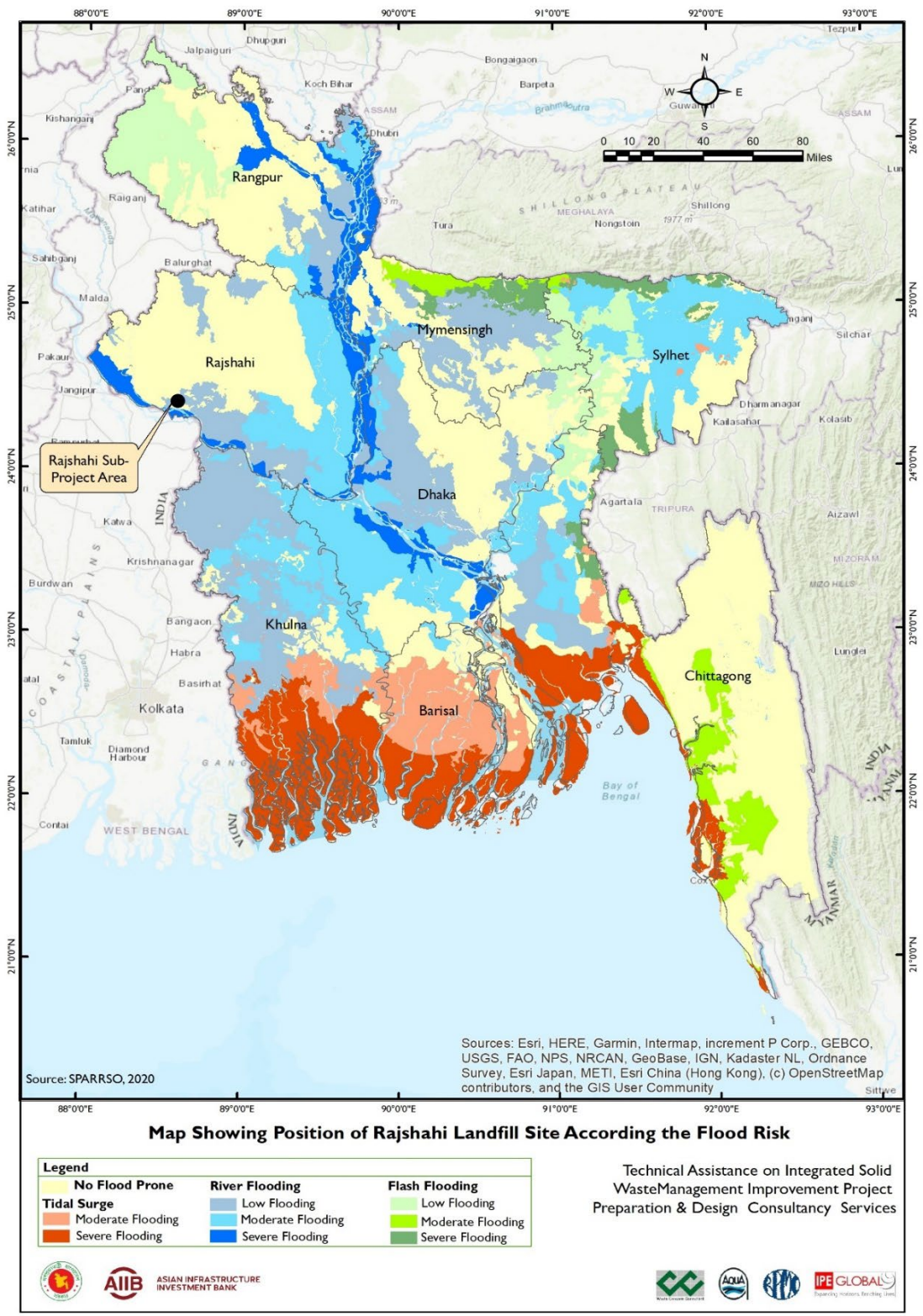


Figure 4.10 Position of Rajshahi Landfill Site according to the Flood Risk

4.7 Physical Environment of Rajshahi City

Rajshahi is a city located in west-central Bangladesh, close to the border with India. It has a tropical weather, with high temperatures, considerable humidity, and moderate rainfall. It is the fourth-largest city in Bangladesh with a population of over 700,000 people. The city might be well-known for its mangoes, but it is gaining even more recognition for its effective measures on urban sustainability. Four years ago, Rajshahi hit the headlines for achieving the largest reduction in the levels of harmful PM₁₀ particulates between 2014 and 2016, as per UN data. It was the result of a number of initiatives taken by the city authorities over several years.

These initiatives have transformed Rajshahi into a 'green city' – it is now known for its abundant greenery and open spaces – helped to reduce air pollution, besides bringing other social and environmental benefits for its citizens. Meanwhile, the city authorities have continued to implement other strategic interventions:

- A major initiative by the Rajshahi City Corporation (RCC) has been a programme called Zero Soil, which aims to cover all open spaces and pavements with plants to reduce the amount of dust particles. The city has been undertaking plantation as an incentive for people to get involved in the campaign.
- The city's government has focused on adopting low carbon solutions in its street lighting infrastructure. About 180 solar streetlights have been installed within the municipal area, supporting the country's Solar Street Lighting programme and the national target that aims at 5% electricity consumption from renewable energy sources by 2015 and 10% by 2020. To further scale up this action, the RCC has recently submitted a proposal to the Government of Bangladesh for the modernization of its entire street lighting system.
- The RCC introduced smart e-rickshaws recently to enable people to move around in a clean and well-managed manner.

The remarkable motivation of the city authorities to persevere with efforts to address climate change and urban sustainability might be a result of the optimism of its citizens, as their city was reportedly voted the happiest in the world by the World Happiness Survey in 2006. As a model city in Urban-LEDS phase II, Rajshahi will focus on developing a climate action plan that brings together its mitigation and adaptation efforts, formulating a long term city-wide greening strategy, and carrying out energy efficiency pilots in its public buildings.

4.7.1 Climate of Rajshahi Region

In Rajshahi, the wet season is hot, oppressive, and mostly cloudy and the dry season is warm and mostly clear. Over the course of the year, the temperature typically varies from 51°F to 97°F and is rarely below 46°F or above 103°F.

Based on the beach/pool score, the best time of year to visit Rajshahi for hot-weather activities is from mid-March to early May.

Under the Köppen climate classification, Rajshahi has a tropical wet and dry climate. The climate of Rajshahi is generally marked with monsoons, high temperature, considerable humidity and moderate rainfall.

4.7.1.1 Temperature of Rajshahi

The hot season lasts for 2.8 months, from March 21 to June 16, with an average daily high temperature above 92°F. The hottest month of the year in Rajshahi is May, with an average high of 95°F and low of 79°F.

The cool season lasts for 1.9 months, from December 8 to February 6, with an average daily high temperature below 77°F. The coldest month of the year in Rajshahi is January, with an average low of 51°F and high of 73°F.

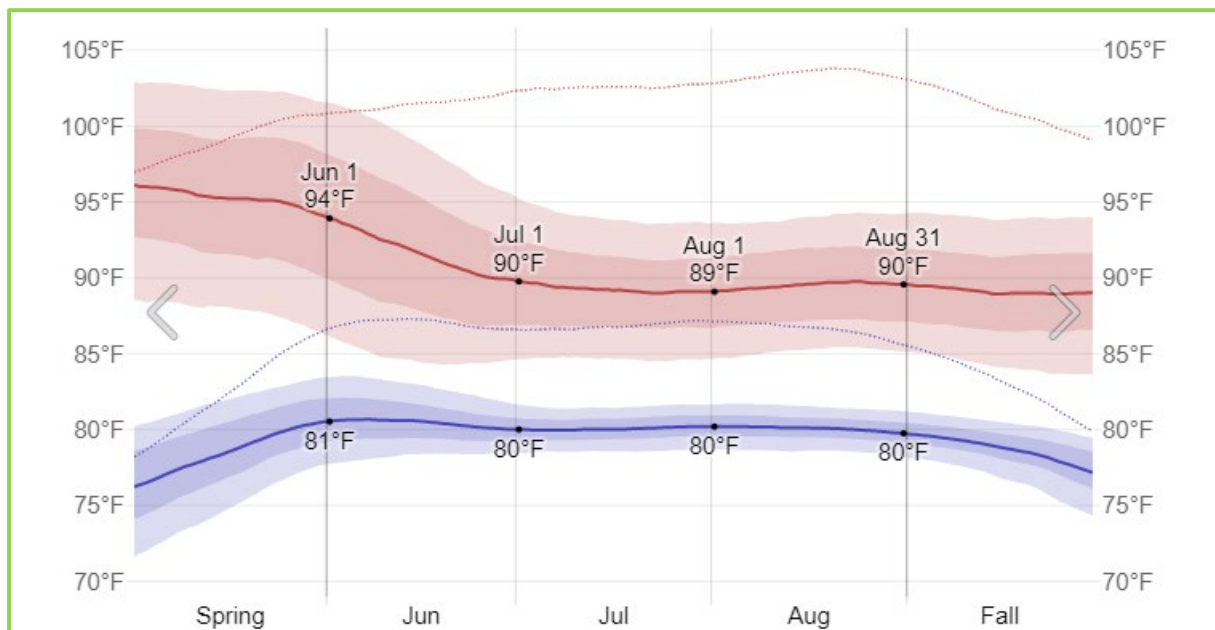


Figure 4.11 Graph Showing Monthly Highest and Lowest Temperature in Rajshahi
<https://weatherspark.com/s/111604/1/Average-Summer-Weather-in-Rajshahi-Bangladesh#Figures-Temperature>

Table 4.5 Average Monthly Highest and Lowest Temperature in Rajshahi

Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High Temp.	73°F	80°F	90°F	96°F	95°F	92°F	89°F	90°F	89°F	87°F	80°F	75°F
Medium Temp.	60°F	67°F	77°F	85°F	87°F	85°F	84°F	84°F	83°F	79°F	71°F	63°F
Low Temp.	51°F	57°F	66°F	74°F	79°F	80°F	80°F	80°F	79°F	73°F	62°F	54°F

<https://weatherspark.com/y/111604/Average-Weather-in-Rajshahi-Bangladesh-Year-Round>

A compact characterization of the entire year of hourly average temperatures is shown in the Figure 4.12. The horizontal axis is the day of the year, the vertical axis is the hour of the day, and the color is the average temperature for that hour and day. The average hourly temperature, color coded into bands. The shaded overlays indicate night and civil twilight.

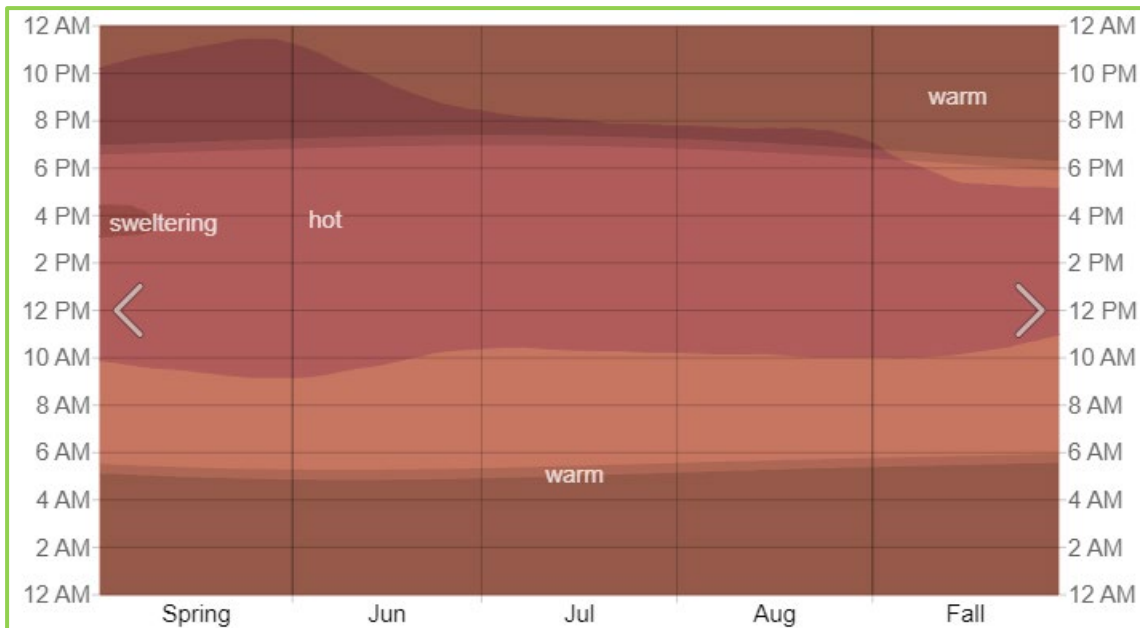


Figure 4.12 Average Hourly Temperature in the summer in Rajshahi

Source: <https://weatherspark.com/s/111604/1/Average-Summer-Weather-in-Rajshahi-Bangladesh#Figures-Temperature>

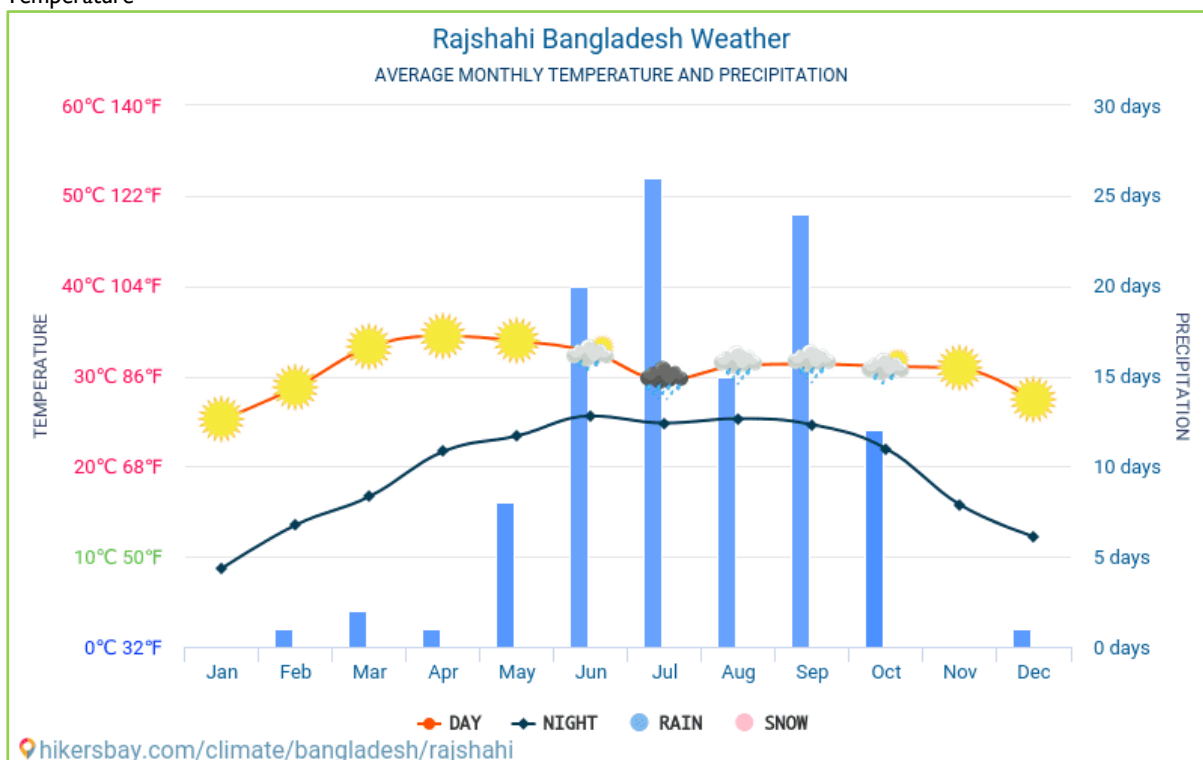


Figure 4.13 Monthly Average Temperature and Precipitation of Rajshahi 2015-2022

<https://cdn.hikb.at/charts/meteo-average-weather/rajshahi-meteo-average-weather.png>

4.7.1.2 Precipitation of Rajshahi

A wet day is one with at least 0.04 inches of liquid or liquid-equivalent precipitation. The chance of wet days in Rajshahi varies very significantly throughout the year.

The wetter season lasts 5.4 months, from April 30 to October 11, with a greater than 32% chance of a given day being a wet day. The month with the most wet days in Rajshahi is July, with an average of 18.7 days with at least 0.04 inches of precipitation.

The drier season lasts 6.6 months, from October 11 to April 30. The month with the fewest wet days in Rajshahi is December, with an average of 0.5 days with at least 0.04 inches of precipitation.

Among wet days, we distinguish between those that experience rain alone, snow alone, or a mixture of the two. The month with the most days of rain alone in Rajshahi is July, with an average of 18.7 days. Based on this categorization, the most common form of precipitation throughout the year is rain alone, with a peak probability of 63% on July 6.

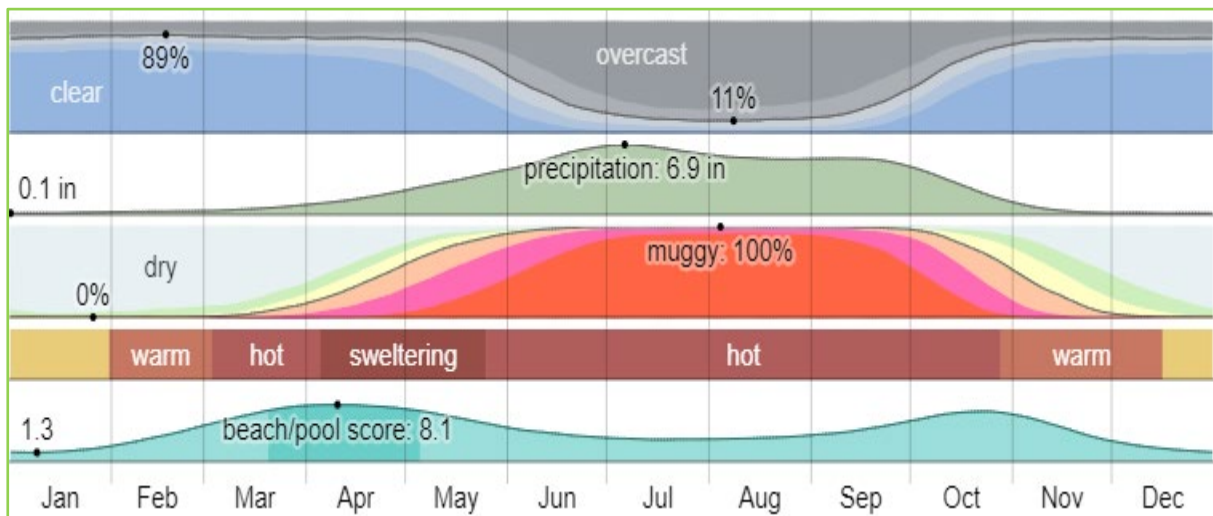


Figure 4.14 Graph showing Rajshahi weather by month

4.7.1.3 Rainfall of Rajshahi Region

To show variation within the months and not just the monthly totals, we show the rainfall accumulated over a sliding 31-day period centered around each day of the year. Rajshahi experiences extreme seasonal variation in monthly rainfall. The rainy period of the year lasts for 8.1 months, from March 11 to November 13, with a sliding 31-day rainfall of at least 0.5 inches. The month with the most rain in Rajshahi is July, with an average rainfall of 6.6 inches.

The rainless period of the year lasts for 3.9 months, from November 13 to March 11. The month with the least rain in Rajshahi is December, with an average rainfall of 0.2 inches.

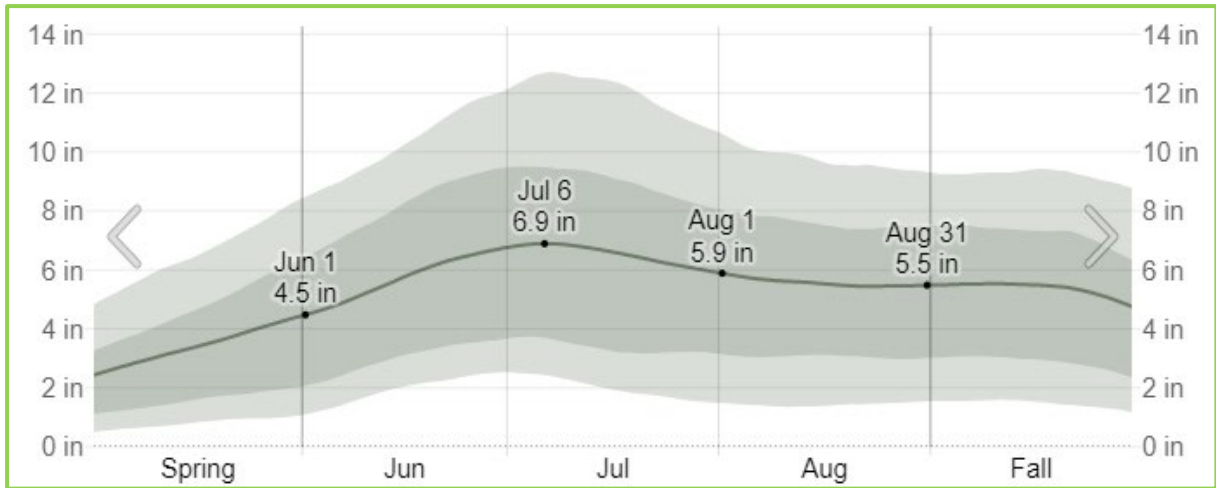


Figure 4.15 Monthly Average Rainfall of Rajshahi Region
<https://weatherspark.com/s/111604/1/Average-Summer-Weather-in-R%C4%81jsh%C4%81hi-Bangladesh#Figures-Temperature>

4.7.1.4 Humidity of Rajshahi Region

We base the humidity comfort level on the dew point, as it determines whether perspiration will evaporate from the skin, thereby cooling the body. Lower dew points feel drier and higher dew points feel more humid. Unlike temperature, which typically varies significantly between night and day, dew point tends to change more slowly, so while the temperature may drop at night, a muggy day is typically followed by a muggy night.

Rajshahi experiences extreme seasonal variation in the perceived humidity.

The muggier period of the year lasts for 7.2 months, from April 9 to November 14, during which time the comfort level is muggy, oppressive, or miserable at least 25% of the time.

The month with the fewest muggy days in Rajshahi is January, with 0.0 days that are muggy or worse.



Figure 4.16 Monthly Average Humidity Comfort Levels in Rajshahi Region
<https://weatherspark.com/s/111604/1/Average-Summer-Weather-in-R%C4%81jsh%C4%81hi-Bangladesh#Figures-Temperature>

4.7.1.5 Wind flow of Rajshahi Region

This section discusses the wide-area hourly average wind vector (speed and direction) at 10 meters above the ground. The wind experienced at any given location is highly dependent on local topography and other factors, and instantaneous wind speed and direction vary more widely than hourly averages.

The average hourly wind speed in Rajshahi experiences significant seasonal variation over the course of the year.

The windier part of the year lasts for 4.5 months, from April 23 to September 7, with average wind speeds of more than 6.9 miles per hour. The windiest month of the year in Rajshahi is June, with an average hourly wind speed of 8.9 miles per hour.

The calmer time of year lasts for 7.5 months, from September 7 to April 23. The calmest month of the year in Rajshahi is October, with an average hourly wind speed of 4.9 miles per hour.

The predominant average hourly wind direction in Rajshahi varies throughout the year.

The wind is most often from the **west** for 2.3 months, from February 2 to April 10, with a peak percentage of 58% on March 8. The wind is most often from the south for 5.9 months, from April 10 to October 7, with a peak percentage of 71% on June 1. The wind is most often from the north for 3.8 months, from October 7 to February 2, with a peak percentage of 62% on January 1.

Average Wind Speed in Rajshahi

This section discusses the wide-area hourly average wind vector (speed and direction) at 10 meters above the ground. The wind experienced at any given location is highly dependent on local topography and other factors, and instantaneous wind speed and direction vary more widely than hourly averages.

The average hourly wind speed in Rājshāhi is decreasing during the summer, decreasing from 8.4 miles per hour to 7.2 miles per hour over the course of the season.

For reference, on June 21, the windiest day of the year, the daily average wind speed is 9.0 miles per hour, while on October 24, the calmest day of the year, the daily average wind speed is 4.8 miles per hour.

The highest daily average wind speed during the summer is 9.0 miles per hour on June 21.

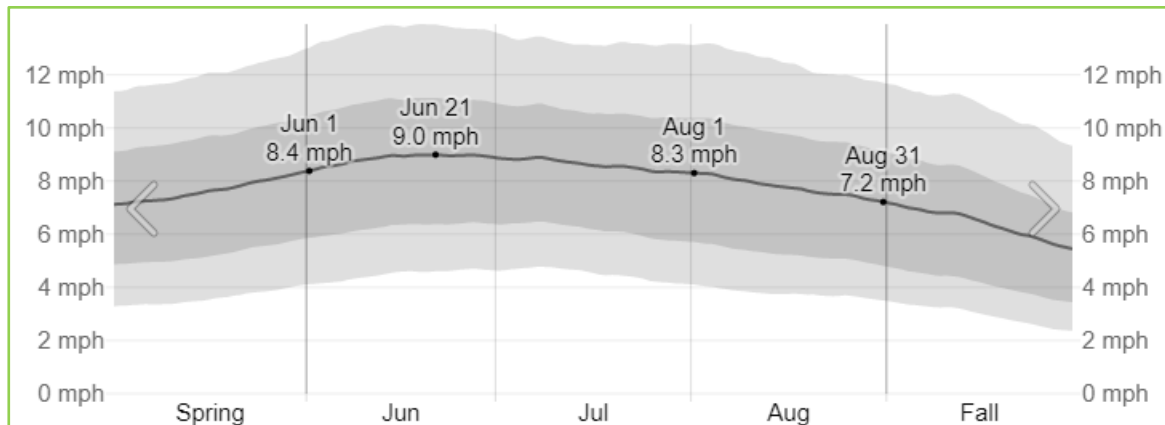


Figure 4.17 Average Wind Speed in Rajshahi

<https://weatherspark.com/s/111604/1/Average-Summer-Weather-in-Rajshahi-Bangladesh#Figures-Temperature>

Wind Direction in Rajshahi

The hourly average wind direction in Rājshāhi throughout the summer is predominantly from the south, with a peak proportion of 71% on June 1.

The percentage of hours in which the mean wind direction is from each of the four cardinal wind directions, excluding hours in which the mean wind speed is less than 1.0 mph. The lightly tinted areas at the boundaries are the percentage of hours spent in the implied intermediate directions (northeast, southeast, southwest, and northwest).

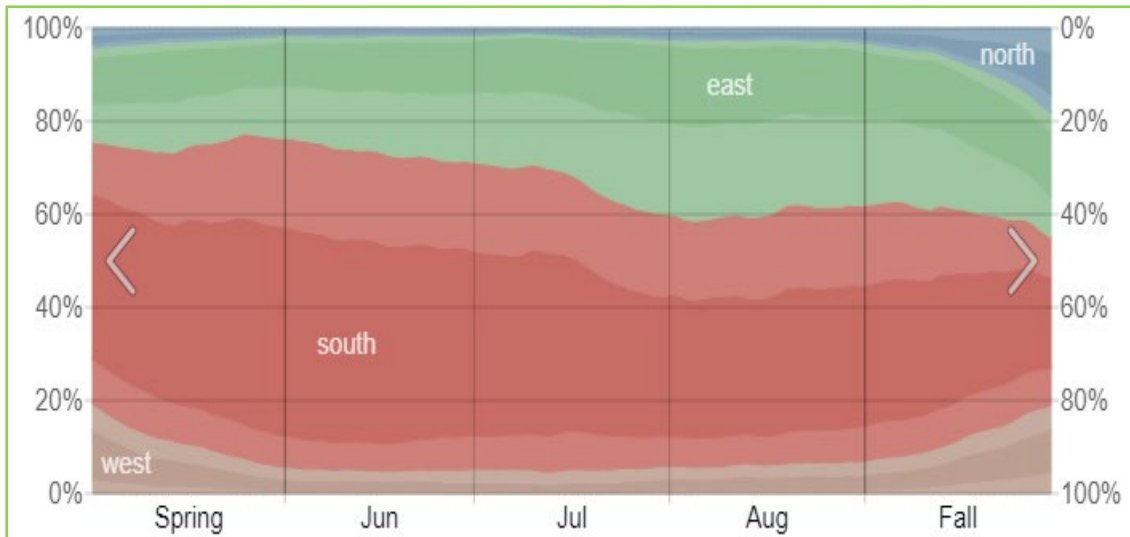


Figure 4.18 Monthly Wind Direction in Rajshahi

<https://weatherspark.com/s/111604/1/Average-Summer-Weather-in-Rajshahi-Bangladesh#Figures-Temperature>

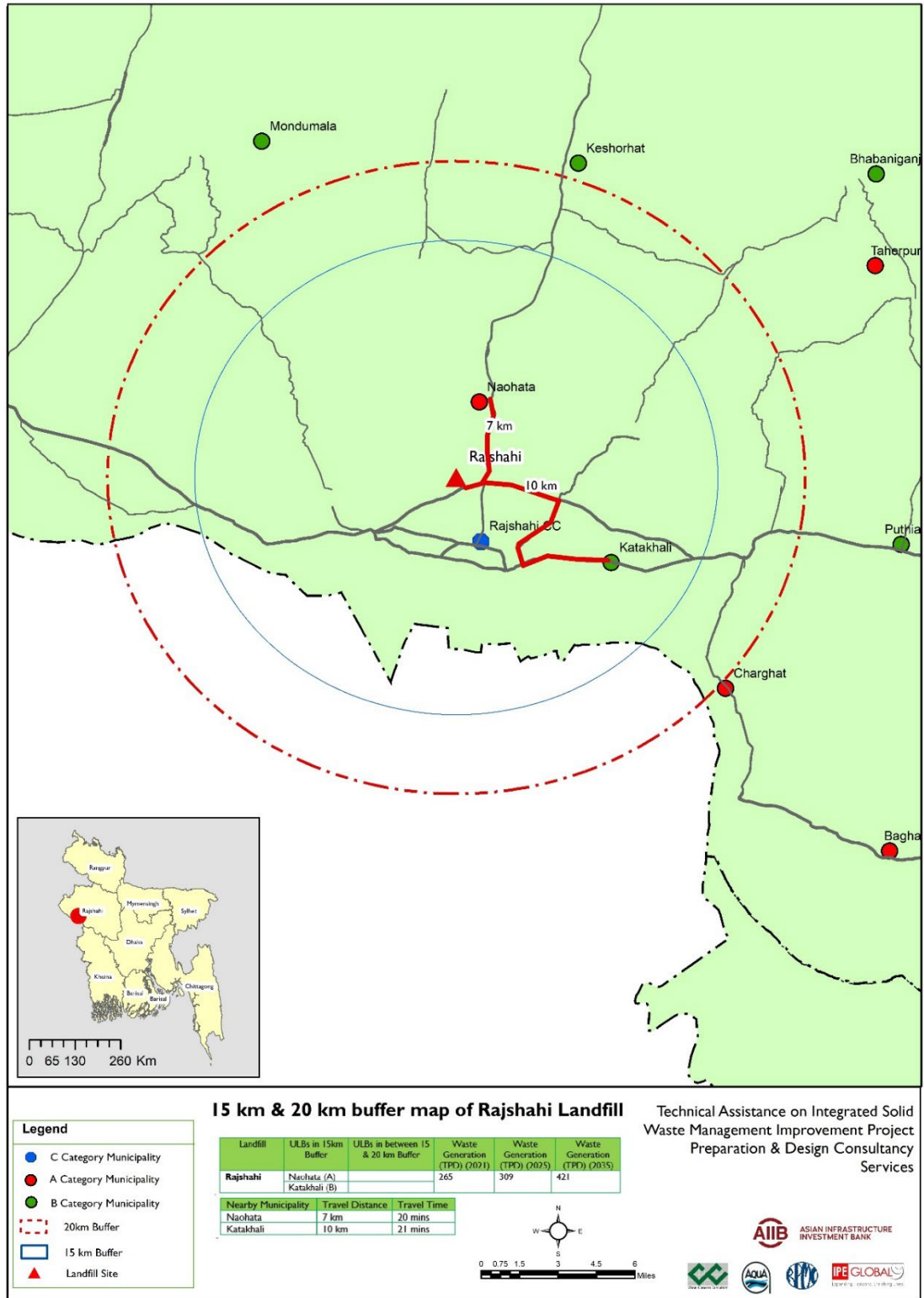


Figure 4.19 Map of 15 Km & 20 Km Buffer Area in RCC Landfill site

4.8 Biological Environment of Rajshahi City Corporation Area

4.8.1 Habitats

Habitat refers to the place or the location where an organism (or a biological population) lives, resides or exists. The term *habitat* came from the Latin “*habitātus*”, meaning “having been inhabited”

In ecology, a habitat is where a species of organism lives or thrives. It is the natural environment of that species. It is where it will derive its food, shelter, and mate for reproduction. It is where the species will attempt to be as adaptive as possible. Habitats may be an open geographical area or a specific site (e.g., a rotten log, a hollow tree, or inside a tree bark). They may be terrestrial or aquatic. Examples of terrestrial habitats are forest, grassland, steppe, and desert. Aquatic habitats include freshwater, aquatic water, and brackish water. Geographically, habitats may be classified into the following types: polar, temperate, subtropical, or tropical.

The aquatic systems include the coastline of the Bay of Bengal, the Ganges River and their tributaries, other freshwater rivers, Khals, wetlands (*beel*), oxbow lakes (*baor*), ponds, borrow-pits along roads and railways, and lakes.

4.8.2 Aquatic Life

The aquatic life includes aquatic plants (flora) and aquatic animals (fauna). Dhol Kolmi, Kolmi, water hyacinth, Halencha etc., as plant and snail, fishes, bull frog, tortoise, water birds among animal species are found common in aquatic habitat. Major fishes in the open water of the subproject area are carps (Rui, Catla, Mrigal, Ghania, Kalbasu, Kalia), cat fish (Tengra, Boal, Pangas, Aor, Bacha) and snake head (Shol, Gazar, Taki). Most fishes breed in the monsoon period.

4.8.3 Terrestrial Habitats

Trees are not a taxonomic group but include a variety of plant species that have independently evolved a woody trunk and branches as a way to tower above other plants to compete for sunlight. Trees tend to be long-lived, some reaching several thousand years old. In wider definitions, the taller palms, tree ferns, bananas, and bamboos are also trees. Trees are also an important part of the terrestrial ecosystem, providing essential habitats including many kinds of forests for communities of organisms. On the ground underneath trees there is shade, and often there is undergrowth, leaf litter, and decaying wood that provide others habitat. Cultivated trees are planted and tended by humans, usually because they provide foods (fruits or nuts), ornamental beauty, or some type of wood products that benefit the people. Unfortunately, the number of such types of plant species is rapidly decreasing due to urbanization. As a result, many species of trees especially grown naturally are now extinct or nearly extinct. Therefore, an enumeration of tree occurring in Rajshahi city is much wanting. Definitely, such a list would help researchers to distinguish the distribution and diversity of tree species in this city. The importance of studying local floristic diversity has been realized. Thus, the present study was made tree species diversity in the Rajshahi city. The islands of the river Padma of Rajshahi district, Bangladesh is rich in various plants and wild animals and adorned with natural beauty. Here, wildlife is facing severe threats due to constant river erosion, flood, and human-environment conflict. Poor communication system and lack of stable land, the Padma islands have been considered one of the safest zones for wildlife. Despite the remoteness of the area, a few insufficient and scattered research works have been done previously.

4.8.4 Flora and Fauna in the Subproject Area

There had been extensive field survey during the study to assess and also quantify to certain extent flora and fauna richness. These concentrated among others, on the wild life (amphibians, reptiles, birds and mammals), separately on fishes and also a floral species (Grass, shrubs, and timber/fuel wood trees and fruit trees).

Flora

The areas of Rajshahi district which fall within the Northern Ganges Basin Flood Plain and levee have soils sandy to sandy loam with grey colour and the areas under the Barind tract have the staff soil of reddish clayey loam. In the farm lands, varieties of crops namely rice, jute, vegetables, spices, pulses, oil seeds, beans etc. are produced. Sugarcane and mango are the major cash crops. Among rice crops, aman covers the largest area followed by aus and boro. Minor crops include barley, potato, motor and arhar etc. litchi, melon, water melon and other fruits are also cultivated. In the village's bamboo and tree growths are numerous. In the barind, palm is grown widely. Common trees found in this area include babla, shet khoiyer, chakua koroy, shiris, bilati siris, batul, akashmoni, catechu, raktachandhan, wood apple, motor koroy, ata, kadam, pitraj, betel-nut, jackfruit, kamranga, margosa, hijal, lotkan, cotton, bastard-teak, papaya, sonalu, jambura, coconut, barun, krishnochura, tamal, gab, olive, mandar, kodbel, batgas, dumur, ashatha, chila, jarul, bhadia, mendi, neem pitali, mango, nageswar, sajna, tut, debdaru, guava, dalim, herenda, boroi, katbadam, arjun, tatul, starapple, black berry, bara mehogoni, talla bans, beora bans, choibans etc. Some plants are grown at the homesteads mainly for aesthetic purposes. These are china box, gardenia, night queen, dolon champa, beli etc. Besides, the floating macrophytes like water hyacinth, topa pana etc. are commonly seen in the village ponds. In shallower ponds and beels are found species of lotus, water lily, bind weed, helencha and the like. List of floral species is given in Table 4.6.

Table 4.6 Floral Species in the Rajshahi Study Area

Sl. No.	Bangla Name	English Name	Type of plant	Scientific Name
1	Aam	Mango tree	Fruit, Timber	<i>Mangifera indica</i>
2	Akashmoni	<i>Akashmoni</i>	Timber, Fuel	<i>Acacia moniliformis</i>
3	Arjun	<i>Arjun</i>	Medicinal	<i>Terminalia arjuna</i>
4	Ashatha	Fig	Tree	<i>Ficus religiosa</i>
5	Ata	Custard-apple	Fruit	<i>Anona squamosa</i>
6	Babla	Acacia	Timber, Fuel	<i>Acacia auriculiformis</i>
7	Bash	Bamboo	Woody plant	<i>Bambusa SP</i>
8	Bara mehogoni	Mahogany	Timber	<i>Swietenia macrophylla</i>
9	Barun	Garlic Pear Tree	Shrub	<i>Crataeva magna</i>
10	Palash	Bastard-teak	Medicinal	<i>Butea monosperma</i>
11	Batgas	Banyan	Timber	<i>Ficus benghalensis</i>

SI. No.	Bangla Name	English Name	Type of plant	Scientific Name
12	Batul	Pitali, Latim	False white teak/ Flowering plant	<i>Trewia nudiflora</i>
13	Beli	Jasmine	Climber	<i>Jasminun scandens</i>
14	Beora bans	Bamboo	Timber bamboo	<i>Bambusa tulda</i>
15	Bhadia	Ash tree/Gurjon	Plywood	<i>Lannea coromandelica</i>
16	Kolmi	Water spinach	Vegetable	<i>Ipomoea aquatic</i>
17	Kala jam	black plum	Fruit and timber	<i>Syzygium cumini</i>
18	Chakua koroy	Chinese Albizzia	Timber	<i>Albizzia chinensis</i>
19	Khoyer	Catechu	Medicinal	<i>Acacia catechu</i>
20	Nata karanja	Jungle cork tree	Timber	<i>Holoptelea integrifolia</i>
21	Comla jui	Orange jasmine / China box	Shrub/ small tree	<i>Murraya paniculata</i>
22	Choibans	Chinese dwarf bamboo	Timber bamboo	<i>Bambusa multiplex</i>
23	Lal shimul	Cotton	Cotton-tree flowers	<i>Bombax ceiba</i>
24	Dalim	Pomegranate	Fruit tree	<i>Punica granatun</i>
25	Debdaru, Saralgoch	Kind of pine	Fuel, Timber	<i>Polyalthia longifolia</i>
26	Dolon champa	white ginger lily	Flower tree	<i>Hedychium coronarium</i>
27	Dumur	Ficus tree	Woody tree	<i>Ficus sp.</i>
28	Gab	Mangoes teen	Fruit, Timber	<i>Diospyros peregrina</i>
29	Gardenia	Cape jasmine	Flower tree	<i>Gadenia augusta</i>
30	Payara	Guava	Fruit tree	<i>Psidium guajava</i>
31	Halencha	Halencha	Vegetable	<i>Enhydro fluctuans</i>
32	Helencha	alligator weed	Food and a medicine	<i>Telanthra philoxcroides</i>
33	Herenda	Ricinus	castor oil plant	<i>Ricenus communis</i>
34	Hijal	Indian Oak	Medicinal	<i>Barringtonia acutangula</i>
35	Jambura	Pomelo	Fruit tree	<i>Citrus decumana</i>
36	Jarul	Queen Crepe Myrtle	Flowering plant	<i>Legerstroemia speciosa</i>
37	Kanthal	Jack fruit	Fruit, Timber	<i>Artocarpus heterophyllus</i>

Sl. No.	Bangla Name	English Name	Type of plant	Scientific Name
38	Kamranga	Star Fruit	Fruit tree	<i>Averrhoa carmabola</i>
39	Kadam	<i>Kadam</i>	Flowering plant	<i>Anthocephalus chinesis</i>
40	Katbadam	Indian almond	Medicinal	<i>Terminalia catappa</i>
41	Kodbel	Wood-apple	Fruit	<i>Limonia acidissima</i>
42	Krishnachura	<i>Krishnachura</i>	Flower, Timber	<i>Delonix regia</i>
43	Kul / boroi	Jujube	Fruit, timber	<i>Zizyphus mauritiana</i>
44	Lotkan	Burmese grape	Fruit	<i>Baccaurea ramiflora</i>
45	Lotus	Laxmi lotus	Flowering plant	<i>Nelumbo nucifera</i>
46	Mandar	Coral tree	Coral fruit, Fuel	<i>Rythrina variegata</i>
47	Mendi	Henna tree	Shrub or small tree	<i>Lawsonia inermis</i>
48	Motor koroy	Siris	Timber	<i>Albizia luciditor</i>
49	Shiris	Broome raintree	Timber	<i>Abizzia lebbeck</i>
50	Nageswar	Ceylon ironwood	Tree or shrub	<i>Mesua nagassarium</i>
51	Narikel, Dab	Coconut	Fruit, Oil	<i>Cocos nucifera</i>
52	Neem pitali	Rusty kamala	Flowering plant	<i>Mallotus albus</i>
53	Nim	Margosa	Timber, Fuel	<i>Azadirachta indica</i>
54	Hasnahena	Night queen	Flowering plant	<i>Cestrum nocturnum</i>
55	Nard champa	Olive	Flowering plants	<i>Elaeocarpus tectorius</i>
56	Pepe	Papaya	Fruit	<i>Carica papaya</i>
57	Pitraj	Pithraj tree	Timber	<i>Aphanamixls polystachia</i>
58	Raktachandhan	Red sanders	Timber	<i>Pterocarpus santalinus</i>
59	Sonajhuri	Wattles or acacias	Shrub/tree	<i>Acacia suma</i>
60	Sonalu	Golden shower	Flowering plant	<i>Cassia fistula</i>
61	Starapple	Water apple	Flowering plant	<i>Syzygium samarengense</i>
62	Supari	Betel Nut	Fruity, Timber	<i>Areca catechu</i>
63	Bilati siris	Rain tree	Flowering plant	<i>Samanea saman</i>
64	Sajna	Drumstick	Vegetable	<i>Moringa oleifera</i>

Sl. No.	Bangla Name	English Name	Type of plant	Scientific Name
65	Talla bans	Indian Timber bamboo	Bamboo	<i>Bambusa tulda</i>
66	Tamal	Bombay ebony	Flowering plant	<i>Diospyros montana</i>
67	Tetul	Tamarind-tree	Timber, Fuel	<i>Tamarindus indicus</i>
68	Topa pana	Water lettuce	freely floating water plant	<i>Pistiastratiotes lemna spirodela</i>
69	Tut	White mulberry	Fruit tree	<i>Morus alba</i>
70	Kochuripana	Water hyacinth	Aquatic plant	<i>Eichhorina crassipes</i>
71	Shapla	Water lily	Flowering aquatic plant	<i>Nymphaea pubescens</i>
72	Bell fal	Wood apple	Fruit tree	<i>Aegle marmelos</i>

Source: BBS district statistics Rajshahi 2011 and Field Survey by ESIA Team of ISWMIP, 2022

Fauna

Findings of the survey have been presented in Table 4.7 -Table 4.11, respectively.

Amphibians: Among the amphibians the most common are Kotkoti bang, jhijhi bang, bhawa bang, Kuno bang etc., (Table 4.7).

Table 4.7 Amphibian Faunal Species in the Study Area

Sl. No.	Bangla Name	English Name	Scientific Name
1	Kuno bang	Common Toad	<i>Bufo melanostictus</i>
2	Kotkoti Bang	Skipper Frog	<i>Rana cyanophyctis</i>
3	Jhijhi Bang	Rice Field Frog	<i>Rana limnocharis</i>
4	Sona Bang/Bhawa bang	Bull Frog	<i>Rana tigrina</i>

Source: BBS district statistics Rajshahi 2011 and Field Survey by ESIA Team of ISWMIP, 2022

Reptiles: The district contains in its area few species of reptiles. The reptiles include different species snakes, lizard, and tortoises, iguana, python, cobra and other varieties of poisonous snakes are found almost all over the district. The commonest poisonous snakes are kal-keotey (*Bungarus fasciatus*), the raj ghokra and the shankhini snake. The chandrabora snake is also common. Of non-poisonous snakes, the largest is the darash. Other common snakes are dhora shap and ghargini shap. List of reptilian fauna is given in Table 4.8.

Table 4.8 Reptilian Faunal Species in the Study Area

Sl. No.	Bangla Name	English Name	Scientific Name
1	Shankhini snake	Common krait	<i>Bungarus caeruleus</i>
2	Kal-keotey	Banded krait	<i>Bungarus fasciatus</i>

Sl. No.	Bangla Name	English Name	Scientific Name
3	Tik Tiki	Lizard	<i>Hemidactylus brooki</i>
4	Kochchhop	Tortoise	<i>Kachuga tecta</i>
5	Ghargini shap	Twin-spotted wolf snake	<i>Lycodon jara</i>
6	Gokhra sap	Cobra	<i>Naja naja</i>
7	Raj ghokra	King Cobra	<i>Ophiophagus hannah</i>
8	Darash	Indian rat snake	<i>Ptyas mucous</i>
9	Deshi Ajogor	Iguana, python	<i>Python molurus</i>
10	Dora sap	Water snake	<i>Xenochrophis piscator</i>

Source: BBS district statistics Rajshahi 2011 and Field Survey by ESIA Team of ISWMIP, 2022

Birds: The resident birds those are usually found in this district are crow, raven, machranga/kingfisher (*Alcedo atthis*), wood-pecker, bhat shalik, jhuti shalik, choto finge, halde pakhi, doyel, sparrow, cuckoo, tila ghugu, water hen, swallow, bulbuli, kali pencha, loxme pacha etc. besides, various species of migratory birds like greenleg goose, raj hash, pitail, geria hash, kadakhucha, chokachoki, khanjon etc. are seen in water bodies of the district during winter season. List of Aves fauna is given in Table 4.9.

Table 4.9 Aves Faunal Species in the Study Area

Sl. No.	Bangla Name	English Name	Scientific Name
1	Jhuti salik	Jungle myna	<i>Acridotheres fuscus</i>
2	Bhat salik	Common myna	<i>Acridotheres tristis</i>
3	Machranga	Common Kingfisher	<i>Alcedo atthis</i>
4	Dahuk	White breasted waterhen	<i>Amaurornis phoenicurus</i>
5	Lenja hansh	Pitail	<i>Anas acuta</i>
6	Geria hansh	Garganey	<i>Anas querquedula</i>
7	Dhusor Rajhas	Greenleg goose	<i>Anser anser</i>
8	Raj hash	Bar-headed goose	<i>Anser indicus</i>
9	Doyal	Magpie robin	<i>Copsychus saularis</i>
10	Dar kak	Jungle crow	<i>Corvus macrorhynchos</i>
11	Pati kak	House crow	<i>Corvus splendens</i>
12	Kokil	Indian cuckoo	<i>Cuculus microplerus</i>
13	Choto Finge	Black drongo	<i>Dicrurus macrocercus</i>
14	Kadakhucha	Common snipe	<i>Gallinago gallinago</i>
15	Kali pencha	Jungle owlet	<i>Glaucidium radiatum</i>
16	Halde pakhi	Black-hooded oriole	<i>Oriolus xanthornus</i>
17	Choroi	House sparrow	<i>Passer domesticus</i>
18	Bulbuli	Red-vented bulbul	<i>Picnonotus cafer</i>
19	Baya weaver	Swallow	<i>Ploceus philippinus</i>

Sl. No.	Bangla Name	English Name	Scientific Name
20	Tila ghugu	Spotted dove	<i>Streptopelia chinensis</i>
21	Chokachoki	Ruddy shelduck	<i>Tadorna ferruginea</i>
22	Chakhachoki	Ruddy Shelduck	<i>Tadorna ferruginea</i>
23	Lokki Pecha	Bran owl	<i>Tyto alba</i>

Source: BBS district statistics Rajshahi 2011 and Field Survey by ESIA Team of ISWMIP, 2022

Mammals: The char areas of the Rajshahi district are covered with thick reeds, bushes, tarmerisk bushes and heavy jungles which serve as a natural habitat for wild animals. Once wild buffaloes and maya horin used to be seen in the thatching grass, but they now totally disappeared. In the Barind, tigers, leopards used to follow the deer and hog to the valley. But they are no more seen. However, the common mammals are found in the jungles both in the chars and the Barind as well as homestead forests include wild cat, fox, mongoose, cola badur, tickell's bat, indian pipistrelle, dura kathbirail, bhondar, idur, metho Idur, common house rat, nengti idur etc. List of mammalian fauna is given in Table 4.10.

Table 4.10 Mammalian Faunal Species in the Study Area

SL. No.	Bangla Name	English Name	Scientific Name
1	Dhari Idur	Lesser Bandicoot rat	<i>Bandicota bengalensis</i>
2	Buno Mohish	Wild buffaloes	<i>Bubalus bubalis</i>
3	Pati Shial	Fox (Golden Jackal)	<i>Canis aureus</i>
4	Bon Biral	Wild cat	<i>Felis chaus</i>
5	Dura kathbirail	Northern palm squirrel	<i>Funumbalus pennant</i>
6	Badur	Tickell's bat	<i>Herperoptenus tickelli</i>
7	Beji	Mongoose	<i>Herpestes edwardsi</i>
8	Bhondar	Smooth-coated otter	<i>Lutra perspicillata</i>
9	Maya Horin	Deer	<i>Muntiacus muntjak</i>
10	Metho Idur	Field mouse	<i>Mus booduga</i>
11	Nengti Idur	House Mouse	<i>Mus musculus</i>
12	Chitabagh	Leopards	<i>Panthera pardus</i>
13	Chamchika	Indian pipistrelle	<i>Pipistrellus coromandra</i>
14	Boro Badur	Giant Flying Fox	<i>Pteropus giganteus</i>
15	Kalo Idur	Common house rat	<i>Rattus rattus</i>

Source: BBS district statistics Rajshahi 2011 and Field Survey by ESIA Team of ISWMIP, 2022

Fishes: With large water area the district is well stocked with fish. Some of the commonly available fishes are ruhi, mrigel, kalboush, katla etc. Shoil fish, Magur, Shing are also found in large quantity in beels and khals. Many other spieces of river and fresh water fishes are also found in the district. Of these the principal varieties are airh, pangas, chitol, koi, gozar etc. However, some of these varieties,

specially, those which inhabit the marshes and tanks, are dwindling due to over catching and other reasons such as use of insecticides and pesticides for crop production etc.

In addition, some exotic varieties of fish such as telapia, nilotica, silver carp, and grass carp are also cultivated in the district and they are also becoming very popular.

Moreover, a small number of hilsa is caught in the Padma river. It has a wide reputation for its excellent flavor and test. List of fishes is given the Table 4.11.

Table 4.11 Fish Faunal Species in the Study Area

Sl. No.	Bangla Name	English Name	Scientific Name
1	Kanoch	Indian Torent Catfish	<i>Amblyceps mangois</i>
2	Mola	Indian Carplet	<i>Amblypharyngodon mola</i>
3	Koi	Climbing perch	<i>Anabas testudineus</i>
4	Catla	Major Carp	<i>Catla catla</i>
5	Gazar	Mural snakehead	<i>Channa marulius</i>
6	Taki	Snakehead	<i>Channa punctatus</i>
7	Shoil	Snakehead	<i>Channa striatus</i>
8	Mrigel	Major Carp	<i>Cirrhinus cirrhosus</i>
9	Magur	Catfish	<i>Clarias batrachus</i>
10	Gheso Rui	Grass carp	<i>Ctenopharyngodon idellus</i>
11	Carpui	Common carp	<i>Cyprinus carpio</i>
12	Shingi	Stinging catfish	<i>Heteropneustes fossilis</i>
13	llish	Hilsa fish	<i>Hilsa ilisa</i>
14	Silver carp	Silver carp	<i>Hypophthalmichthes molitrix</i>
15	Kalboush	Black rohu	<i>Labeo calbasu</i>
16	Rui	Major Carp	<i>Labeo rohita</i>
17	Ayre	Long whiskered Catfish	<i>Mistus aor</i>
18	Tengra	Days mystus	<i>Mystus vittatus</i>
19	Chitol	Feather backs	<i>Natopterus chitala</i>
20	Telapia	Mozambique mouth-breeder	<i>Oreochromis mossambicus</i>
21	Telapia	Tilapia	<i>Oreochromis niloticus</i>
22	Pangash	River catfish	<i>Pangasius pangasius</i>
23	Batasi	Indian Potasi	<i>Pscudeutropicus atberinoides</i>
24	Thaipunti	Thaibarb	<i>Puntius gonionotus</i>
25	Shar punti	Silver barb	<i>Puntius sarana</i>
26	Sar Puti	Spot-fin swamp barb	<i>Puntius sophore</i>
27	Punti	Stigma barb	<i>Puntius stigma</i>
28	Tit Punti	Barb	<i>Puntius ticto</i>
29	Boal	Giant Catfish	<i>Wallago attu</i>

Source: BBS district statistics Rajshahi 2011 and Field Survey by ESIA Team of ISWMIP, 2022

Activities are not being located in the nearby area of Rajshahi City Corporation. There are no protected areas in or around sub-project sites, and no known areas of ecological interest. Detail design shows there are no trees at the sites that need to be removed.

- No trees, shrubs, or groundcover can be removed or vegetation stripped without the prior permission of the environment management specialist.

- All efforts shall be made to preserve trees by evaluation of minor design adjustments/ alternatives (as applicable) to save trees.
- Special attention shall be given for protecting giant trees and locally-important trees (with religious importance) during implementation.
- Prevent workers or any other person from removing and damaging any flora (plant/ vegetation) and fauna (animal) including fishing in any water body in the sub-project vicinity.
- Prohibit employees from poaching wildlife and cutting of trees for firewood.
- Plantation of trees at the surrounding landfill and approach road embankment and maintain the saplings for the duration of contract.

4.9 Acoustic Environment in Rajshahi City Corporation

Sub-project components are in nowdapara and located 8 km away from the city center. The nearest village is located approximately 3 km far from the proposed location. Additionally, the location is also 500m away from the RHD road. So, the noise level at the sub-project site is very minimum. Further, the volume of traffic that passes through these sections is not significant and traffic jams are not frequent. However vehicular movement can be considered as major cause of noise pollution.

The baseline noise level will be measured by the sub-project contractors prior to commencement of work. The results will be provided in the Quarterly Environmental Monitoring Report and all other measurements during implementation will be reported as part of ESMP implementation.

4.9.1 Existing Traffic Noise of Rajshahi City Corporation

The sources of noise from a traffic stream can be separated into two components. The first is generated by the engine, exhaust system and transmission, and is the dominant noise source when traffic is not freely flowing, particularly from heavy vehicles which contribute most low frequency noise. Noise levels will vary primarily according to engine speed rather than vehicle speed. The second noise source component is generated from the interaction of tires, with the road surface and is the dominant noise source under free flow noise conditions at moderate to high road speeds and contributes a significant proportion of high frequency noise. Noise levels will vary depending on vehicle speed, the road surface and whether the surface is wet or dry.

The noise from a stream of traffic at a reception point at any one instant is an aggregation of noise from each of many vehicles at various distances. Among factors which influence a basic traffic noise level are traffic flow, speed and composition, road gradient and road surface characteristics. The noise level at a particular reception point will also be affected by other factors among which are distance from the noise source, the nature of the intervening ground surface and the present of obstructions.

Under the Rajshahi City Corporation subproject, the construction activities will be far from settlements, sensitive receptors and areas from small-scale businesses. Temporary increase in noise level and vibrations may be caused by excavation equipment and the transportation of equipment, materials, and people. However, the proposed sub-project situated out of core area and impact is short-term, site-specific and within a relatively small area. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.

- Involve the community in planning the work program so that any particularly noisy or otherwise invasive activities can be scheduled to avoid sensitive times.
- Plan activities in consultation with local authority so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance.

- Use of high noise generating equipment shall be stopped during night time.
- Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach;
- Utilize modern vehicles and machinery with the requisite adaptations to limit noise and exhaust emissions and ensure that these are maintained to manufacturers' specifications at all times.
- All vehicles and equipment used in construction shall be fitted with exhaust silencers. Use silent-type generators (if required).
- Monitor noise levels. Maintain maximum sound levels not exceeding 80 decibels (dBA) when measured at a distance of 10m or more from the vehicle/s.
- If it is not practicable to reduce noise levels to or below noise exposure limits, the contractor must post warning signs in the noise hazard areas. Workers in a posted noise hazard area must wear hearing protection.
- Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity. Complete work in these areas quickly.

4.9.2 Noise Level Measurement at Rajshahi City Landfill site

The Ambient Noise standards in Bangladesh as per the Department of Environment suggest standards for different categories of areas (

Table 4.12). To get up to date noise quality data near the proposed landfill sites, the noise level was measured. Noise measurement location and co-ordinates are given in Table 4.13 and Result of the monitoring of the noise level data presented in Table 4.14.

A total of 4 (four) Ambient Noise level (NL) measuring locations had been selected for the monitoring to understand the condition of the noise level at Rajshahi CC. These locations had been considered based on the potential sources of the construction activities and the nearest receptors.

Noise level measurement data were recorded during both day and night-time. The sound level meter was mounted on a tripod at 1.5m above ground level and at least 3.5m away from any sound-reflecting surfaces. The measurements were made using a Noise data logger. The SLM (Sound Level Meter) was calibrated before the noise monitoring survey. The sound level had recorded in the form of A-weighted equivalent continuous sound pressure level (Leq) values with the use of A-weighting filters in the noise measuring instrument. Noise level measurement data had been collected 8 hours in the day time with 2-minute interval and 4 hours at Night time with a 2-minute interval. Then noise level data were analyzed to Leq (day) and Leq (night).



Figure 4.20 Noise Level Measurement Photographs of Rajshahi CC Landfill Site

The Ambient Noise standards in Bangladesh as per the Department of Environment suggest standards for different categories of areas (Table 4.12).

Table 4.12 Standard for Ambient Noise Level

Sl. No.	Category of areas	Standards determined at dBA unit	
		Day	Night
1	Silent zone	50	40
2	Residential area	55	45
3	Mixed area	60	50
4	Commercial area	70	60
5	Industrial area	75	70

Reference of Standard: Ministry of Environment and Forest, Notification related to Environment Conservation Rules, 1997, Schedule 4 and subsequent amendments in 2006.

According to the area, the most part would fall under the 'Residential area' category.

- Notes:
 - a. The time from 6 a.m. to 9 p.m. counted as daytime.
 - b. The time from 9 p.m. to 6 a.m. counted as nighttime

The sampling points are listed in the Table 4.13 below.

Table 4.13 Ambient Noise Level Measurement Locations at Rajshahi CC

Sl. No.	Sampling Code	Name of the Point	Geographic Coordinates	
			Latitude (N)	Longitude (E)
01.	ANL1	Rajshahi City Corporation Landfill Site	24.40904167 N	88.59191111 E
02.	ANL2	Rajshahi City Corporation Landfill Site	24.411274 N	88.591444 E
03	ANL3	Rajshahi City Corporation Landfill Site	24.410864 N	88.593278 E
04	ANL4	Rajshahi City Corporation Landfill Site	24.40942500 N	88.59310000 E

Table 4.14 Ambient Noise Level Analysis Data of Rajshahi City Corporation

Site Location ID	Site Condition	Day Time (LAeq) dBA.	Nighttime (LAeq) dBA.	DOE Standard
ANL1	Preconstruction Stage	57.91	61.0	At residential area ❖ Day time 55 dBA ❖ Night time 45 dBA
ANL2	Preconstruction Stage	59.71	42.36	
ANL3	Preconstruction Stage	57.54	45.20	
ANL4	Preconstruction Stage	55.68	43.24	

4.10 Ambient Air Quality of RCC Landfill Area

The atmospheric air is basically polluted with hazardous substances emitted in the environment by the oil and gas production, oil extraction, oil and chemistry, energy, machine building and other industrial enterprises and vehicles.

The highest concentration of contaminating substances in the atmospheric air is observed during the unfavorable meteorological condition period (June–September). At this time, inversion and windless weather processes are repeated often in the above ground atmospheric layers and this has a direct impact on the collection of chemical compounds in the above ground air masses. Mainly natural (climate, relief, temperature, etc.) and anthropogenic factors have a direct impact on the formation of the background chemical composition of atmospheric precipitation.

Annually tones of solid substances, sulfur dioxide, carbon dioxide, of nitrogen oxide and carbon hydrogen are emitted in atmosphere by the industrial enterprises located in city area. Besides, tones of different hydrochloric compounds enter the atmosphere during the evaporation processes taking

place in the river. The impact of these wastes on the chemical composition of precipitation on the city area is of local scale, but their background chemical composition is mainly formed in the area of the country. As the evaporation processes have a miserable impact on other chemical substances including nitrates, ammonium, phosphates and magnesium concentrations their indicators usually do not change during the year.



Figure 4.21 Ambient Air Quality Measurement Pictures and Locations

The baseline survey program related to the atmospheric air quality include the following:

PM₁₀, PM_{2.5}, NO₂, SO₂, CO, O₃ and Methane

PM₁₀ (Particulate Matter 10)

Particulate Matter are inhalable pollutant particles with a diameter less than 10 micrometers. Particles that are larger than 2.5 micrometers can be deposited in airways, resulting in health issues. Exposure can result in eye and throat irritation, coughing or difficulty breathing, and aggravated asthma. More frequent and excessive exposure can result in more serious health effects.

PM_{2.5} (Particulate Matter 2.5)

Fine Particulate Matter are inhalable pollutant particles with a diameter less than 2.5 micrometers that can enter the lungs and bloodstream, resulting in serious health issues. The most severe impacts are on the lungs and heart. Exposure can result in coughing or difficulty breathing, aggravated asthma, and the development of chronic respiratory disease.

NO₂ (Nitrogen Dioxide)

Breathing in high levels of Nitrogen Dioxide increases the risk of respiratory problems. Coughing and difficulty breathing are common and more serious health issues such as respiratory infections can occur with longer exposure.

SO₂ (Sulfur Dioxide)

Exposure to Sulfur Dioxide can lead to throat and eye irritation and aggravate asthma as well as chronic bronchitis.

CO (Carbon Monoxide)

Carbon Monoxide is a colorless and odorless gas and when inhaled at high levels can cause headache, nausea, dizziness, and vomiting. Repeated long-term exposure can lead to heart disease

O₃ (Ozone)

Ground-level Ozone can aggravate existing respiratory diseases and also lead to throat irritation, headaches, and chest pain.

CH₄ (Methane)

Methane (CH₄) is a hydrocarbon that is a primary component of natural gas. Methane is also a greenhouse gas (GHG), so its presence in the atmosphere affects the earth's temperature and climate system. Methane is emitted from a variety of anthropogenic (human-influenced) and natural sources.

In city corporation area the combustion of fuels in motor vehicles produces mainly carbon dioxide and nitrogen. Some fuel remains unburnt or partially burnt. This results in the additional presence in exhaust emissions of hydrocarbons and other organic compounds, together with carbon monoxide and carbon soot. At the high temperatures and pressure some nitrogen is oxidized to form various oxides of nitrogen. Carbon monoxide and NO_x have implications for health and plant life is regarded as pollution. Since the landfill site is located in urban areas, hence pollution level is distributed over vast urban area and the concentration would be a minimum. The air quality data is presented in Table 4.15 & Table 4.16.

Table 4.15 Ambient Air Quality Sampling Locations at Rajshahi City Corporation

Sl. No.	Sampling Code	Sampling Location	Geographic Coordinates	
			Latitude (N)	Longitude (E)
1	AAQ1	Beside Rajshahi City Corporation Landfill Site	24.40962778 N	88.59182778 E
2	AAQ2	Outside Rajshahi City Corporation Landfill Site	24.41040556°N	88.59201111° E

Table 4.16 Air Quality Test Results of Rajshahi City Corporation Subproject

Parameter	Unit	Method	AAQ1	AAQ2	DOE Air Quality Standard*
Carbon Monoxide (CO)	ppm	Jacob and Hochheiser	0	0	20 (1hr) 5 (8hr)
Particulate Matter (PM ₁₀)	µg/m ³	Gravimetric	68.65 (8hr)	76.69 (8hr)	150 (24hr) 50 (Annual)
Particulate Matter (PM _{2.5})	µg/m ³	Gravimetric	62.23 (8hr)	65.61 (8hr)	65 (24hr) 35 (Annual)
Sulfur Dioxide (SO ₂)	µg/m ³	West-Geake	47.18	93.32	250 (1hr) 80 (24hr)
Ammonia (NH ₃)	µg/m ³	Ammonia meter	0	0	400 (24hr) 100 (Annual)
Methane (CH ₄)	%	IR methodology	0	0	N/A

*Landfill and surrounding area Air Quality Standard as per Gazette of Ministry of Environment, Forest and Climate Change (MEFCC) published on 23 December 2021

Carbon Monoxide

Eight (8) hourly CO concentrations were reported 0.0ppm at both the monitoring location AAQ1 and AAQ2 while comparing with the Bangladesh Standards of 8 hourly bases (9 ppm).

Particulate Matter 10 (PM₁₀)

PM₁₀ had been measured and the data was represented for the 8 hours' period. The lowest concentration (68.65µg/m³) was found in AAQ1. Highest concentration (76.69µg/m³) was found in AAQ2. From the testing data, it was observed that in all the two points, PM₁₀ value was found within the national standard (150 µg/m³) level of Bangladesh.

Particulate Matter 2.5 (PM_{2.5})

The 8 hourly PM_{2.5} concentrations in ambient air quality in the sampling area was recorded and the maximum PM_{2.5} concentration was reported at (AAQ2) was 65.61µg/m³. The minimum PM_{2.5} concentration was reported at (AAQ1) was 62.23µg/m³. All the monitoring locations' results were lower than the 24-hourly National Ambient Air Quality Standard (NAAQS) for PM_{2.5} in Bangladesh.

Sulphur-Dioxide (SO₂)

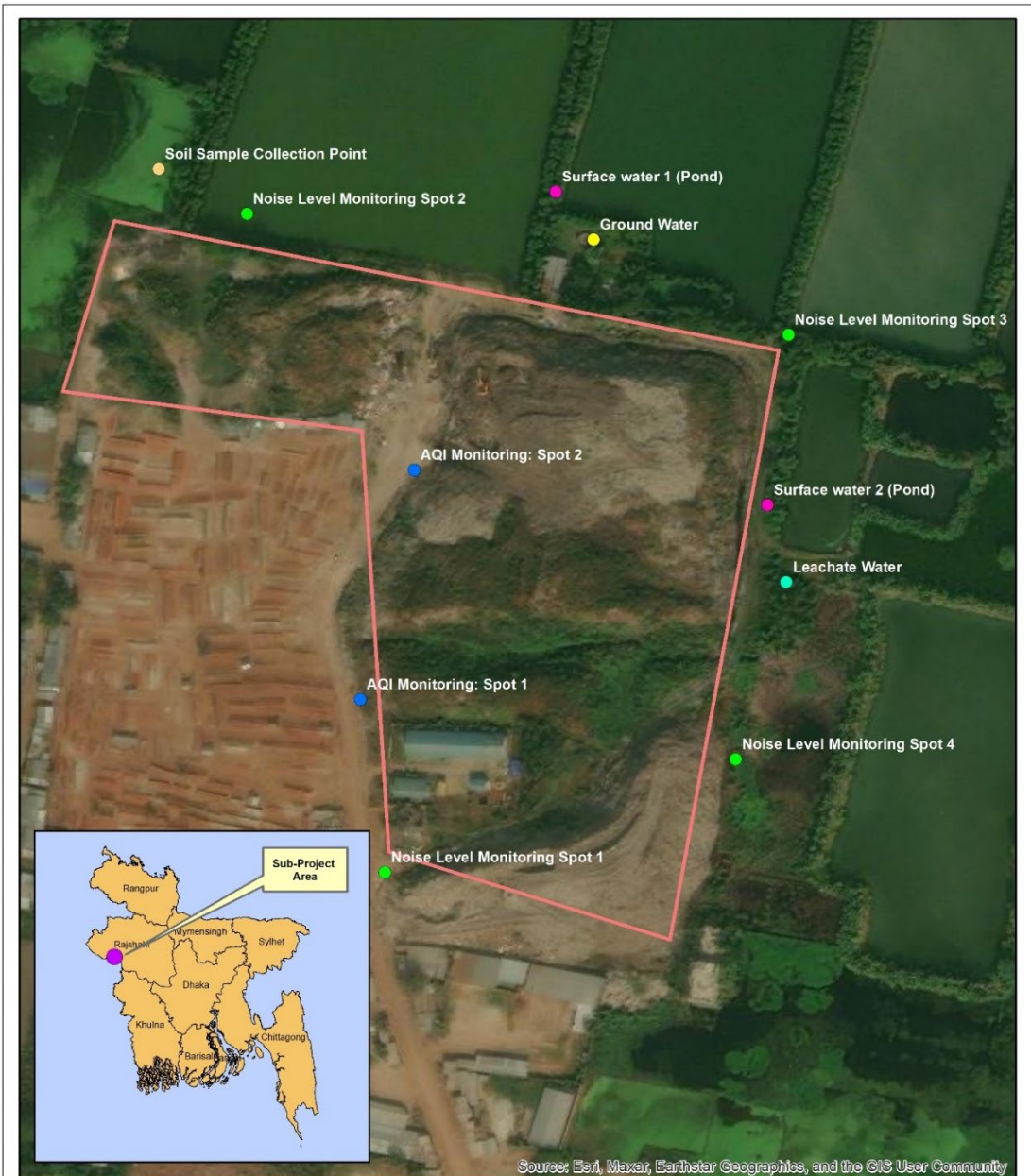
The SO₂ concentration was recorded 47.18µg/m³ in AAQ1 location. Concentration of SO₂ is reported 93.32µg/m³ at AAQ1. The highest value of SO₂ was found in AAQ2 and lowest value was recorded in AAQ1. SO₂ concentrations for all locations were reported well below the National Ambient Air Quality Standard (NAAQS) for SO₂ (250µg/m³) in Bangladesh.

Ammonia (NH₃)

The NH₃ concentration was recorded 0.0µg/m³ in both the locations AAQ1 and AAQ2.

Methane (CH₄)

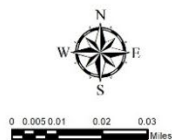
The CH₄ concentration was recorded nil at AAQ1 and AAQ2.



Map Showing Spots of Air Quality and Noise Monitoring, Soil and Water Samples at Rajshahi Municipality

Legend

- Air Quality Monitoring Spot
- Ground Water Spot
- Noise Monitoring Spot
- Leachate Water
- Surface water (Pond)
- Soil Collection Point
- Rajshahi Landfill



Technical Assistance on Integrated Solid Waste Management Improvement Project
Preparation & Design Consultancy Services



Figure 4.22 Map Showing Environmental Quality Parameters Sampling Spots

4.11 Surface and Ground Water Quality of the Subproject Area

Trenching and excavation, run-off from stockpiled materials, and contamination from fuels and lubricants may result to silt-laden runoff during rainfall that may cause siltation and reduction in the quality of adjacent bodies of water. However, the site is located in the low-lying land of Nawdapara and there are some water bodies like ponds along the approach road ROW. The nearest water body from the SLF site is the local in low land area. Therefore, the expected impacts are moderate negative but short term, site-specific within a relatively small area and reversible by mitigation measures.

- Prepare and implement a spoils management plan.
- Prioritize re-use of excess spoils and materials in construction activities. If spoils will be disposed, consult with city corporation local authority on designated disposal areas.
- All earthworks must to be conducted during dry season to maximum extent possible to avoid the difficult working conditions that prevail during monsoon season such as problems from runoff.
- Location for stockyards for construction materials shall be identified at least 300m away from watercourses.
- Place storage areas for fuels and lubricants away from any drainage leading to water bodies.
- Take all precautions to minimize the wastage of water in the construction activities.
- Take all precautions to prevent entering of wastewater into streams, watercourses, or irrigation system.
- Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies.
- Ensure diverting storm water flow during construction shall not lead to inundation and other nuisances in low-lying areas.
- While working across or close to any water body, the flow of water must not be obstructed.
- Ensure no construction materials like earth, stone, or appendage are disposed of in a manner that may block the flow of water of any watercourse and cross drainage channels.
- Monitor water quality according to the environmental management plan.

4.11.1 Surface Water Quality of the Subproject Area

Water grab samples are “single point in time” measurements. They only relate to the sampling point (water column) at the instant the sample is taken. Water samples have the shortest temporal (time) and spatial (area/location) coverage of all measurements taken by the consultant team.

Table 4.17 Surface Water Sampling Locations and GPS Coordinates at Rajshahi CC

Sl. No.	Sampling Code	Name of Sampling Point	Geographic Coordinates	
			Latitude (N)	Longitude (E)
01.	SWQ1	Pond-1, Rajshahi Landfill area	24.411349 ⁰ N	88.592490 ⁰ E
02.	SWQ2	Pond-2, Rajshahi Landfill site	24.410288 ⁰ N	88.593207 ⁰ E

Table 4.18 Surface Water Quality Parameters Analysis Data of Rajshahi CC

Parameter	Unit	SWQ1 Results	SWQ2 Results	Bangladesh Standard for Drinking Water (ECR'97)	WHO Guideline for Drinking Water, 2004	Method
Faecal coliforms	CFU/100ml	560	1000	-	-	Membrane Filtration
pH	-	9.13	8.06	6.5-8.5	6.5-8.5	Electronic (pH Meter)
Total dissolved solids (TDS)	mg/L	314	548	1000	<1000	Electrical Conductivity
Total Alkalinity as CaCO ₃	mg/L	275	300	-	-	Titrimetric
Biochemical Oxygen Demand (BOD ₅ , 20°C)	mg/L	15	<2.0	0.2	-	5-Day BOD Test
Nitrate (NO ₃)	mg/L	6.56	7.65	10	<45	Ion Chromatography
Iron	mg/L	0.76	1.15	0.3-1.0	<0.3	FAAS
Sulphate	mg/l	18.30	16.92	400	<400	Ion Chromatography
Total Suspended Solids (TSS)	mg/L	173	104	10	-	Gravimetric
Arsenic	mg/l	0.014	0.004	0.05	0.01	HGAAS

Reference of Standard: Ministry of Environment, Forest and Climate Change notification related to Environment Conservation Rules, 1997. Schedule10 (Inland Surface Water). No preservative was used but ice box was used at sampling time because sample drop at laboratory within 24 hours from water sampling.

Faecal coliforms (FC)

The acceptable range of Faecal coliform set by the DoE is 0. The Faecal coliform value was found 560 CFU/100ml in SWQ1 and that of SQW2 was found 1000 CFU/100ml. The Faecal coliform value found very higher in respect of DOE standard which is 0/100ml.

pH

The acceptable range of pH set by the DoE is between 6.5 and 8.5. This is the range, which indicates adequate protection to the life of freshwater fish and bottom dwelling invertebrates. The pH value was found 9.13 in SWQ1 and 8.06 in SWQ2. The pH value followed both Bangladesh standards (ECR, 1997) and WHO guideline.

Total Dissolved Solids (TDS)

The concentration of Total Dissolved Solid (TDS) of surface water was found 314mg/l & 548mg/l in SWQ1 and SWQ2 respectively. The highest concentration had been found at SWQ1 and lowest concentration was found in SWQ2. Both the values found within Bangladesh and WHO standard. There is stipulated standard of surface water in Bangladesh and that is 1000mg/l as per guideline of DOE for TDS.

Total Alkalinity as CaCO₃

The standard for surface water for Total Alkalinity as CaCO₃ is not available. The concentration of Total Alkalinity as CaCO₃ of sampled surface water SWQ1 was found 275 mg/l. The Total Alkalinity value of SWQ2 was found 300mg/l. The test result showed that the Total Alkalinity value of Rajshahi landfill site was found within the limit though the standard value is unknown.

Biochemical Oxygen Demand (BOD₅)

BOD₅ in sample SWQ1 was found 15mg/l which is very higher than standard level as per ECR'97. This value of sample SWQ2 was also found higher (<2.0mg/l). The stipulated standard for BOD₅ in Bangladesh is 0.2mg/L.

Nitrate (NO₃)

Nitrate value in sample SWQ1 had been found 6.56mg/l and that of SWQ2 was found 7.65mg/l. Both the values were found within the Bangladesh standard value and WHO standard value. The stipulated standard value for nitrate in Bangladesh is 10 mg/l and that of WHO is <45mg/l for surface water.

Iron (Fe)

The iron concentration in the sampling point SWQ1 was found 0.76mg/l and in SWQ2 it was found 1.15mg/l. Both the values were more than the standard level (0.3-1.0mg/l) as per ECR'97 and the WHO standards (<0.3mg/l).

Sulphate (SO₄)

Sulphate value in the sample SWQ1 had been found 18.30mg/l and that of SWQ2 was found 16.92mg/l. Both the values were found within the Bangladesh standard value and WHO standard value. The stipulated standard value for Sulphate in Bangladesh is 400 mg/l and that of WHO is <400mg/l for surface water.

Total Suspended Solids (TSS)

The concentration of Total Suspended Solid (TSS) of surface water SWQ1 was found 173mg/l and that of SWQ2 was found 104 mg/l respectively. The highest concentration had been found at SWQ1 and lowest concentration was found in SWQ2. The stipulated standard for surface water of Bangladesh is 150mg/l as per guideline of DOE for TSS.

Arsenic (As)

Arsenic concentration of all the two surface water samples SWQ1 & SWQ2 were found 0.014mg/l & 0.004mg/l respectively and are within the national and WHO standards. The standard value of Arsenic is 0.05mg/l as per ECR'97 and that of WHO standard is 0.01mg/l.



Figure 4.23 Surface Water Sampling Photos at RCC Landfill Site

4.11.2 Ground Water Quality

Two representative samples of groundwater points at Rajshahi CC landfill area were collected on 7.02.2023 to analyze Faecal coliforms, pH, Total Dissolved Solids (TDS), Total Alkalinity as CaCO₃, Biochemical Oxygen Demand (BOD₅), Nitrate (NO₃), Iron (Fe), Sulphate (SO₄), Total suspended Solids (TSS) and Arsenic (As). The analyses of the parameters have been done in Laboratory of Environmental Health, ICDDR, B, Dhaka, and the result dated 20.02.2023 has been placed in the report. One ground water sample (GWQ) was collected from the Rajshahi City Corporation landfill site. Sampling location of the ground water is given in Table 4.19 and Figure 4.22. The sample was tested and analyzed as per different standard procedure/methods in the Laboratory of Environmental Health, ICDDR, B, Dhaka. The methodology for the ground water testing and tested results is given in the Table 4.20.

Table 4.19 Ground Water Sampling Location and GPS Coordinates at Rajshahi CC

Sl. No.	Sampling Code	Name of the Point	Geographic Coordinate	
			Latitude (N)	Longitude (E)
01.	GWQ	Rajshahi CC Landfill site dip tube-well	24.411187°N	88.592618°E

Table 4.20 Ground Water Quality Parameters Analysis Data of Rajshahi CC

Parameter	Unit	GWQ Results	Bangladesh Standard for Drinking Water (ECR'97)	WHO Guideline for Drinking Water, 2004	Method
Faecal coliforms	CFU/100ml	0	0	0	Membrane Filtration
pH	-	7.12	6.5-8.5	6.5-8.5	Electronic (pH Meter)
Total dissolved solids (TDS)	mg/l	601	1000	<1000	Electrical Conductivity
Total Alkalinity as CaCO ₃	mg/l	475	-	-	Titrimetric

Parameter	Unit	GWQ Results	Bangladesh Standard for Drinking Water (ECR'97)	WHO Guideline for Drinking Water, 2004	Method
Biochemical Oxygen Demand (BOD ₅ , 20°C)	mg/l	<2.0	0.2	-	5-Day BOD Test
Nitrate (NO ₃)	mg/l	12	10	<45	Ion Chromatography
Iron	mg/l	1.02	0.3-1.0	<0.3	FAAS
Sulphate	mg/l	9.39	400	<400	Ion Chromatography
Total Suspended Solids (TSS)	mg/l	<10.0	150	-	Gravimetric
Arsenic	mg/l	0.008	0.05	0.01	HGAAS

Reference of Standard: Ministry of Environment and Forest, Notification related to Environment Conservation Rules, 1997. Schedule 3.

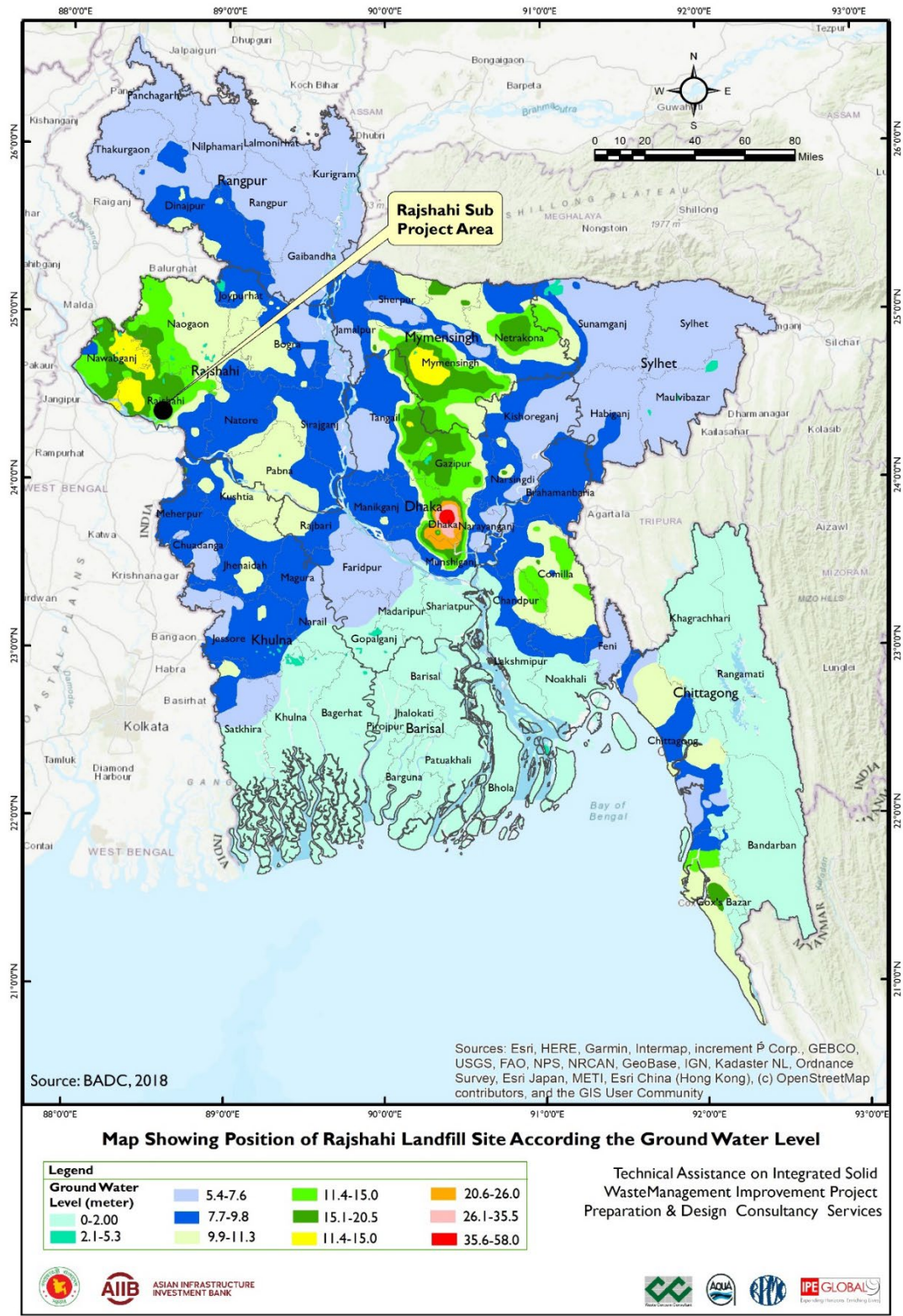


Figure 4.24 Map Showing the Rajshahi Landfill Site Ground Water Level



Figure 4.25 Ground Water Sampling Pictures of RCC Landfill Site Tube well

Faecal Coliforms (FC)

The acceptable range of Faecal coliform set by the DoE is 0/100ml. No Faecal coliforms was found in the sampled ground water (Tube well water) of Rajshahi City Corporation landfill area. The Faecal coliform value complied with the DOE standard.

pH

The acceptable range of pH set by the DoE is between 6.5 and 8.5. This is the range, which indicates adequate protection to the life of human being. The pH value was found 7.12. The pH value follows both Bangladesh standards (ECR, 1997) and WHO guideline.

Total Dissolved Solid (TDS)

The standard for ground water for Total Dissolved Solids is 1000mg/L. The concentration of Total Dissolved Solid (TDS) of sampled ground water (GWQ) was found 601mg/l. Test result showed that the TDS value of Rajshahi landfill site was found within the national standard.

Total Alkalinity as CaCO₃

The concentration of Total Alkalinity as CaCO₃ of sampled ground water (GWQ) was found 475.0 mg/l. The Bangladesh standard for ground water for Total Alkalinity as CaCO₃ is not available.

Biochemical Oxygen Demand (BOD₅)

BOD₅ value in the sample was found <2.0 which is within the standard level as per ECR'97. The stipulated standard for BOD₅ in Bangladesh is 0.2mg/l.

Nitrate (NO₃)

Nitrate value in the sample (GWQ) had been found 12mg/l. The stipulated standard for Nitrate in Bangladesh is 10 mg/l and as per WHO guideline is <45mg/l.

Iron (Fe)

The iron concentration in the sampled ground water was found 1.02mg/l. The iron concentration in the sampling point was less than the standard level (0.3-1.0mg/l) as per ECR'97 and the WHO standards (<0.3mg/l).

Sulphate (SO₄)

Sulphate value in sample GWQ was found 9.39mg/l. The value was found within the Bangladesh standard value and WHO standard value. The stipulated standard value for Sulphate in Bangladesh is 400 mg/l and that of WHO is <400mg/l for surface water.

Total Suspended Solids (TSS)

The concentration of Total Suspended Solid (TSS) of sampled ground water (GWQ) was found <10.0mg/l. There is stipulated standard in Bangladesh and that is 10mg/l as per guideline of DOE for ground water TSS.

Arsenic (As)

The value of Arsenic of the sampled water (GWQ) was found 0.008mg/l which is within the national and WHO standards. The standard value of Arsenic is 0.05mg/l as per ECR'97 and that of WHO standard is 0.01mg/l.

4.12 Leachate Water Quality of Rajshahi City Corporation Landfill

Table 4.21 Leachate Water Sampling Locations with Coordinates at Rajshahi CC

Sl. No.	Sampling Code	Name of the Point	Geographic Coordinates	
			Latitude (N)	Longitude (E)
01.	LWQ	Lechate pond of RCC	24.410026°N	88.593271°E

Table 4.22 Leachate Water Quality Parameters Analysis Data of Rajshahi CC

Parameter	Unit	LWQ Results	Bangladesh Standard for Drinking Water (ECR'97)	WHO Guideline for Drinking Water, 2004	Method
Faecal coliforms	CFU/100ml	20000	-	-	Membrane Filtration
pH	-	8.39	6-9	-	Electronic (pH Meter)
Total dissolved solids (TDS)	mg/L	5390	2100	-	Electrical Conductivity
Biochemical Oxygen Demand (BOD ₅ , 20°C)	mg/L	448	50	-	5-Day BOD Test
Nitrate (NO ₃)	mg/L	52.26	10	-	Ion Chromatography
Total Alkalinity as CaCO ₃	mg/l	2500.0	-	-	Titrimetric
Total Suspended Solids (TSS)	mg/l	480	150	-	Gravimetric
Iron (Fe)	mg/l	5.07	2	-	FAAS

Parameter	Unit	LWQ Results	Bangladesh Standard for Drinking Water (ECR'97)	WHO Guideline for Drinking Water, 2004	Method
Arsenic (As)	mg/l	0.021	0.2	-	HGAAS
Sulphate (SO ₄)	mg/l	68.06	-	-	Ion Chromatography

Reference of Standard: Ministry of Environment, Forest and Climate Change notification related to Environment Conservation Rules, 1997. Schedule 10 (Inland Surface Water). No preservative was used but ice box was used at sampling time because sample drop at laboratory within 24 hours from water sampling.

Faecal Coliforms (FC)

The acceptable range of faecal coliform set by the DoE is 0/100ml. Faecal coliforms found in the sampled leachate water (Landfill) of Rajshahi City Corporation landfill area was 20000/100ml. The Faecal coliform value is very high and does not comply with the DOE standard.

pH

The acceptable range of pH set by the DoE is between 6-9. This is the range, which indicates adequate protection to the life of freshwater fish and bottom dwelling invertebrates. The pH value was found 8.39. The pH value follows Bangladesh standards (ECR, 1997).

Total Dissolved Solids (TDS)

The standard for leachate water for Total Dissolved Solids is 2100mg/l. The concentration of Total Dissolved Solid (TDS) of sampled leachate water Quality (LWQ) was found 5390mg/l. Test result showed that the TDS value of Rajshahi landfill site was found very higher than the national standard.

Biochemical Oxygen Demand (BOD₅)

The standard value of BOD₅ as per ECR'97 is 448mg/l. BOD₅ value in sampled leachate water was found very higher than the standard level as per ECR'97. The stipulated standard of BOD₅ for leachate Water in Bangladesh is 1635mg/L.

Nitrate (NO₃)

Nitrate value in sample had been found 52.26mg/l. The stipulated standard for nitrate in Bangladesh is 10 mg/l.

Total Alkalinity as CaCO₃

The standard for leachate water for Total Alkalinity as CaCO₃ is not available. The concentration of Total Alkalinity as CaCO₃ of sampled leachate water (LWQ) was found 2500mg/l.

Total Suspended Solids (TSS)

The concentration of Total Suspended Solid (TSS) of leachate water was found 480mg/l. The stipulated standard for TSS in leachate water in Bangladesh 150mg/l as per guideline of DOE.

Iron (Fe)

The iron concentration in the sampled leachate water was found 5.07mg/l. The iron concentration in the sampling point was more than the standard level (2mg/l) as per ECR'97.

Arsenic (As)

Arsenic concentration of leachate water sample was found within the national standard. The value of Arsenic of the sampled water (LWQ) was found 0.021 mg/l which is within the national standards. The standard value of Arsenic is 0.2mg/l as per ECR'97 standard.

Sulphate (SO₄)

Sulphate value in sample leachate water (LWQ) was found 68.06mg/l. The value was found cannot be compared with the Bangladesh standard value and WHO standard value as such standards are not available.



Figure 4.26 Leachate Water Sampling Photograph of Rajshahi Landfill Site



Figure 4.27 Sample of groundwater, surface water, leachate and surface water

4.13 Landfill Site Soil Quality

One soil sample from Rajshahi City Corporation landfill site was collected from a depth of 0–30 cm depth within the one demarcated zone of the dumpsite namely; RCC Landfill site. The results revealed that the soil at the dumpsite is heavily contaminated as opposed to less than 0.55 mg kg^{-1} for the remaining heavy metals (Zn). However, heavy metals contamination at the various sampling locations of the dumpsite were within the permissible limits recommended by DOE/FAO/WHO. Analysis of soil physicochemical properties revealed that mean soil pH values recorded at the dumpsite was 7.7.

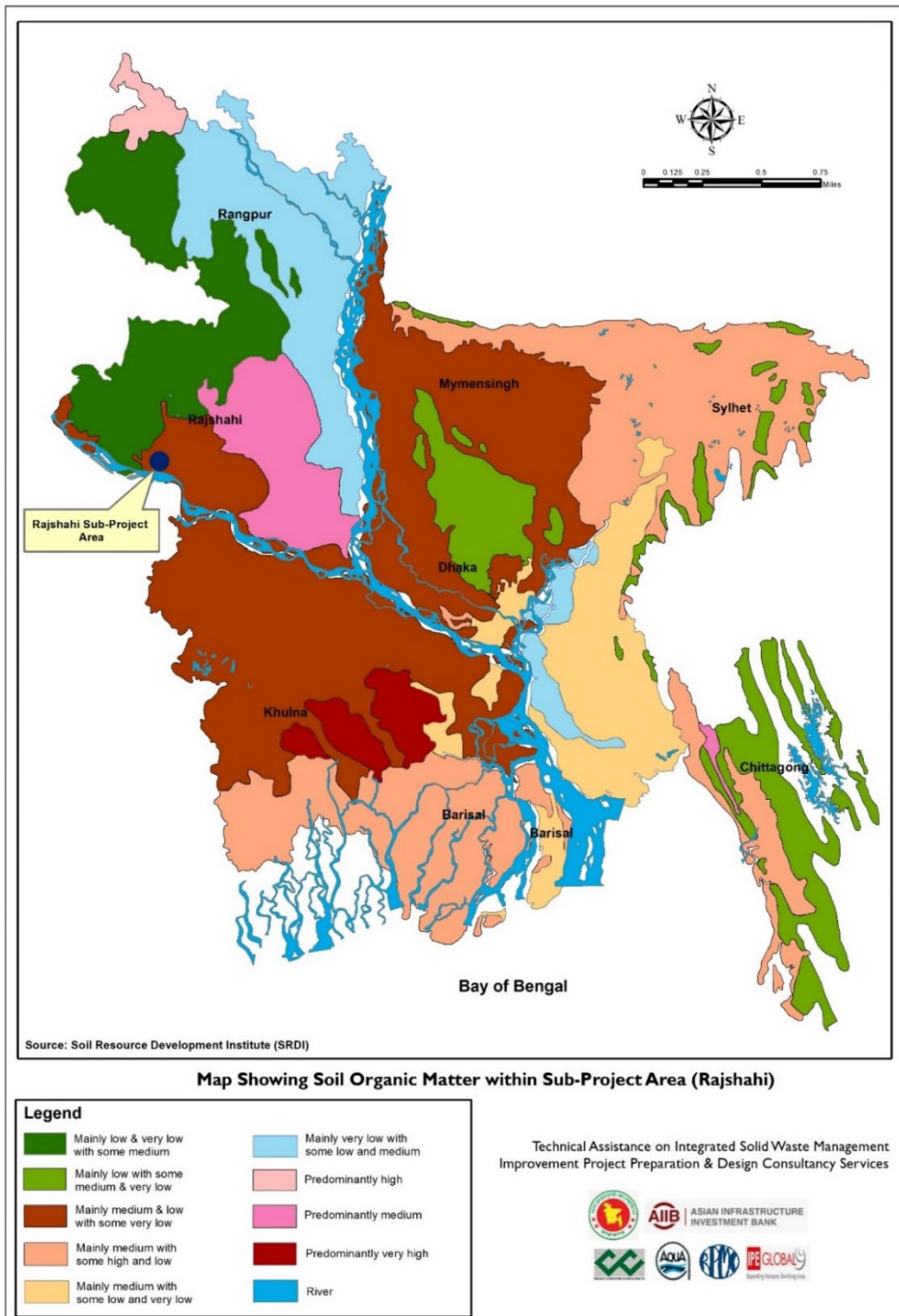


Figure 4.28 Map Showing Soil Organic Matter of Rajshahi CC Subproject Area

Table 4.23 Soil Quality Sampling Locations at Rajshahi CC

Sl. No.	Sampling Code	Name of the Point	Geographic Coordinate	
			Latitude (N)	Longitude (E)
01.	SQ1	RCC Landfill site	24.411426°N	88.591145°E

Table 4.24 Soil Quality Parameters Analysis Data of RCC Landfill Site

Parameter	Unit	SQI Results	Government Specification (Maximum Allowable Limit)	Method	Remarks
pH	-	7.7	NA	1:2.5 Glass Electrode Method	
Moisture	%	29.17	NA	Gravimetric Method	
Organic Matter	%	1.32	NA	Wet Oxidation Method	
Total N	%	0.07	NA	Kjeldahl Method	
Phosphorus (P)	mg/kg soil	32.93	NA	Olsen Method and Bray & Kurtz Method	
Potassium (K)	meq/100g soil	0.45	NA	NH ₄ OAc Extraction Method	
Sulfur (S)	mg/kg soil	34.45	NA	Calcium Dihydrogen Phosphate Extraction Method	
Boron (B)	mg/kg soil	0.64	NA	Calcium Chloride Extraction Method	
Copper (Cu)	mg/kg soil	10.32	NA	DPTA Extraction Method	
Nickel (Ni)	mg/kg soil	43.66	NA	Nitric Acid Digestion Method	
Cadmium (Cd)	mg/kg soil	0.00	NA	Nitric Acid Digestion Method	
Lead (Pb)	mg/kg soil	10.56	NA	Nitric Acid Digestion Method	
Chromium (Cr)	mg/kg soil	37.19	NA	Nitric Acid Digestion Method	
Zinc (Zn)	mg/kg soil	4.12	NA	DPTA Extraction Method	

Reference of Standard: Ministry of Environment, Forest and Climate Change notification related to Environment Conservation Rules, 1997. Schedule 10 (Inland Surface Water). No preservative was used but ice box was used at sampling time because sample drop at laboratory within 24 hours from water sampling.

pH

The pH of collected soil sample was 7.7. The soil pH should be within the limits of 6-8.5. Leachate is acidic in nature and will reduce the pH of soil. Therefore, soil pH less than 8.5 are suitable for solid waste.

Moisture Content (MC)

During the operation of a landfill, significant quantities of moisture may infiltrate the facility, with the infiltration volume dependent upon both soil cover design and operational practices. Generally, soil moisture will range from 10% to 45%, but can be higher during and after watering. When the initial moisture content of waste is greater than 50%, the squeezed leachate becomes the primary source of total leachate generation rate. Rajshahi City Corporation landfill area shows 1.32% moisture content. The collected soil sample shows moisture content is below the limit.

Organic Matter (OM)

The limitation organic matter of the soil is less than 0.5 %. Rajshahi City Corporation landfill area shows less organic matter in the soil and microbial activity is also less due to less water holding capacity so that soil is unsuitable for crop production and suitable for solid waste disposal.

Total N

Nitrogen is one of the macro nutrients of the soil. The available nitrogen is dependent on varying degree of soil microbial decomposition. It is found 0.07%. The limitation of N is 110-220kg/ac. The N content of soil sample is below the limitation is due to less N fixation in the soil and less microbial decomposition taken in soil. So that all collected soil sample are not suitable for crop production and suitable for solid waste dumping.

Phosphorus (P)

Phosphorus acts as co-limiting factor of eco-system productivity. It is limited to less than 9 kg/ha. Rajshahi City Corporation landfill area shows 32.93 mg/kg soil. P present in the soil is not favorable for crop grow but suitable for solid waste dumping, because excess phosphorous will runoff, interflow and cause ground water and surface water pollution.

Potassium (K)

Potassium is the main source of nutrients to plant growth. This is from runoff of agricultural field. The potassium was found 0.45 meq/100g soil. The limitation of K is less than 120kg/ha. Soil has less K not supply nutrient to grow plant and the water holding capacity of the soil become less. Leaching of leachate is less and less cause of ground water contamination.

Sulphur (S)

Sulphur is a macronutrient and—like nitrogen, phosphorus, potassium, calcium, and magnesium—must be available in relatively large amounts for good crop growth. Sulphur (S) found in RCC is 34.45mg/kg soil. Total sulfur concentrations in plants normally vary from 0.1 to 0.3% but under some conditions may range from a low of 0.05% to a high of 0.9% (Blanchar, 1986).

Boron (B)

Boron was found 0.64mg/kg soil of a day. It is therefore unlikely that the boron found in the contaminated soil would pose a health risk if ingested. Problems with boron toxicity can occur when crops sensitive to boron toxicity are planted with boron fertilizers present or sprayed with liquids containing boron.

Copper (Cu)

Copper was found 10.32mg/kg soil of a day. It is therefore unlikely that the boron found in the contaminated soil would pose a health risk if ingested. Total Cu in soils commonly ranges between 1 to 40 mg/kg soil, but the Cu concentration dissolved in the soil solution is much lower. The availability

of Cu in soils for plant uptake is affected by the following characteristics: Organic matter. Copper is more tightly bound to organic matter than any other micronutrient.

Nickel (Ni)

Nickel was found 43.66mg/kg soil of a day. It is therefore unlikely that the boron found in the contaminated soil would pose a health risk if ingested. Nickel in Soils and Plants brings together discussions on Ni as a trace element and as a micronutrient essential for plant growth and its role in plant physiology. It analyzes the biogeochemistry of Ni at the soil plant interface.

Cadmium (Cd)

Cadmium (Cd) was found 0.00mg /kg soil. It is deposited onto the earth below by rain or falling out of the air. Once on the ground, cadmium moves easily through soil layers and is taken up into the food chain by uptake by plants such as leafy vegetables, root crops, cereals and grains (ATSDR 1999).

Lead (Pb)

Lead naturally occurs in soil at low levels. Lead (Pb) was found 10.56 mg/kg soil. An acceptable level of 600 mg/kg soil of lead in soil suggested as a "safe" level would contribute no more than 5 micrograms/dl to total blood lead of children under 12 years of age.

Chromium (Cr)

Chromium levels in soil vary according to area and the degree of contamination from anthropogenic chromium sources. Test on soil has shown chromium concentration 37.19 mg/kg,

Zinc (Zn)

Concentrations of zinc can be high in soils from contaminated sites, such as waste dumps. Concentration of Zinc (Zn) found was 4.12mg/kg soil. Concentrations above 150 mg Zn/kg corresponded to severe stunting, while concentrations as high as 900 mg Zn/kg were measured in severely affected plants. In soil, a DTPA-extractable Zn concentration above 10 mg/kg is considered potentially harmful in acid soils.

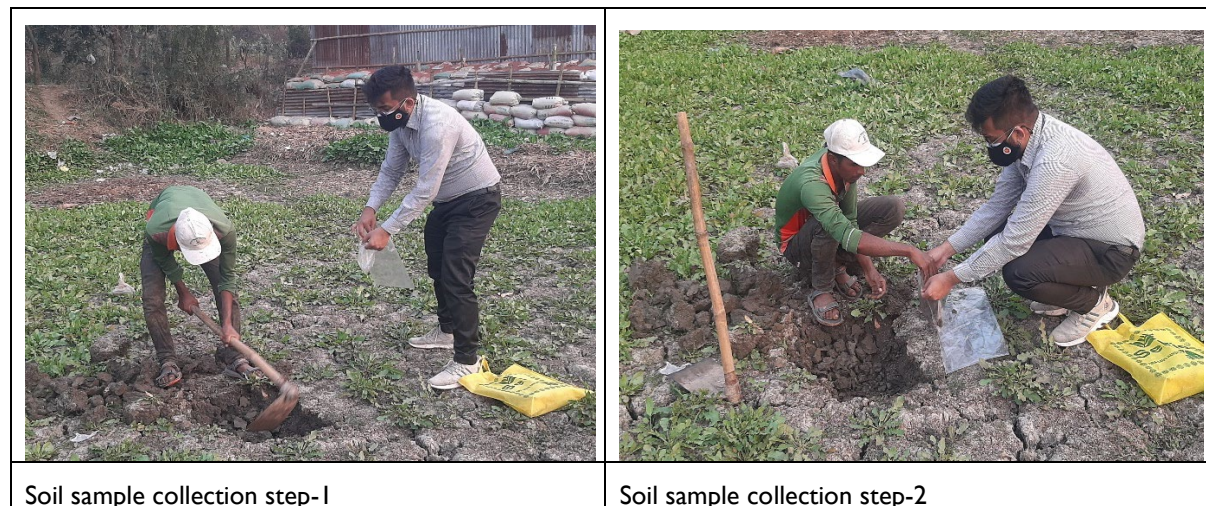


Figure 4.29 Soil Sample Collection Photographs of Rajshahi Landfill Site

Ideally, sites should be located in silt and clay soils that restrict leachate and gas movement. A landfill constructed over a permeable formation such as gravel, sand or fractured bedrock can pose a significant threat to groundwater quality.

4.14 Agroecological resources of Rajshahi

Agroecological zone is a zone which has a unique combination of physiographic, soil, hydrological and agroclimatic characteristics. Thirty agroecological zones (AEZ), 88 sub-zones (sub-regions) and 535 agroecological units have been identified in Bangladesh on the basis of important differences in physiography, soil, hydrological and agroclimatic characteristics. Agroecological zoning helps classify regions where a particular crop may or may not be grown. Most of greater Rajshahi fall under High Ganges River Floodplain, High Barind Track and Level Barind Track agroecological zone.

Land use: Land use for annual crop, SCA, DCA, TCA, QCA and other NCA represent the status of agricultural land utilization in the region. The net cropped area of the Rajshahi region is 693,620 ha. Crops occupying the particular land for round the year were considered under annual crops. The major annual crops reported in the region were pineapple, sugarcane, banana, papaya, betel leaf, ginger and turmeric. The annual crops area in different Upazila ranged from 40 to 7,940 ha. The annual crops area accounted only 5.96% of the net cropped area (NCA) in the region. At a glance the region possesses 10.73% single cropped area (SCA), 48.38% double cropped area (DCA), 33.58% triple cropped area (TCA). The quadruple cropped area QCA also exists as a very negligible portion (0.67%) and is limited in only six Upazila viz Badalgachhi, Manda, Mohadepur and Raninagar of Naogaon district, and Bagha and Mohanpur of Rajshahi district. Compared with DCA and TCA the SCA remained much lower in each and every Upazila. In Rajshahi region, DCA remained higher in Singra Upazila of Natore district followed by Godagari Upazila of Rajshahi district. Chapainawabganj Sadar and Shibganj Upazila are the exceptions where TCA occupied the biggest share of NCA.

Cropping patterns of Rajshahi: The major annual crops reported in the region were **pineapple, sugarcane, banana, papaya, betel leaf, ginger and turmeric**. The annual crops area in different Upazila ranged from 40 to 7,940 ha.

Cropping patterns of Rajshahi: In total 172 cropping patterns were observed in Rajshahi region of which eight cropping patterns with exclusive rice crop covers over 40% of the NCA. There were 40 cropping patterns with exclusive non-rice crop covering over 7% of the NCA. Rest of the NCA i.e. about 53% area is covered by 124 rice - non-rice cropping patterns.

Rice and non-rice crops at a glance: A wide range of cropping patterns were recognized in the ESIA study area and the important feature of the region is that eight patterns were composed of absolutely rice crops. Of all lands used for cultivation, 40.48% was used only for rice production showing that the farmers are engaged with the traditional rice farming and it is also applicable in Bangladesh. Boro-Fallow-T. Aman was the most predominant cropping pattern in this area (Table 4.25). Out of 32 Upazila, the Boro-Fallow-T. Aman cropping pattern remained in 27 Upazila and 22.83% of the NCA belonged to this pattern. Single Boro was the 2nd dominant pattern, which occupied about 7.23% of the net cropped area in 28 Upazila. Boro-T. Aus-T. Aman cropping pattern exists in 17 Upazila which was the 3rd dominant cropping pattern and occupied 3.65% of NCA in the region. Single T. Aman was also common in eight Upazila which covered 2.75% of NCA. Very negligible portion i.e. less than 1% NCA was practiced by Fallow-Aus-T. Aman cropping system in this region.

In the current investigation, 40 cropping patterns were identified that was free from rice. Among them first 24 have been arranged in descending order in Table 4.28. The rest 16 patterns with negligible area coverage are arranged with other patterns of different categories. Aggregate of the 40 patterns

have had 7.43% of NCA. In critical comparison it is clear that exclusive rice area is about six folds of exclusive non-rice area. In Rajshahi region, crop diversity is much wider than that of other regions like Sylhet and Chittagong, where exclusive rice area covers 37 folds and 23 folds, respectively, of exclusive non-rice area (Muttaleb et al., 2017; Shahidullah et al., 2017). Appropriate cropping patterns may facilitate maximum possible land utilization as well as efficient use of other scarce resources in a sustainable manner. Diversified cropping pattern may be an option for the farmers as a coping strategy against risks (Mandal and Bezbaruah, 2013). Typology, of different cropping systems, is the base for the managers of these systems to intensify production (Shriar, 2000).

Table 4.25 Cropping patterns with exclusive non-rice in Rajshahi region, 2014-15.

SL No.	Cropping pattern	Area (ha)	% of NCA
1	Vegetable-Vegetable-Vegetable	10715	1.54
2	Wheat-Jute-Fallow	6720	0.97
3	Garlic-Jute-Fallow	4310	0.62
4	Vegetab-Vegetab-Fallow	3500	0.54
5	Maize-Fallow-Blackgram	3350	0.50
6	Lentil-Fallow-Fallow (Orchard)	2780	0.43
7	Wheat-Mungbean-Fallow	2670	0.40
8	Potato-Jute-Fallow	2450	0.35
9	Onion-Vegetab-Vegetab	2370	0.34
10	Wheat-Mung-Fallow (Orchard)	2150	0.31
11	Onion-Jute-Fallow	2010	0.29
12	Garlic-Vegetab-Vegetab	1030	0.15
13	Maize-Fallow-Fallow	1000	0.14
14	Potato-Chilli-Fallow	980	0.14
15	Lentil-Vegetab-Vegetab	760	0.11
16	Chilli-Vegetab-Fallow	600	0.09
17	Wht-Sesame-B. gram (Orchard)	730	0.11
18	Wheat-Vegetab-Vegetab	500	0.07
19	Wheat-Jute-Blackgram	370	0.05
20	Wheat-Chilli-Fallow	290	0.04
21	Potato-Maize-Fallow	270	0.04
22	Chilli-Fallow-Fallow	240	0.04
23	S. Potato-Fallow-Fallow	220	0.03
24	Groundnut-Fallow-Fallow	210	0.03

Non-rice cereal crops: Forty-four cropping patterns were identified for non-rice cereal cropping systems covering 143,730 ha which represents 20.72% of NCA in the region. The dominant cropping pattern was the Wheat-Fallow-T. Aman which was practiced on 30,130 ha (4.34% of NCA) in 14 Upazila of Rajshahi region. Next cropping pattern under this combination was Wheat-Aus-T. Aman and existed in 2.31% of the NCA in 14 Upazila. Out of 44 cropping patterns under non-rice cereal systems, 22 patterns were wheat based and the aggregate area under wheat-based patterns stands for 16.58% of NCA in this area. Local production of wheat and maize is extremely insignificant to meet up the demand. The situation is increasing our dependency on import causing a great pressure on foreign currency (BBS, 2014). Loam and sandy-loam soil of the comparative dry area is very suitable for maize cultivation. Wheat cultivation with its better yield in this region is specially favoured by long winter season that is normally unavailable in southern parts of the country. Light textured soil with low water-holding capacity as well as less availability of irrigation water are driving forces that discourage the farmers for modern boro cultivation. During the harvesting period of wheat, the crop

is privileged by clear sun-shine and low humidity. All these are the factors this area is dominated by wheat-based cropping systems (FAO, 1988).

Table 4.26 Cropping patterns with exclusive rice in Rajshahi region, 2014-15

SL.	Cropping pattern	Area (ha)	% of NCA	Frequency (no. of Upazila)
01	Boro-Fallow-T. Aman	158390	22.83	27
02	Boro-Fallow-Fallow	50130	7.23	28
03	Boro-Aus-T. Aman	25290	3.65	17
04	Fallow-Fallow-T. Aman	19100	2.75	8
05	Boro-B. Aman	11680	1.68	8
06	Boro-Aus- Fallow	9500	1.37	9
07	Fallow-Aus- T. Aman	6120	0.88	3
08	Boro-Sesbania-T. Aman	580	0.08	3
	Total	280790	40.48	-

Pulse crops: Fifty cropping patterns are holding different pulse crops. Among them blackgram is covering the largest area whereas pea in the smallest area. Thirteen cropping patterns of blackgram in-together cover 31,720 ha representing 4.57% of NCA in the Rajshahi region. Mungbean holds the second position in pulse crop cultivation in the region. There are 10 cropping patterns for mungbean covering 24,020 ha (3.46% of NCA). In some area of Rajshahi region specifically in Barind tract, Boro cultivation faces some constraints such as scarcity of irrigation water and low-water holding capacity of soil. Moreover, high market price of pulse crops is a driving force for ample cultivation of pulse crops. Among the Rabi crops stress-tolerant mungbean, blackgram, grasspea can easily be grown as relay system and other cropping systems (FAO, 1988).

Oil-seed crops: Mustard is the most important one among the oil-seed crops in Rajshahi region. There are 13 cropping had been led by mustard alone which in-together covers 66,050 ha (9.52% of NCA). The pattern Mustard-Boro-T. Aman has the highest coverage (3.70% of the NCA) and was recorded in 17 Upazila out of 32 followed by Mustard- Boro-Fallow (1.88% of NCA). Oil is an essential ingredient of human food and also for feed industries. The country is almost dependent on import for oil. Mustard is a very potential crop that can be grown widely in various parts of the country (BBS, 2014). At present, the lion-share of mustard cultivation is related to the land for double rice. If technology transfer activities could be strengthened much more area of the aforesaid category will be possible to make room for the mustard crop (FAO, 1988).

Vegetables and spices crops: A total of 66 cropping patterns were identified in Rajshahi region for vegetables and spices crops. Potato and other vegetables belong to Rabi, Kharif-I and Kharif-II, spices crop viz onion, garlic, coriander, black cumin and chili had been included in this list. Total area coverage under spices and vegetables is 106,355 ha (15.27% of NCA). Among them Potato Boro-T. Aman is holding the largest coverage with 15,610 ha (2.31% of NCA) distributed to 12 Upazila. The 2nd contributing pattern in this category was year-round vegetables, which occupied 1.54% of NCA with its widest spreading into 19 Upazila.

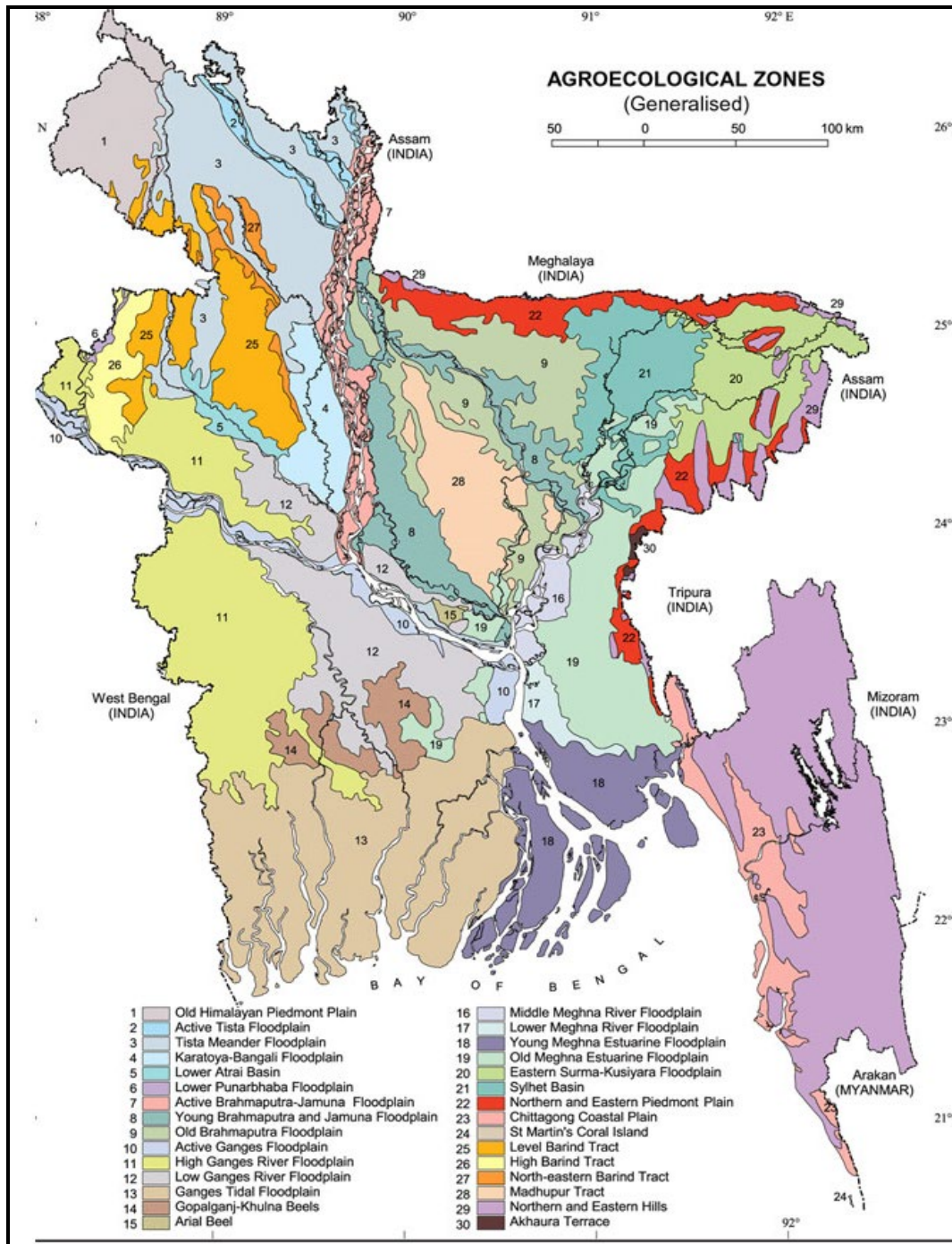


Figure 4.30 Agroecological Zones of Bangladesh



Figure 4.31 Maize and Potatoes Production in Rajshahi Under Agri. Extension Office

4.15 Livestock and Poultry of Rajshahi District

4.15.1 Livestock of Rajshahi District

Dairy farming along with beef fattening has become boon for many marginalized and other grassroots people because they got the scopes of overcoming the financial hardships caused by the Covid-19 pandemic, reports BSS. Local animal husbandry sector has marked a revolutionary boost in recent years following massive steps taken by the government and different development organizations. Both rural and urban areas, the poor and marginalized people including women have achieved tremendous successes in the sector getting various assistance from the government and development partners.

Abdul Awal, a dairy owner of Bargachhi, said many of the families have adopted new and improved practices and technologies in dairy farming coupled with bull rearing and fattening contributing to enhanced production and productivity. He said the Rajshahi region has started becoming enriched with animal resources during the last couple of years as a result of house to house cattle farming. The feature has brightened the prospects of mitigating any disaster situation through exporting domestic animals to areas within the country after meeting up the local demands.

Artificial insemination of cows is also gaining popularity in the region following significant achievement in improving the breeding system. Due to the cross breeding the cows are giving milk ten times more than the previous record, said Dr Golam Rahid, a successful dairy farmer in the city.

Artificial insemination is a process of collecting sperm cells from a male animal and manually depositing them into the reproductive tract of a female. He said the region has an enormous opportunity to meet up existing protein deficiency of the local people through boosting the sector.

District Livestock Officer Dr Ismail Haque said many of the rural families have been rearing and fattening bulls commercially and earning huge profits every year. Animal husbandry sector has marked a boost bringing fortune to hundreds of people in the region.

Dr Hemayetul Islam, Deputy Chief Veterinary Officer of Department of Veterinary and Animal Sciences in Rajshahi University, opined substantial and sustainable promotion of dairy farming is very important for removing the existing protein deficiency of the people along with decreasing the poverty rate in the region. Dr Islam said the unemployment problem in the rural areas could be reduced to a

great extent through making the dairy farming popular at the grassroots level. Moreover, the dairy sector can play a vital role in alleviating poverty in the region.

Meanwhile, the Rajshahi Dairy and Cattle Development Farm have been playing a pivotal role in boosting milk and meat production through the best uses of modern technologies in the region.

Located on 92.43 acres of land in Rajabarihat area under Godagari upazila in the district, the farm contributes a lot to breed up-gradation of cattle side by side with slashing down the protein deficiency through enhancing milk and meat production. In addition to necessary office building, the farm has a 60-acre fodder ground for grass production, 15.78-acre Byre section and 3.57-acre afforestation.

It also has eighteen sheds of various types with a holding capacity of 1,015 cattle-heads. At present, there are 259 cattle including 61 milking cows, 46 bulls and 107 heifers in the farm.

There is a total of 17,700 cattle farms in the district. In 2018, a total of 3,96,519 cattle heads were sacrificed in the district out of which 2,981 were calves, 71,256 bulls, 745 buffaloes, 31,76,94 goats and 3,843 sheep. It is learnt, till now there are 3,69,574 cattle heads in the farms and cow-sheds in the district of which 6,018 are calves, 71,831 bulls, 2,675 buffaloes, 2,74,075 goats and 13,675 sheep and 1,136 other animals. An official told this correspondent the local stock is a little better this year as there had been a jump in the country's production during the last one year. The number of cattle farms has increased recently. According to a recent statistic prepared by the Livestock Department, there are more than 50,000 cows and goats in the region.

Table 4.27 Meat and Milk Production of Rajshahi District in the Year 2019 -2020

Sl. No.	Name of the Produces	Unit	Demand	Production	Surplus/ Deficit
1	Milk	Lakh M.T.	2.603	3.787	1.184
2	Meat	Lakh M.T.	66.6	29.6	37
3	Eggs	Number	22 crores	34 crores	12
As per demand of milk xxml/cap/day, meat xxxgm/cap/day and eggs xxxpieces/cap/year					

Source: District Livestock Office, Rajshahi (Collected in April 2023) and website



Figure 4.32 A local cattle and sheep Farm of Rajshahi

4.15.2 Poultry of Rajshahi District

Government farm: Regional Poultry Farm, Rajabari is the government poultry farm of Rajshahi. The farm is located in the Rajabari village under Godagari thana in Rajshahi district. The farm reared exotic Fayoumi and crossbred (Sonali) chickens' breeds. The specialty of this farm was that it provided an opportunity for comparative study of rearing both exotic and crossbred chickens.

Private farms: The private farms in the study area generally rear both exotic and crossbred chickens, for instance, broiler, cockerel, Fayoumi, RIR and Sonali. The farmers rear these breeds equally for meat and egg purpose excluding broiler and cockerel that are merely intended for meat purpose. Location-wise and concise description of the private farms is as follows:

Baghmara: The selected farm is situated in Sreepur village under Baghmara Thana. The farm rears only the exotic breed RIR. The specialty of this farm was that it provided knowledge on small scale rearing of a layer breed.

Boalia: The farm is located in Mirer Chak village under Boalia Thana. The farm raises the exotic Fayoumi and crossbred Sonali. The specialty of this farm was that it provided knowledge on meat purpose.

Godagari: The farm is sited in Rajabari village under Godagari Thana. The farm rears simply the exotic breed RIR and it provided vast information on the exotic rearing at small scale pattern.

Mohanpur: The visited farm is located under Khoira village of Mohanpur Thana. The exotic Fayoumi and crossbred Sonali was the rearing breeds of this farm. The farm furnished understanding on meat purpose rearing of the exotic and crossbred chicken.

Motihar: The farm is situated in Kapasia village under Motihar thana. The rearing breeds of this farm were the exotic broiler, cockerel and crossbred Sonali. This farm also bears adequate knowledge on meat purpose rearing of the exotic and crossbred chicken.

Paba: It is placed under Sayer Pukur village of Paba thana. Rearing breed of this farm is the exotic RIR. The farm possesses a guide of rearing exotic breed for egg purpose rearing with an aim of achieving profit from poultry enterprise.

Puthia: The farm is situated in the Kajir Para village of Puthia. The farm raises the exotic Fayoumi and crossbred Sonali. The specialty of this farm was that it provided awareness on small-scale meat purpose rearing of the exotic and crossbred chickens.

Rajpara: The farm is located under Nagar Para village of Rajpara Thana. The farm usually rears cockerel and RIR breeds. The farm provides conception on both meat and egg purpose rearing of the exotic breed at a profit-making approach.

Shahmokdum: The selected farm is located under Baroipara village of Shahmukdum Thana. The farm raises only the exotic RIR for egg purpose. The farm represents a manner of raising an exotic breed for earning from eggs.

Tanor: The visited farm is placed under Jeol village of Tanor Thana. The farm rears basically the exotic breed RIR and it endows with vast information on the exotic rearing practices.

Chicken breeds

Broiler (Cobb 500): The broilers are classified as the Mediterranean breeds and are originated in Italy and so far, there are twelve varieties of which three popular are single comb white, single comb buff and single comb brown. Broiler meat is considered a major source of high-quality animal protein, required for growth and mental development (Adetola and Simeon, 2013). This type of chicken rises

especially for meat production. The standard body weight of cock is 2.3-3.0 kg, hen 1.5-2.0 kg and pullet 1.5-2.0 kg.

Cockerel: The cockerels are an isolated male chicken from the exotic breeds. They constitute 50% of day-old layer chicks. Such chicks have become an indispensable component of poultry development with the rapidly increasing trends of commercial layer farming in Bangladesh (Sarkar *et al.*, 2008). It is very fast maturing and grows within eight weeks of age. The adults reach a weight of 0.5-1.0 kg. Cockerels are raised especially for meat production. Utilization of cockerels through smallholder family poultry farming helps to control environment pollution, increase nutrition, generates income and self-employment in the rural community.

Fayoumi: Fayoumi the exotic pure breed is extensively used in rural areas. This breed is from Egypt and possesses the characteristics of early sexual maturity, more egg production and low mortality (Zaman *et al.*, 2008). It is a high profitable breed with low cost and farmer can easily rear this breed both in intensive and scavenging systems. The pullets may start laying a small tinted egg when 4 months old, while the cockerels often grow at 6 weeks of age. Adult males reach a weight of 2 kg and females 1.5 kg, which produce 200 eggs per year (Das, 1994).

Indigenous: The Indigenous chickens are reported to be derived from the *Gallus gallus* (Beede, 1931; Faruque *et al.*, 1987). Among the native fowls there are some distinct categories namely Hilly, Naked Neck, Aseel, Native dwarf and non-descriptive Deshi (*Gallus domesticus*). They have an inherent scavenging habit and more resistant to diseases, less prone to predator attacks and can survive under harsh nutritional and environmental conditions and are characterized by small pea comb, head and beak is long; earlobes are small, usually red and at times admixtures with a little white. The breed possesses excellent fleshing properties and good laying abilities. The standard body weight of cock is 3.5-4.5 kg and hen 3.0-4.0 kg.

Rhode Island Red: Rhode Island Red is an American breed, originated from New England of the USA and crosses among Malay wild fowl, Leghorn and Asian local variety (Zaman *et al.*, 2008). Body structure is slender, triangular and heavy weighted. They are sometimes completely red, slight yellow, white and brown in colour. Combs are single or rose but single is common. RIR cock is weighed about 4 kg; hen 3 kg, cockerel 3.4 kg and pullets are of 2.5 kg.

Sonali: A crossbred of Fayoumi female and RIR male first developed in 1986. It has specially been advocated in terms of their higher egg production rate and better adaptability in rural situation (Ahmed, 2013). Females produce about 180 eggs per year on an average. It is considered as dual-purpose breed considering environmental factors such as predators, rainfall and housing and economic traits as survivability and rapid growth of male chicks as well as egg production (Amber, 2000). Body plumage, legs and ear-combs are yellowish. Therefore, this crossbred has been given an appropriate name, Sonali.



Figure 4.33 Poultry photographs taken from Rajshahi City area

4.16 Fisheries Resources of Rajshahi District

Fisheries and aquatic resources are economically, ecologically, culturally and aesthetically important to the nation. The survey reports from the Department of Fisheries (DOF, 1986) showed that 1,24,216 acres of open water area in the greater Rajshahi District including rivers, numerous beels and floodplains, is gradually declining because of flood control, drainage and irrigation project as well as Farakkan impact.

The present work is an approach to gain some information on different aspects of fisheries resources in the greater Rajshahi district. The information was collected from multiple sources. Firstly, an extensive literature reviews were made in the area of fisheries resources. Secondly, the primary data for the study were collected through survey method from the fishermen, fish traders, Government and NGO personnel and experienced persons related to fisheries research and education. The information thus collected was analyzed to bring it to bear on the hypothesis by simple tabulation and statistical calculations. The fishery information was collected from the different fish markets, landing carters and on the fishing spots of the study area for the taxonomic study. Supporting papers, documents, information and records were collected from the Water Development Board, Rajshahi, Bangladesh. Contracts were also made with different Fisheries Co-operative Societies and other experienced personnel to obtain data on the fisheries resources of the greater Rajshahi district.

The greater Rajshahi district has vast fisheries resources, covering 2,39,292 ha, nearly one-third of the total land mass. There are 18,991 ha of rivers and canals, 19,889 ha of beels and 1,85,043 ha of floodplains. It has also 56,954 ponds covering an area of 15,369 ha. The total fish production of the area was estimated at 59864 metric tons (mt), of which open water contributed 24,562 mt (41.03%) and culture fishery produced 35,302 mt (58.97%) for the year 2000. The fish production from rivers and canals, beels, floodplains, and ponds were estimated as 2,316, 6,518, 15,728 and 35,302 mt, receptively. The data shows that ponds contributed the highest fish production (2,297 kg/ha), followed by beels (328 kg/ha), river and canals (122 kg/ha), and floodplain (85 kg/ha). The average fish production was calculated as 110 and 2297 kg/ha for capture and culture fishery, respectively. The relative share of fish production for different water bodies were calculated as 3.87, 10.89, 26.27 and 58.97% for rivers and canals, beels, floodplains, and ponds respectively. The growth rate of fish production from 1990 to 2000 for these areas were calculated as -0.96, -1.91, -2.06 and 5.68%, respectively. From 1990

to 2000, capture fishery declined nearly 5,855 mt (1.92%) per year, whereas culture fishery increased 5.68%, and combined total fish production increased by 1.31%.

Fish production from the open water has declined due to many factors such as water quality degradation by pollution, environmental modification, fish diseases, and high fishing pressure (Ali, 1991). Environmental pollution is one of the major causes for the reduction of open water fish production. Environmental pollution caused by the pesticides in Bangladesh has been reviewed by Showler (1989). Nearly 4000-5000 mt of pesticides are used for agricultural crops every year in Bangladesh. It is estimated that nearly 25% or, 1000 mt pesticides ultimately dissolved in the water of crop lands, floodplains and drained into other water bodies (Showler, 1989). These chemical residues either directly kill the fishes or indirectly decrease the population causing diseases, retarded aquatic growth, even shifting the breeding and feeding grounds by the fishes themselves in evidence to the pollution. At low percentage of the residues, biological activities of fish and aquatic organisms have been hampered. Most of the fish and small aquatic animals cannot survive these pesticides in concentration greater than 1 ppb (Task Force Report, 1991).

Increasing food demand is now being placed on the aquatic resources and floodplains are now among the fastest disappearing of all ecological systems. Changes in pattern of land use and the widespread development of flood control schemes nation-wide have had an important impact on the extent of natural floodplain available for fish feeding and reproduction. Fishing pressure from a growing population has increased dramatically and has seriously affected the abundance of some species, particularly major carps and many even be putting the availability of more resilient floodplain fish at risk. Siltation, often a result of upstream changes in catchments, has reduced water flows and cut off vital access routes for fish from one habitat to another. Increased use of pesticides and fertilizers in agriculture and growing industrial pollution are also contributing to the deterioration of the aquatic environment.

Tsai & Ali (1997) pointed out that the flood control and drainage (FCD), and flood control drainage and irrigation (FCDI) projects became threat to the fish resources during the last 20 years. The same fate has been observed in the Rajshahi study area. A total of 11 species of fish is now in threatening condition and some are extinct from the greater Rajshahi district. On the other hand, nine species of exotic carp and catfishes have been introduced so far in the Rajshahi study area under semi-intensive and extensive fish culture. Culture fish production was peaked in the 1980s as a result of increased fish and shrimp grown in ponds. However, such increase does not alleviate the problems of subsistence part-time fishermen, who have traditionally been able to provide fish for their families for free from the declining resources of floodplain fisheries.

It is therefore necessary to understand and recognize the need for aquatic habitats and the adaptation of different fish and prawn populations to certain sets of hydrological conditions for breeding, feeding, migration and movement. The negative impacts of flood control and road infrastructure on floodplain fisheries are being mitigated through a programme of floodplain stocking and fish pass construction. While planning water resources development projects, comprehensive studies on different aspects of ecological needs of fisheries species should be undertaken so that a meaningful understanding of the needs for fish and other aquatic animals emerges.

Fish production has increased appreciably in Rajshahi district after taking multidimensional development and extension programmes. "Fish production was 52,171 metric tonnes in 2009 while it increases to over 80,870 metric tonnes in 2017, District Fisheries Officer (Rajshahi) Subhash Chandra Shaha said. Highlighting various programmes taken by the Department of Fisheries, he said about 95,477 kilograms of fish fingerlings were released in internal water-bodies to increase fish production.

Noting that some 18,857 fishermen were given registration, the Fisheries Officer said, of them, about 12,232 fishermen have already got identity cards so that they can get necessary supports and incentives from the government to improve their livelihood. He said a total of 35 beel nurseries with area of 3,062.03 hectares were established in the district to boost the production of carp fishes while 15 fish sanctuaries were established with a view to preserving indigenous fish species, which are on the verge of extinction.

Around 50,176 people, who were involved in fish farming, were imparted training for enhancing fish production through improving their fish farming management, the Fisheries Officer said. They have established 312 projection hatcheries with area of 76.60 hectares for wide-ranging dissemination of modern fish farming technology through projection. About the fish habitat development, Shubhash said about 100 derelict water-bodies and wetlands measuring 39.025 hectares were excavated in the district during the last nine years, reports BSS. They have distributed eco-friendly net among 5,880 fishermen as their alternative employment support.

Fish growers in Rajshahi attained success in fish production in the last couple of years after the Department of Fisheries took diversified efforts to boost fish production there. After meeting up the growing local demand, the district is now supplying at least 100 trucks of fish to different districts, including Dhaka city, every day, officials said. This year, fish production target for Rajshahi was set to 83,084 tonnes and the target is expected to be achieved.

In Rajshahi district, there are 50,515 ponds of 13,428.10 hectares, 6108 commercial farms of 3462 hectares and 486 open water-bodies, including canal, beel, river and floodplain.



Figure 4.34 Photos of different open water fish species of Rajshahi

The present study deals with the mixed fish culture of carps in improved traditional fish culture system in Rajshahi City Corporation district. The highest water area is in 130 decimal and lowest 4.6 decimal. It is observed that those ponds which water area is high are made low profit. Because the cost of culture at large size pond is very expensive. So, it is a factor from making a better profit. Collins (1971) reported that pond size had certain influence on fish growth. The highest water depth recorded 5.39m at rainy season and the lowest as 1.5m at winter. The highest averages water depth is 3.87m and lowest average water depth is 1.25m. Ehsan et al. (1997) reported lower water depth during dry season. From the point of view of biological productivity of a pond Jhingran (1985) suggested 2m depths may be congenial forms. Because the water of these pond is used for irrigation in the dry season. Thus, the point of view of average water depth, it can be said that most of the ponds are adequate for carp culture. The shapes of the ponds are different dimensions. In the sampling ponds, rectangular shape is common. Which are suitable for fishing. Mohsin (1999) reported that rectangular shape of pond suitable for culture. In the sampling ponds, rain is common source of water at the rainy season. Others are drainage.

The water color of the most ponds is clear and greenish which is suitable for fish culture. Two type of ownership system are found. These are personal pond and leased pond. In case of lease total money should be deposited during base agreement, years of lease duration and total amount of money are varied between pond and owner. Pond preparation is one of the most important tasks for successful and pond culture operation. The ponds were stocked with 6000 fingerlings per ha. After a year the gross production recorded for two ponds were 15.91 kg/dec/ha respectively. The ponds recorded average gross and net production of 30.90 kg/dec/ha and 30.14 kg/dec/ha respectively, which was about 7 times the normal production of around 4.04 kg/dec/ha reported by the ordinary fish farms. Two types of inorganic fertilizers are used. Urea, TSP are used at an average rate of 0.27 kg/dec/ha and 0.21 kg/dec/ha orderly. The overall survival was highest is the medium urea treatment. Total net fish production was highest is the medium urea treatment (Dinesh et al., 1986) higher fish production could be achieved managing with the right type of nitrogen fertilizers (Shah et al., 1975). One types of organic fertilizer is used. Cow dung is used at an average rate of 0.06 kg/dec/ha. Fertilizer is used mostly daily or weekly. Jhingran and Pullin (1985) suggested different does of organic and inorganic fertilizer for increasing growth and survival of fry and fingerlings Khan and Jhingran (1975) mentioned both organic and inorganic fertilizer used in the carp nursery ponds. Organic fertilizer used in daily. Most of the ponds used supplementary feeds. Rice bran, wheat bran, wheat flour, maize flour, mustard oil cake are used as supplementary feed at an average rate of 0.64, 0.21, 0.41, 1.34 kg/dec/ha respectively. Supplementary feed is used daily. Fertilizer and supplementary feed are used regularly daily or weekly. In some times, fertilizers are used irregularity. Four groups of fishes are produced.

In the present study, it is clearly indicating that the fish farmer at Rajshahi City Corporation area are showing productivity and they have improved traditional method of fish culture. The environmental condition and socio-economic condition of fish farmer are attracting them to work with improved traditional fish farming because of the improved traditional method of fish bio-mass production and net profit. Two types of ownership were found (three years and five years) in the study period. During the study time two types of harvesting method were found. They were partial and final harvest. Mainly two types of production cost such as variable cost (lease, pond preparation, pesticide use, fertilizer etc.) and fixed cost (cost of net, net preservation, tax of pond etc.) were observed in the study period.

In Rajshahi yearly fish demand is 52,063 Metric Tons and yearly fish production is 84,803 MT. So fish surplus is 32,740 TM.

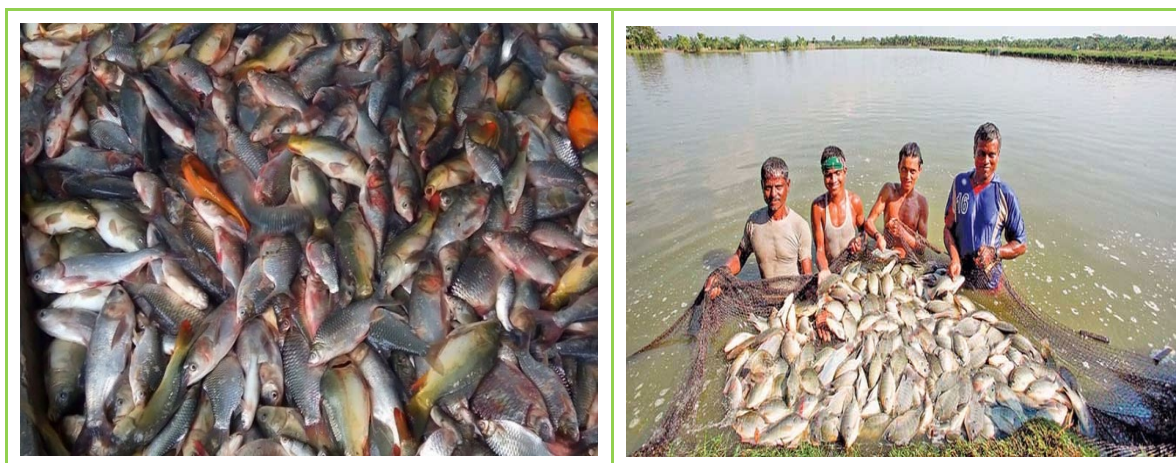


Figure 4.35 Photos of different closed water fish species of Rajshahi

Table 4.28 Rajshahi District Fisheries Resources Information at a Glance

Water Bodies	Number	Area (ha)	Production (M. Ton)
Ponds	50515	13428.10	66053.10
Beels	76	6492	4373.22
Khal	160	1225	
Floodplain	80	10313.98	6185.16
Rivers	11	9160.27	2318.55
Borrow pits	229	309	

Source: District Fisheries Office, Rajshahi (Information Collected in March 2023)

Table 4.29 Rajshahi District Fish Production Information at a Glance

SL. No.	Description of Fish	Production	Unit
1	Carp fish	32765	Metric Ton
2	Pangas fish	2384	Metric Ton
3	Golda P.L.	0.02	Piece
4	Golda Chingri	2.02	Metric Ton
5	Pabda fish	250	Metric Ton
6	Shing & Magur fish	2674	Metric Ton
7	Telapia fish	612	Metric Ton
8	Koi fish	1157	Metric Ton
9	Gulsa / Tengra fish	249	Metric Ton
10	Other fishes	4971	Metric Ton
	Yearly total fish production	84803	Metric Ton
	Yearly total fish demand	52063	Metric Ton
	Yearly total fish surplus	32740	Metric Ton

Source: District Fisher Office, Rajshahi (Information Collected in March 2023)

4.17 Ecological Resources of Rajshahi District

The Ecological resources are natural resources that provide certain necessary but overlooked system maintenance functions within ecosystems. Environmental economics is in search of an appropriate analysis framework to determine economic values of such resources. Natural resources are important because they supply us with the things we need to live: food, shelter, and energy. Without natural resources, we would not be able to survive on this planet. They provide us with the food necessary for survival and fuel used in our everyday lives.

4.17.1 Ecologically Critical Areas of Bangladesh

Biodiversity is defined as the number and types of plants and animals that exist in a particular area or in the world generally. Protecting the biodiversity is of utmost importance in today's world. Similarly, in Bangladesh, the biodiversity of which is in fact an excellent combination of forestry, hills and aquatic ecosystems, the issue of conservation has become essential. Since the advancement of industrial activities, a sharp decline has been recorded in the number of species living in this beautiful country. The worrying state of such destruction has become apparent when the 2015 IUCN Red list of Bangladesh declared that, among 1619 species of seven wildlife groups, 31 species are already extinct and 390 others are threatened with extinction.

In this context, the flagship legislation on environmental protection, the Bangladesh Environment Conservation Act (BECA) of 1995 has empowered the Government to declare an area facing environmentally critical situation to be an Ecologically Critical Area under Section 5. To make such a declaration, the Government must be satisfied that due to degradation of environment, the ecosystem of that given area has reached or is threatened to reach a critical state or condition. Therefore, an Ecologically Critical Area (ECA) is an area in Bangladesh, which, being enriched with unique biodiversity or being environmentally significant, needs protection from destructive activities or conservation and is basically an environmentally protected zone defined by the legal authorities.

The legal mandates under the BECA empower the Ministry of Environment, Forests and Climate Change to determine which of the territories require this special recognition in order to be protected. Rule 3 of the Environment Conservation Rules, 1997, therefore, determines that the following factors must be considered while declaring any ECA: a) human habitat, b) ancient monument, c) archeological site, d) forest sanctuary, e) national park, f) game reserve, g) wild animals' habitat, h) wetland, i) mangrove, j) forest area, k) biodiversity of that area along with other relevant factors. Through the years 1999, 2001, 2009, 2015 and 2016 the following areas have been declared as ECAs in the country (Table 4.35):

Table 4.30 Declared Ecologically Critical Areas (ECAs) of Bangladesh

Name of the ECA	Category of Ecosystem	Location (Zilla)
Sundarbans	The outside of Sundarbans Reserved Forest at 10 km extent	Bagerhat, Khulna, Saatkhira, Pirojpur, Borguna
Cox's Bazar–Teknaf Sea beach	Village, Agricultural Land, Hills, Forest	Cox's Bazar
Saint Martin's Island	Coastal Waterways, Oceanic Island with Corals	Cox's Bazar
Sonadia Island	Mangrove forests	Cox's Bazar
Hakaluki Haor	Haor (Watershed)	Sylhet, Moulvibazar
Tanguar Haor	Haor (Watershed)	Sunamganj

Name of the ECA	Category of Ecosystem	Location (Zilla)
Marjat Baor	Oxbow Lake	Jhenaidah
Gulshan-Baridhara Lake	Urban Lake	Dhaka
Buriganga River	River	Beside Dhaka Metropolitan
Turag River	River	Beside Dhaka Metropolitan
Balu River	River	Beside Dhaka Metropolitan
Sitalakshya River	River	Beside Dhaka Metropolitan and Narayanganj
Jaflang-Dauki River	River and the surrounding area of 500 metres	Sylhet
Halda River	River and the surrounding area of 500 metres	Chattogram, Khagrachhari

The legal requirements under BECA compel the concerned authorities to ban certain activities within the ECAs, which are: - felling or collecting trees, hunting, catching or killing wildlife, industrial establishment, fishing, and other activities that might affect fish or aquatic life. In general, any activity that could destroy the natural characteristics of soil or water in these areas are to be prevented under this law.

To address the extreme events of extinction, the Government of Bangladesh has also taken some institutional steps which include area-based observation, project implementations and awareness-raising programme. The Department of Environment, which is the technical arm of the Ministry, reports quite a few engaging activities that have been undertaken to protect and conserve the ECAs of Bangladesh.

The subproject is out of the 13 Ecological Critical Areas identified by the Department of Environment (DoE) shown in Figure 4-36. There are no reserve forest/biodiversity conservation areas in and around the Rajshahi City Corporation subproject area. For this subproject, the Biodiversity Assessment Plan is not required.

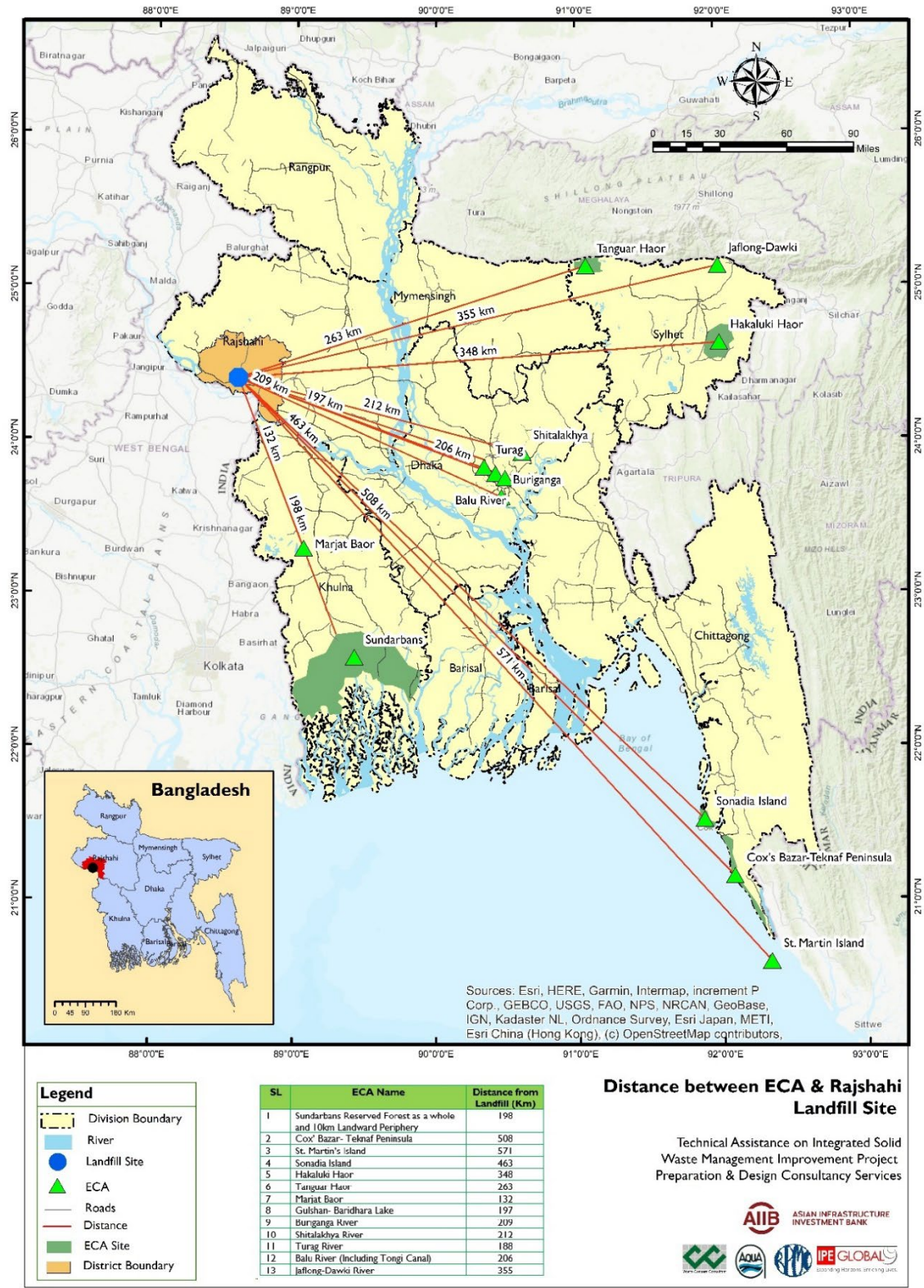


Figure 4.36 Ecologically Critical Area and Subproject Rajshahi City Corporation

4.18 Socio-economic Resources of Rajshahi District

4.18.1 Introduction

Rajshahi City Corporation (RCC) is in the Rajshahi division of North Western Bangladesh which was established in 1876. In terms of population, Rajshahi is the eighth largest populated city corporation in Bangladesh. Located on the north bank of the Padma River, it is one of the oldest cities in the country and a major urban, commercial and educational center. The city corporation comprises of 30 wards with an area of 97.18 sq.km. In 2004-2005, after completion of the land acquisition procedures, the Deputy Commissioner (DC) handed over the acquired land of 15.95 acres to the Rajshahi City Corporation (3 acres is used for City Haat) and mutation has been done. The city corporation has absolute access rights to the acquired land to be used for waste disposal.

The acquired land remains an open space demarcated by the municipality with no residences, shops, or other structures existing in an around. There are no social conflict or court case regarding the ownership of the acquired land. If the proposed solid waste management subproject is implemented in this land, no adverse social impact will be emerged. Moreover, local people will be benefited and new income source will be opened during the implementation and operation of the subproject under ISWMIP.

4.18.2 Social Survey and Key Findings

Landfill site is situated in northern part of the city corporation at ward 17.

It will not be possible to conduct the survey in all the population of the municipality. Instead, the survey has been conducted in 62 respondents of different occupation whose livelihood is related to the Landfill management. Following table shows the distribution of the respondents.

Table 4.31 Respondents of the Rajshahi City Corporation Social Baseline Survey

Occupation	Frequency	Percent
Landfill Tokai	26	41.9
Town Area Tokai	6	9.7
Ferry Wala	11	17.7
Van Driver	4	6.5
Landfill Vangari Shop	1	1.6
Town Area Vangari Shop	14	22.6
Total	62	100.0



Figure 4.37: Photos of the Social Survey near Landfill of RCC

4.18.3 General Socio-Economic of the Sub Project

Almost all of the respondents are male except some female Tokai in landfill (44%) & in the town area 50% waste pickers are female. Following table shows the gender distribution of the respondents.

Table 4.32 Occupation Wise Gender Distribution

Gender	Landfill Tokai (%)	Town Area Tokai (%)	Ferriwala (%)	Van Driver (%)	Landfill Vangari Shop (%)	Town Area Vangari Shop (%)	Wholesaler (%)	Broker (%)
Male	56.0	50.0	100.0	100.0	100.0	100.0	56.0	50.0
Female	44.0	50.0	0	0	0	0	44.0	50.0

Most of the respondents are illiterate except town area Vangari shop owner. Primary education is noticeable in town area Vangari shop owners, Ferriwala and Van drivers. Moreover, 25% of the van drivers are of JSC. None of the respondents are higher level education than HSC. Following Table 4.33 shows the education level of the surveyed people.

Table 4.33 Education Level of the Respondents

Education level	Landfill Tokai (%)	Town Area Tokai (%)	Ferriwala (%)	Van Driver (%)	Landfill Vangari Shop (%)	Town Area Vangari Shop (%)	Wholesaler (%)	Broker (%)
Illiterate	72.0	100.0	45.5	50.0	100.0	14.3	72.0	100.0
Primary	24.0	0	54.5	25.0	0	50.1	24.0	0
JSC	4.0	0	0	25.0	0	7.1	4.0	0
SSC	0	0	0	0	0	21.4	0	0
HSC	0	0	0	0	0	7.1	0	0
Graduate	0	0	0	0	0	0	0	0
Masters	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100

Except these surveyed people some of their family members are also involved waste management related works. The following Table 4.34 shows the scenario of the involvement of other family members to the waste management related works.

Table 4.34 Involvement of any other persons of the family in waste recycling work

Response	Landfill Tokai (%)	Town Area Tokai (%)	Ferriwala (%)	Van Driver (%)	Landfill Vangari Shop (%)	Town Area Vangari Shop (%)	Wholesaler (%)	Broker (%)
Yes	27.8	0	0	0	0	0	27.8	0
No	72.2	100.0	100.0	100.0	100.0	100.0	72.2	100.0

4.19.4 Status of the Waste Management Related Occupation

Some of the respondents choose these works considering high income source specially town area Vangari shop owners (27.3%). Whereas all the town area waste picker and Van driver prefer these jobs as other jobs are not available. Following Table 4.35 shows the scenario of the reasons to choose these occupations.

Table 4.35: Reasons of choosing these occupation

Income Source	Landfill Tokai (%)	Town Area Tokai (%)	Ferriwala (%)	Van Driver (%)	Landfill Vangari Shop (%)	Town Area Vangari Shop (%)	Wholesaler (%)	Broker (%)
High income source	0	0	0	0	0	27.3	0	0

Income Source	Landfill Tokai (%)	Town Area Tokai (%)	Ferriwala (%)	Van Driver (%)	Landfill Vangari Shop (%)	Town Area Vangari Shop (%)	Wholesaler (%)	Broker (%)
Familiar Work	30.4	0	55.6	0	100.0	45.4	30.4	0
Other work is not available	69.6	100	44.4	100.0	0	27.3	69.6	100
Total	100	100	100	100	100	100	100	100

Few of the Landfill waste pickers (15.4%), town waste pickers (16.7%), town Vangari shop (14.3%) Ferriwala (9.1%) are doing their works for recent years, whereas rest of them are doing their work for long time. Table 4.36 shows distribution of the duration of their engagement with these works.

Table 4.36 Duration of the engagement with these works

Years	Landfill Tokai (%)	Town Area Tokai (%)	Ferriwala (%)	Van Driver (%)	Landfill Vangari Shop (%)	Town Area Vangari Shop (%)	Wholesaler (%)	Broker (%)
1 - 5	15.4	16.7	9.1	25.0	0	14.3	15.4	16.7
6-10	30.8	0	18.2	25.0	0	7.1	30.8	0
11-15	23.1	16.7	27.3	0	0	14.3	23.1	16.7
16-20	15.4	33.3	18.2	0	100.0	35.7	15.4	33.3
More than 20	15.4	33.3	27.3	50.0	0	28.6	15.4	33.3
Total	100	100	100	100	100	100	100	100

Cent present of the town area waste pickers, van driver and town area Vangari shop work for the whole week. Also, noticeable respondents work 6 days a week and very few works 3 and 4 days a week. Table 4.37 shows the scenario.

Table 4.37 Working group and Weekly working days

Days	Landfill Tokai (%)	Town Area Tokai (%)	Ferriwala (%)	Van Driver (%)	Landfill Vangari Shop (%)	Town Area Vangari Shop (%)	Wholesaler (%)	Broker (%)
3	0	0	9.1	11.1	0	0	0	0
4	4.0	0	0	0	0	0	4.0	0
5	0	0	0	0	0	0	0	0
6	76.0	0	81.8	0	100.0	0	76.0	0
7	20.0	100.0	9.1	100.0	0	100.0	20.0	100.0

Days	Landfill Tokai (%)	Town Area Tokai (%)	Ferriwala (%)	Van Driver (%)	Landfill Vangari Shop (%)	Town Area Vangari Shop (%)	Wholesaler (%)	Broker (%)
Total	100	100	100	100	100	100	100	100

According to following Table 4.38, majority of the town area waste pickers, half of the van driver and all the landfill shop owners work only 3-6 hours in a day. Whereas, Majority of the landfill Tokai and town area Vangari shop owners work 10-12 hours in a day.

Table 4.38 Duration of work in a day

Hours	Landfill Tokai (%)	Town Area Tokai (%)	Ferriwala (%)	Van Driver (%)	Landfill Vangari Shop (%)	Town Area Vangari Shop (%)	Wholesaler (%)	Broker (%)
3-6	16.7	66.7	0	50.0	100.0	0	16.7	66.7
7-9	16.7	16.7	81.8	50.0	0	28.6	16.7	16.7
10-12	58.3	16.7	18.2	0	0	71.4	58.3	16.7
13-15	8.3	0	0	0	0	0	8.3	0
Total	100	100	100	100	100	100	100	100

Income & Expenditure are usually high of the Ferriwala and landfill & town Vangari shop owners. Whereas, town area & landfill Tokai and van driver have low income and expenditure. Following Table 4.39 show the monthly income and expenditure of the respondents.

Table 4.39 Monthly income of the respondents

Income Range	Landfill Tokai (%)	Town Area Tokai (%)	Ferriwala (%)	Van Driver (%)	Landfill Vangari Shop (%)	Town Area Vangari Shop (%)	Wholesaler (%)	Broker (%)
5000-10000	24	16.7	0	0	0	0	24	16.7
10001-15000	12	83.3	0	100.0	0	0	12	83.3
15001-20000	64	0	27.3	0	0	0	64	0
20001-35000	0	0	72.7	0	0	0	0	0
35001-50000	0	0	0	0	0	0	0	0
More than 50000	0	0	0	0	100.0	100.0	0	0
Total	100	100	100	100	100	100	100	100

Table 4.40: Monthly expenditure of the respondents

Expenditure Range	Landfill Tokai (%)	Town Area Tokai (%)	Ferriwala (%)	Van Driver (%)	Landfill Vangari Shop (%)	Town Area Vangari Shop (%)	Wholesaler (%)	Broker (%)
5000-10000	24.0	16.7	0	0	0	0	24.0	16.7
10001-15000	40.0	83.3	0	100	0	14.3	40.0	83.3
15001-20000	36.0	0	72.7	0	0	0	36.0	0
20001-35000	0	0	27.3	0	0	21.4	0	0
35001-50000	0	0	0	0	100.0	28.6	0	0
More than 50000	0	0	0	0	0	35.7	0	0
Total	100	100	100	100	100	100	100	100

The survey along both sides of the connecting roads reveals that the average monthly income of the business owners is Taka 25,551 where the lowest income is Taka 7,000 and the highest income is Taka 200,000. Detail status is shown in **Table 4.41**.

Table 4.41: Average Monthly Income of the Business Owners along the Connecting Roads

Income Range (BDT)	No. of the Owners	Percentage of the Owners
Up to 5000	0	0
5001-10000	12	13.47
10001-15000	21	23.60
15001-20000	27	30.33
20001-35000	17	19.10
35001-50000	6	6.74
More than 50000	6	6.76
Total	89	100.00

The table below shows the details about the types of businesses located along both sides of the connecting roads proposed for improvement under the subproject.

Table 4-42: Types of businesses located along the connecting roads

Sl. No.	Type of Business	No. of Shops	% of Shops
1	Grocery Shop	43	48
2	Small Restaurant/Tea Stall	14	16
3	Barber Shop	4	4
4	Tailor/Cloth Seller	4	4
5	Wiring/Workshop	4	4
6	Poultry Shop	3	3
7	Cement and Accessories	2	2
8	Mechanic/Cycle Repairing Garage	2	2
9	Pharmacy	2	2
10	Electronics/Flexiload	2	2
11	Shoe Shop	2	2
12	Computer Compost, Photocopy	1	1

13	Confectionary		
14	Furniture Shop		
15	Hardware		
16	Laundry Shop		
17	Sanitary Shop		
18	Vegetable Shop		
Total		89	100

4.19.5 Details of Affected Entities

4.19.5.1 Affected Persons with Direct Impact on Livelihood

The implementation of the landfill project in Rajshahi City Corporation will impact the livelihood of (i) Twenty-seven (27) waste pickers, (ii) one (1) Vangari shop, (iii) sixteen (16) temporary restaurants/shops, (iv) eleven (11) ponds and (v) one (1) medical waste management and recycle Plant located within 250m of the landfill area, and (v) 89 small shops, mills and business enterprises along two connecting roads. Figure 4.38 shows the affected entities of landfill.

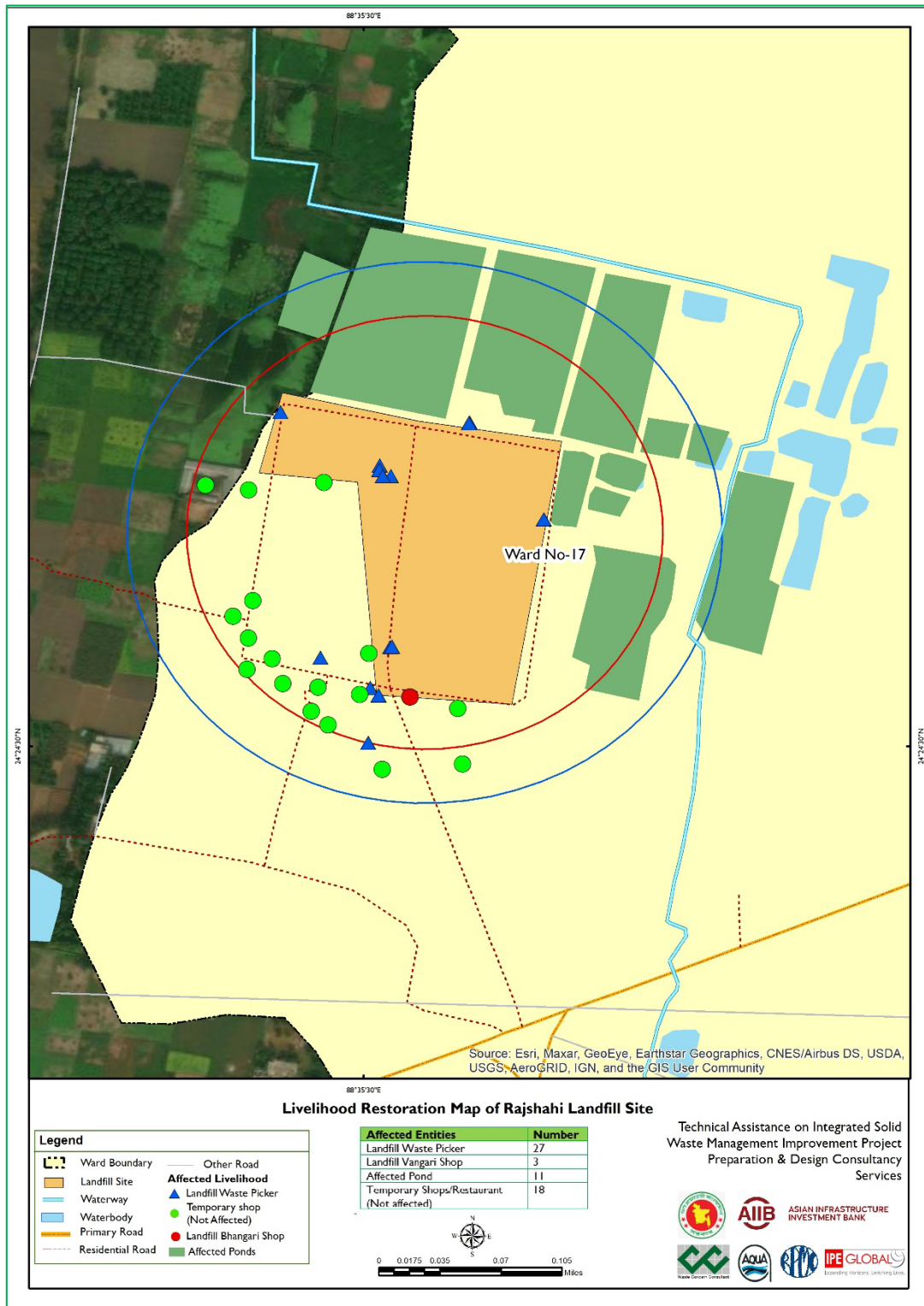


Figure 4.38: Affected Entities of Rajshahi City Corporation Landfill Area

Table 4.43 Affected Persons of Direct Livelihood Impact

Sl. No.	Affected Persons/ Entities	Number	Location
1	Waste Pickers	27	Landfill Area
2	Vangari Shop	1	Landfill Area
3	Restaurants/Tea stalls/Other shops	16	Within 250m (Buffer Zone) of Landfill Area
4	Ponds	11	Within 250m of Landfill Area
5	Small Shops, Mill and Business Enterprises	89	Along 2 connecting roads

The pictures of surveyed affected entities are shown in **Figure 4.39** below.



Landfill Area Waste Picker

Owner of the Vangari Shop Near Landfill area

Affected Pond located within 250m of the Landfill area

Affected Medical waste management and recycle Plant located within 250m of the Landfill area



Figure 4.39: Surveyed affected entities

4.19.6 Affected Entities out of 250m Buffer

Almost all the respondents are male, only some waste pickers are female. Following table shows the scenario.

Table 4.44 Demographic Status of Waste Pickers, Vangari and Whole Seller Shops

Sl. No.	Total Number of Affected Persons	Male	Female	Total
1.	Landfill site Waste Pickers	11	16	27
2.	Landfill site Vangari shop	1	0	1
Total				28

Source: Social Survey, January 2023

Waste Pickers will be directly impacted by the implementation of the subproject. These Waste Pickers work in proposed landfill area. Detail information of twenty-seven Waste Pickers are shown in **Table 4.44** below.

Table 4.45: Detail of Waste Pickers of Landfill Area

Sl. No.	Name of Affected Persons	Address	Gender	Age	NID/Birth Certificate Number	Contact Number
1	Mst. Sorifa Khatun	Hogram, Rajshahi Court-6201,	F	40	239 382 9052	013113275368

Sl. No.	Name of Affected Persons	Address	Gender	Age	NID/Birth Certificate Number	Contact Number
2	Mst. Renuka Bibi	Buruj, Kaliganj Hat-6230.	F	35	870 338 2823	01737298516
3	Shree Biren	Chalk Para, Sopura-6203.	M	24	735 814 3886	01307143958
4	Salma	North Nowdapara, Sopura-6203.	F	39	148 694 4364	01767413087
5	Mrs. Agata Biswas	Vugroil, Poba-6210.	F	56	281 263 9769	01310527059
6	Fatema	North Nowdapara	F	38	868 698 0700	01301189832
7	Asma	North Nowdapara	F	57	238 696 6283	01773855679
8	Shree Lalon Kumar	Hogram, Shekh Para	M	28	19948198502000205	01792528425
9	Mst. Nazma	North Nowda para	F	45	328 695 7091	01324094942
10	Nazu Biswas	Boro Bongram, Chalk Para	M	38	868 588 6957	01731452989
11	Munil Murmu	Mushroile, Bachchur Mor.	M	19	20048127505081208	01309625529
12	Shapwn Biswas	Mushroil	M	27	826 151 6093	01790887657
13	Shree Ranjit Kumar	Chalk Para	M	31	956 344 5122	01795529512
14	Sundori Biswas	Soto Bongram, Mushroil	F	62	236 379 6026	01790887657
15	Khokon Toppu	Bachchur Mor	M	27	196 165 3381	01985096153
16	Shimul Biswas	Christian Para, Mushroil	M	28	642 287 4468	01317225107
17	Ratna Biswas	Mushroil	F	20	686 406 3604	01307859468
18	Shopon Biswas	Christian Para	M	42	911 408 4719	01779332236
19	Ujjol Biswas	Mushroil	M	22	737 428 8806	01305491191
20	Prarthona Biswas	Christian Para	F	33	600 984 8299	01827111596
21	Lusia Biswas	Vugroil	F	67	596 264 6211	01942142793
22	Manik Biswas	Christian Para , Mushroil	M	27	466 496 3602	01716751357
23	Maini Biswas	Bongram, Christian Para	F	40	823 587 6730	01905294647
24	Rabeya Khatun	City Hat Area	F	57	598 678 1028	01752723147
25	Rumali	Boro Bongram, chalk Para	F	20	811 722 7456	01319327317
26	Firoza Rani	Vugrol, Kanthalbaria	F	49	8113135546314	01727912689
27	Sagori Bishwas	Borobongram, Chalk Para	F	34	148 585 7450	01576618653

Source: Social Survey, January 2023

Livelihood of One (1) Vangari Shop owner and Sixteen (16) Restaurants/Tea stalls/Other shops owners will be directly impacted due to the implementation of the subproject. These shops are located near proposed landfill area where the waste pickers sell the retrieved inorganic materials. Detail information

of One (1) Vangari Shop owner and Sixteen (16) Restaurants/Tea stalls/Other shops owners are described in **Table 4.45**.

Table 4.46: Detail of Vangari and Whole Seller Shop Owners Near Landfill Area

Sl. No.	Name of the Vangari Shop Owner	Address	Area (sq.ft)	Gender	Age	Contact Number
1	Md. Aesh Uddin	Guabari, Dacra	1152	M	57	01738674940
Sl. No.	Name of the Whole Seller Shop Owner	Address	Area (sq.m)	Gender	Age	Contact Number
1	Md. Rocky		450	M		01740121215
2	Shishir Ahmed Rubel		280	M		01915550473
3	Nur Islam		560	M		01733747050
4	Md. Jony Ahmed		480	M		01734780834
5	Md. Moniruzzaman		120	M		01828182345
6	Md. Selim Islam		200	M		01942142668
7	Md. Jakir Hossain		450	M		01747909449
8	Md. Rakib		240	M		01728842182
9	Md Sajjad Hossain		30	M		01757447907
10	Ahsan Habib Jony		84	M		01722858438
11	Dr. Md. Tayeb Ali		80	M		01796708920
12	Shiplu		120	M		01712130588
13	Omor		180	M		01835665901
14	Azabul		180	M		01761572975
15	Tazuddin Poltu		320	M		01714690263
16	Md. Montaj		105	M		01724051590

Source: Social Survey, January 2023

4.19.7 Affected Entities inside 200m and 250m Buffer

Eleven (11) ponds are located within 200m and 250m of the landfill area. Livelihood of the affected persons related to the ponds will also be compensated. Detail information of the affected persons is shown in **Table 4.47**.

Table 4.47: Detail of Affected Pond located within 250m buffer zone

Sl No	Name and Mobile number, NID number and address of Pond Owner	Monthly Income	Monthly Expenditure	Name and Mobile number, NID number and address of Employee	Employee position and Salary (Monthly)	Area (Dec)	Type of Fish Cultured
1	Foyisal Islam, 01713734165/238 684 8069/	2,00,000	1,50,000	Md. Akbor Ali, -/733 693 6096/ Holding-132, Moddho Nowdapara, Sopura-6203.	Guard 25,000	15	Rui, Katla, Mrigel, Japanee

SI No	Name and Mobile number, NID number and address of Pond Owner	Monthly Income	Monthly Expenditure	Name and Mobile number, NID number and address of Employee	Employee position and Salary (Monthly)	Area (Dec)	Type of Fish Cultured
	Holding-132, Moddho Nowdapara, Sopura-6203.						Carp, Silver Carp
2	Md.Asaduzzaman,01712506185/866 237 9364 Vugrail, Poba-6210, Naohata Pourashava.Rajshahi.	150,000	150,000	Md. Nur Hossain,- /1479312702/ Vugrail, Poba-6210, Naohata Pourashava.Rajshahi.	12,000	5.5	Rui, Katla, Mrigel, Japanee Carp, Silver Carp
3	Md. Kurman Ali,01734919452/506 653 3976 Borjonpur, Aamgasihat-6240, Durgapur, Rajshahi	50,000	50,000	NA	NA	1.5	Rui, Katla, Mrigel, Japanee Carp, Silver Carp
4	Foimuddi, 01780140146/			NA	NA	0.619	Rui, Katla, Mrigel, Japanee Carp, Silver Carp
5	Shirajul, 01716133310/ Naodapara	12,500	12,500	NA	NA	0.619	Rui, Katla, Mrigel, Japanee Carp, Silver Carp

Source: Social Survey, January 2023

4.19.8 Focus Group Discussion (FGD) & Stakeholder Consultation Meeting

4.19.9.1 Strategy as Per Resettlement Framework

During implementation of the Resettlement Plan (RP) with the assistance of the consulting team and LGED, City Corporation will conduct meaningful consultations with PAPs, their host communities, and civil society for each sub-project identified as having involuntary resettlement impacts. Meaningful consultation is a process which will:

- Start beginning in the project preparation stage and be carried out on an ongoing basis throughout the project cycle;

- Provide timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;
- Be undertaken in an atmosphere free of intimidation or coercion;
- Be gender-inclusive and responsive, tailored to the needs of disadvantaged and vulnerable groups;
- Incorporate all relevant views of affected people and other stakeholders into decision makings, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues; and
- Share the anticipated impacts of the sub-project, the EA /LGED will pay particular attention to the need of disadvantaged or vulnerable groups, especially those below the poverty line, the landless, the elderly, female-headed households, women and children, Indigenous Peoples, and those without legal title to land.

As the Livelihood Restoration Plan (LRP) is a part of Resettlement Plan (RP), necessary consultation and information dissemination also required during implementation of the Livelihood Restoration Plan (LRP). During preparation of Livelihood Restoration Plan (LRP) required number of Focus Group Discussion and Stakeholder Consultation Meetings were conducted by the Consultant.

4.19.9 Focus Group Discussion (FGD)

One (1) Focus Group Discussions (FGDs) was conducted with 16 male sweepers located in sweeper colony of Hetem Kha, Ward No 11, Rajshahi city corporation beside of the landfill area. All of them are from the Harizon community. Their age group is 31-65. Average family size is 5. They live in the city corporation sweeper colony. Every family accommodation comprises 2 Semi-Pacca rooms and a veranda with common kitchen and toilet.

Out comes from the FGD are following

- During the discussion the FGD group discussed about their daily expenditures which shows their challenges of everyday life. Considering the price of the necessary goods their earning is quite insufficient.
- They are involved mainly drain cleaning, Office cleaning, sewerage line cleaning, safety tank cleaning etc. In city Corporation, those who are employed for 3 hours get a monthly salary of Tk 4500 and those who are employed for 8 hours get a monthly salary of Tk 13,500. Considering the price of the daily necessary goods, this amount is very insufficient
- They have dissatisfaction about getting PPEs. They added that they get it very irregularly and quantity is very insufficient.
- They faced job related health hazards. Cold, cough, small injuries are regular phenomenon of their life. They must expend expenditure to manage the hazards. The FGD group claimed medical facilities for it.
- Now a days the posterity of the community is getting education. According to the female respondent their descendants are deprived to get proper job. They requested for job scope in the upcoming ISWMP based on competence. They added that it will change their livelihood.

Some photos of FGD are shown in Figure 4.42 as below:



Figure 4.40: Photos Taken During Focus Group Discussion in RCC

4.20 Transportation System of Rajshahi City

Introduction

Rajshahi Metropolitan City (RMC) is one of the largest cities in Bangladesh. It constitutes a high urbanization rate of 32.93% (BBS, 2011). The total area of this city is 96.72 kilometer and population is around 0.9 million. This city is known as the center of education for north side of Bangladesh. It is an important city for medical and industrial purpose of this country. People from different district around Rajshahi come to take a fresh breath in this city. Because, WHO (World Health Organization) declared Rajshahi, as the most “Air pollution less” city in the world in 2016. But nowadays the environment and human life are seriously hampered by the shabby transportation system of this city. S. M. Z. Tanzim shows parking accumulation on street parking of some specific intersection of Rajshahi city. Md. Sakib Zubayer shows pedestrian walkway environment on some specific point of Rajshahi city. Mizanur shows the deficiencies of traffic signal system in Dhaka city. Though Rajshahi is an important part of Bangladesh but yet there is no research is done on the transportation and traffic signal system of this city So, the aim of this paper is to find out the deficiency in transportation and traffic signal system of Rajshahi city and showing the actual condition of transportation and as well as total traffic signal system of Rajshahi city, Bangladesh. At present 41.37% road of this city is pukka (BBS, 2011). There are 96 metaled roads with a total length of about 1270 kilometer, 108 semi-metaled

roads of about 506-kilometer length and 6 railways of about 63-kilometer total length. But unfortunately, most of these roads do not have proper transportation characteristics. Bad road surface condition, lack of maintenance, operational deficiencies and damaged traffic signal system are main problem in this city. These deficiencies cause great traffic jam and human sufferings. That is why, this complete transportation study is implemented to investigate the situation of existing transportation and traffic signal system as well as to suggest for improvement.

Scope of Study

Rajshahi is one of the major cities in Bangladesh with lots of important office, schools, colleges, universities. So, transportation is an important factor to ensure the safe and comfortable movement of the inhabitants of this area. If the actual demand and the existing scenario of the transportation system are determined, it can help to ensure an effective and sustainable management system for the inhabitants. By this way Rajshahi can be converted to a well transportation facilitated as well as transportation management system.

Objective

Objective of this study is

1. To study of existing transportation conditions.
2. Identifying the current transportation problems.
3. Classify the problems and solutions according to their impacts and importance

Methodology

The 186.64 km roadways of Rajshahi City Corporation are taken into consideration for our study. We have conducted field survey of these roads to find out the physical deficiencies of transportation system. For why, we divided these roadways into 27 wards and the roads connected to them. The drainage system affiliated with these roads are also investigated. To find out the deficiencies of traffic signal system, we surveyed every intersection point, railway crossing and important points of this city. The major traffic conflicted parking areas of Rajshahi city are also taken into consideration for our study.

Identification of Physical Deficiencies of Transportation System

From the field survey following physical deficiencies are identified in the transportation system in Rajshahi city.

Broken Roads

It is the main problem of the transportation system of this city. Most of the road surface are peeled off and this makes potholes and open aggregates from the road surface. The dusty aggregates contaminate the air and as a result the environmental condition of this city is no more in favor fresh breath. According to field survey, we observed that 13% roads are in primary broken condition, 28% roads are in intermediate broken condition and 8% roads are in tertiary broken condition in every 10 kilometers road length. In some places it is so acute that the vehicles can't pass over it. As a result, overturning of vehicles is a common news nowadays. It is shown a crucial condition of road of Talaimari intersection in Rajshahi city. And it is the common scenario of roadways of this city. After a little bit raining the potholes are filled with water and make the situation worst. About 65m road are totally damaged in front of rail station. This road is the most important road for the city but it is totally useless for its condition and this causes traffic jam every day at the intersection. Sometimes, buses miss their time schedule due to this problem.

Roadside Garbage

Various types of garbage are seen on road side or on road surface in this city. It lessens the road area and create obstruction on the free flow of traffic. In every 10 km, there are 2 open dustbins of about 270 square feet on just sideways of road. About 350 tons wastes are produced each day while the amount increases to 400 tons during summer in Rajshahi city, among them 12 tons are treated as hazardous wastes. Among the total collected wastes, only 210 tons are dumped into the dumping ground and the remaining 140 tons are dumped straight into drains, water bodies and open spaces (Atik, 2013). And maximum dustbins are on different roadsides. That creates frowsy smell through that road area. Figure 5 is taken from kajla where we get open dustbin on road side. Another garbage thing is water. 60% of roads suffer from roadside water blockade after a little raining. It creates mud on roadside and makes the road slippery and frictionless. Figure 4.43 is taken from RUET gate where we found that water blockade after a little bit raining.

Viewing Problem

Different types of obstacles are seen on roadside that hinders the viewing of signal post's information on road. In Rajshahi city, every business or educational places are filled with different sized posters. Sometimes these hanging posters generally made of clothes create fire spark because of hanging them on electric wires. These hampers the purposes of signal system. In other area the signal posts are covered by different products or waste materials. Broken milestone is shown in Figure 4-43 and obstruction of traffic signs is shown in Figure 4-44.



Figure 4.41 Broken letters of milestone of roadside



Figure 4.42 Road Side Posters create obstruction

Drainage Problem

Among the total waste produced in each day there are 140 tons wastes which are dumped straight into drain in Rajshahi city. As a result, huge number of drains are seen as filled by solid wastes. This make the drainage of waste water flow unsteady. 30% of total 142.18 kilometers drains are less or more blocked by garbage materials. And when the wastes are cleaned, generally it placed on road surface just beside the drain. As a result, difficulties come forward in passage of people and vehicles. During rainy season it becomes so painful for general people. Figure 4.45 and Figure 4.46 show the rotten drainage condition that becomes totally unused.



Figure 4.43 Blocked drain at Kajla, Rajshahi



Figure 4.44 Roadside wasteful drainage, Rajshahi

Another problem in Rajshahi city is shown in Figure 4.47. This kind of short, wasteful roadside drain hampers both the environment and road users at a stretch. Sometimes, the drain becomes open and wastes come to the road surface. This creates so much sufferings for people and causes accident also.

Footpath Problem

Footpath system is provided for pedestrians but here it is grabbed by business purposes, placing construction materials and somewhere personal use. In some important points, it creates serious traffic jam. Some important points of Rajshahi city are taken into consideration for identifying the denseness of illegal shops on footpath. And the terrible result is shown in Figure 4.47 and in Figure 4.48, the actual practical condition is shown. This tremendous problem tends the city to a great traffic jam every day. It has been shown that traffic capacity is reduce for using footpath for business purpose.



Figure 4.45 Footpath and road grabbed by shopkeeper



Figure 4.46 Muddy road and illegal parking

Illegal parking and illegal foot path

In Rajshahi city, there is no well parking facility system. Markets are grown up nearby roadside without maintaining any rules. For this reason, bus, truck and other vehicles use road side as a parking place.

Thus, traffic flowing capacity of road becomes less and traffic jam occurs randomly in Rajshahi city. Besides another horrible problem is stopping vehicle on road at any instant for picking passengers. Figure 4.49 is captured from Talaimari. Here 50 feet road is contracted to 20 feet road for this illegal parking.



Figure 4.47 Illegal footpath taken, Rajshahi

Wrong side traffic flow

Because of bad condition of roads, illegal parking of vehicles, illegal footpath taking, elastic traffic signal system people often try to go through a shortcut path to save their time. This breaks down the transportation system and makes bad condition of traffic flow resulting traffic jam. And it is a common scenario of this city. It has been seen that a bike uses wrong entry to change the lane. And human use main carriageway of road instead of using footpath.

Besides, there are also some other problems in transportation system of this city. Broken shoulder of roads, on street parking, leaning wires on roads, expired vehicles, vanished road marks etc.

Physical Deficiencies in Traffic Signal System of Rajshahi City

From the field survey, following physical deficiencies are identified in the traffic signal system in Rajshahi City.

- Placement of Signal post

According to traffic signal guideline, the traffic signal should be placed one meter ahead from the stop line. Besides, position of signal for each approach should be sited on the left-hand side at the entrance to the intersection. If the approach is more than two lanes wide then second primary signal may be needed on the right-hand side and where necessary, a traffic island must be built to accommodate it. From our observation, we found that most of the cases, signals are placed in front of the pedestrians crossing and too far from the stop line in Rajshahi city. From field survey it is revealed that out of 23 signalized intersection placements of signal are wrong at 46% intersections.

- Traffic Signal Light Condition at Intersection

For controlling of traffic, the signal lights should be operated at intersection. From field survey it is revealed that signal lights are not operated perfectly. Signal light is missing at 5.8% approaches and at 6.2 % intersections. It has been shown a condition in where the signal light is missing at Barnali intersection. Due to traffic signal light broken or missing, it increases probability of traffic hazard and makes difficulty to manage traffic flow in rush hours. Signal light size is important, as it should be clear view by the road users. According to the sign guidelines, the minimum diameter for normal signal lenses is 200mm, but 300mm is preferred especially at large and busy junctions. All arrow signals, and signals mounted overhead must have lenses that are at least 300mm in diameter. The signal light size

is correct at 98.4% of approaches. There is no significant deficiency observed in signal light sizes.

- **Traffic Signal Poles and Mast arm Condition**

The size of pole and mast arm is an important factor because the signal head position changes with the changes of sizes of signal poles. Here the pole size is correct at 87% approaches. From survey data it is revealed that 67% mast arm condition is worse. Maximum poles and mast arms are found in beveled or tilted condition. Colors in pole and mast arm are essential to resist from corrosion and weathering effect. Pole and mast arm are colorless at 47% approaches and at 36.2% intersections. For these reason pole and mast arm life times are reduced. Location of pole and mast arm is an important part for signal system. In accordance with the sign guidelines, location of pole and mast arm should be close to the kurb or edge of the carriageway, but have to leave sufficient clearance to prevent the signal head being struck by vehicles. Figure 18 shows the tilted pole condition at Sagorpara intersection. Vehicle was struck the pole. Location of the pole and mast arm is wrong at 12.8% approaches and at 13.6% intersections. For incorrect location of poles and mast arm most often vehicles struck signals and tilt the pole.

- **Obstructed/Poor Visibility of Signal Light**

According to the sign guidelines, drivers in each approach lane must have a clear view of at least one primary signal. The signal lights are obstructed by tree at bypass intersection. Same thing is happened at Bahrampur crossing.

From the field survey it is revealed that sign board or bill board obstructed visibility of traffic light at 17.6% intersections, tree at 46% intersections, electric cable at 6.2% intersections and electric pole at 5.6% intersections respectively.

- **Operational Deficiencies in Traffic Signal System**

There is no active signal system in this city. All the signals are damaged. As a result, vehicles maintain the rules shown by the traffic police. The Lane discipline is maintained at few numbers approaches and intersections. Stop line and Pedestrian crossing are violated at most of the intersections. Footpath is blocked by different shops. So, people use main road as their running purpose. As a result, vehicles have to press brake repeatedly after a little bit driving and this increases the accidental tendency. There a train was passing at Barnali intersection in the evening but there was no signal light shown. This kind of incidents happen every day in this city for the cause of an active traffic signal system.

In Rajshahi city, the traffic is controlled by traffic police. The police personnel don't have proper knowledge about traffic engineering, signal timing design and signal system. As there is no active electronic signal system, they use their individual judgment or visual observation to avoid traffic jam by giving a timing control by their hand according to their own observation. But when there appears a large queue of vehicles, many drivers cannot see the hand indications of traffic police due to the low height of the traffic police. So, the drivers follow the path of his front vehicle. As a result, startup lost time and delay time is increased respectively. From field observation it is found that illegal parking and stopping auto rickshaw instantly at any place without rules is so much common incident that causes traffic jam. In traffic engineering there are some specific time priority mode for specific vehicles. Such as the train will get more priority than other vehicles. And the signal system is designed on this basis. But there is no rule maintained here. Such as the traffic control room doesn't give any signal to the road users when the train passes through the city. Instead, there is a gateman at the crossing who shows a barricade to the road users at that time. There is no traffic engineer found for traffic signal operation in Rajshahi City Corporation. The signal systems in Rajshahi city have no planning provided in the controller for incident management, VIP movements, rally, accident and for special events

Large numbers of physical and operational deficiencies are observed in transportation and traffic signal system in Rajshahi city. Physical deficiencies are observed largely like broken roads, roadside garbage, blocked drainage, illegal parking, and illegal footpath taking and so on. Besides, deficiencies in traffic signal system are placement of signal, traffic signal light, pole and mast arm condition, pedestrian signal, signal visibility and activity of signal system. The operational deficiencies are mainly found in traffic signal system. Frequent traffic flow without rules, stopping vehicles on road instantly for taking passenger, no speed monitoring system, no overpass system for pedestrians, illegal shops on roads, and mixed traffic flow on road causes unnecessary traffic delays and congestion and wastes our millions of hours. These deficiencies of proper transportation facilities fail to fulfill the actual demand of people of Rajshahi city. Ineffective operation, maintenance and monitoring of transportation system make the system worse. The roadways should be monitored at a regular time basis. Drainage system should be checked. Centralized traffic control system should start its operation by solving the problems associated with them. The technical problems of signal system such as equipment fixing, replacement of damaged signal light and poles, and the network should restart its activity. Traffic engineers should be deployed in operation and the staffs associated with it should be trained perfectly by hand on experience. The city corporation should take proper steps on this sector. Introduction of above, mentioned modern measures might improve the transportation and traffic control system of Rajshahi city.

4.21 Livelihood Restoration of the Subproject Affected Entities

Based on the socioeconomic condition of the affected peoples of this subproject detailed out in Section 4.20, a separate livelihood restoration plan has been developed by the consultant. The Livelihood Restoration dealt with the income generating assistance to the affected persons includes both short and medium-term strategies required to be taken. Short-term income restoration strategies are for immediate assistance during relocation and include the following:

- Compensation for land, structures, and all other affected/ lost assets is paid in full before a construction activity begins;
- PAPs losing entire structures are entitled to shifting and reconstruction allowance (cash) for moving to the alternative premise for re-establishing house/business
- Shifting allowance for households based on the actual cost of moving/unloading
- Sixty days" advance notice to harvest standing seasonal crops, if harvest is not possible, compensation for a share of standing crops at market rates
- Business owners/tenants including farmers earning a livelihood from crops and experiencing loss of income are entitled to a one-time lump sum grant of one-month income based on the nature and type of losses assessed on a case-to-case basis or on minimum wage rates, whichever is more.
- For vulnerable groups, additional subsistence allowance equal to their average three months income Tk. 15,000 per vulnerable household for restoring or enhancing their livelihood. Vulnerable households will be prioritized in any project employment.

For the RCC subproject, the Compensation Provision under Livelihood Restoration Program has been estimated at Tk. 23,959,684 (Tk. 10,315,684 for landfill site improvement and Tk. 13,644,000 for connecting road improvement). The Project Director of ISWMIP will allocate the compensation payable, and CC authority will disburse the compensation to the PAPs under the supervision of the social safeguard team of the supervision consultant of the project. A social survey was conducted in December 2022 and a road survey was conducted in June 2023. The quoted numbers regarding the

affected categories are currently considered an estimate, and their numbers will be updated six months before the commencement of civil works to reflect the fluidity of the waste-picking ecosystem and the change in the commercial establishments along the connecting roads. No person will be eligible for any Livelihood Restoration Compensation after the update. During the social and road survey, GPS coordinates are taken for the affected entities. This GPS location will be used to verify and update the affected persons during compensation payment for livelihood restoration. The entitlement matrix and the project affected persons compensation are detailed out in the livelihood restoration plan report of Rajshahi City Corporation subproject. The social impact assessment is briefly listed in the matrix below which comprises construction, operation & maintenance phases of the subproject.

Table 4.48: Social Impact Assessment of Rajshahi City Corporation

Social Impact Assessment in Construction and Operation Phase of Landfill Site							
SI No.	Affected Entities	Construction Phase			Operation and Maintenance Phase		Remarks
		No. Affected	Compensation	Engaged in work	Engaged	Work field	
1	Waste Pickers	27	√	√	√	Engage in MRF	Will be absorbed by the Municipality
2	Vangari Shop	1	√	√	√	Better Livelihood	Transfer and Reconstruction Grants will be made before the construction phase
3	Restaurants/Tea stalls/Other shops Owner in Landfill Area	16	√	√	√	Better Livelihood	Transfer and Reconstruction Grants will be made before the construction phase
4	Affected Pond	1	√	X	Pending	To be compensated by resettlement	Based on the decision of DOE and Municipality
Social Impact Assessment in the Construction and Operation Phase of Two Connecting Roads							
SI No.	Affected Entities	Construction Phase			Operation and Maintenance Phase		Remarks
		No. Affected	Compensation	Engaged in work	Engaged	Work field	
1	Small Shops, Mills and Business Enterprises along the connecting roads	89	√	X	X	X	Compensation payment for income loss will be made before the construction phase

5 ALTERNATIVE ANALYSIS

5.1 General

The alternatives analysis for this subproject was conducted early in the subproject inception to examine feasible alternatives; alternative site locations, designs; or alternative ways of dealing with environmental and social impacts. The alternatives considered are discussed below in some detail.

5.2 Location of the RCC Subproject

Due to land scarcity in the town, seeking an alternative site for establishing the new landfill is quite difficult. Also, land acquisition is now most difficult part of the Rajshahi City Corporation considering the subproject nature and land availability.

Like any other project, the subproject site was selected based on economic, technical, social, environmental, and regulatory issues. These criteria have been assessed qualitatively, as landfill area is comparatively small. The criteria used are given in the Table-5.1.

Table 5-1: Criteria used in the Selection of Subproject Site

SI	Criteria	Justification for the Selected Site
1.	Availability of the land	In the Rajshahi City Corporation, land scarcity is very common and availability of suitable land for the subproject siting is a major concern. In the selected site land is still available at relatively better condition. The existing landfill site is the property of Rajshahi City Corporation hence no land use conflict is expected. The existing landfill site will be utilized to construct the Integrated Landfill and Resource Recovery Facility. There are no social conflicts with land acquisition.
2.	Regulatory Environment	The site is complying with the SWM Rules of 2021. However, one pond, one vangari shop and sixteen shops are within 250 m of the landfill site.
3.	Availability of basic infrastructure	All basic infrastructure i.e., roads, power connection, fuel supply etc. are available in the area.
4.	Water availability	Municipal water supply is available.
5.	Wastewater disposal	Wastewater will be generated from the plant operation shall be collected, treated and reused.
6.	Environmental, Ecological and social Impacts	This subproject will have very low environmental, ecological, and social Impact as analyzed in this report; so that it will be acceptable to the local population.
7.	Availability of labor	The locality has a pool of labor which can be employed at subproject construction works. On some highly skill labor and professional must be brought in from the Rajshahi City Corporation area.
8.	Availability of by product disposal	The project will produce compost, diesel and recyclable items that will sold.

A total of 4 categories of attributes have been chosen for evaluation of the site. The details of the parameters and the rationale for selection of the site have been provided in Table-5.2. The selected attributes are as follows:

- (i) Site accessibility;
- (ii) Distance from nearby receptors;
- (iii) Environmental sensitivity; and
- (iv) Socio-economics;

Table 5-2: Rationale for Site Selection

Sl. No.	Attribute	Parameter	Rationale for Site Selection	Justification for proposed Site selection
1	Accessibility	Road	The site should be accessible for transport of waste from the source of generation till the selected plant site.	The present location is accessible from the waste collection area.
2		Distance from the collection area	The distance of the selected site should not be more than 5km from Main Roads. Also, the access roads should not be passing from densely populated residential areas.	The site is well situated at well-established road which is less populated.
3	Distance from nearby receptors	Use of site by nearby residents	The present usage pattern of the site should be evaluated in order to determine whether the site is in use at present for agriculture/ settlements.	The site is currently used as waste disposal site.
4		Land use/ zoning	The existing land cover depicts the economic importance of the site. The site shall be more suitable for setting up of the waste management plant if there is less economic importance of the site.	There is less economic importance of the land as it is not used for agriculture and residential purpose. The site is already in use for waste disposal.
5		Public acceptability	The acceptance of the people in the nearby residential areas plays a very important role in setting of the project.	The acceptance of local councilor has been obtained for selection of the site.
6	Environmental sensitivity	Environmentally critical area	The selected site should not fall into environmentally critical area.	The proposed site does not fall in ECA.
7	Socioeconomics	Health	There should not be any chronic health diseases in the adjoining areas due to prevailing air quality.	There are no prevalent chronic diseases in the area.
8		Odor	The technology selection for the waste management plant should be such that there shall not be any air pollution issues in 2 km radius.	The site is currently used as open dump site. The sub project will improve the local environmental situation with the activities to meet the standards prescribed in SWM Rules 21.

The proposed site has therefore been chosen for setting up of the proposed integrated landfill and resource recovery plant because of its accessibility and the location in less populated area.

5.3 Technology Choice

Rajshahi City Corporation subproject has proposed the following interventions:

- Modified van to cover all the households (including slums);
- Improved rickshaw van with bins and secondary storage containers for direct loading;
- Improved rickshaw van with bins and covered secondary storage point/transfer station/tractor-trailers with direct loading facility;
- Improved demountable container truck;
- Integrated controlled landfill with resource recovery facility (landfill, composting facility, pyrolysis plant, and leachate treatment ponds);
- Proper equipment with standard of service for removal of street sweepings and drain cleaning;
- All kind of technology shall be supportive to the Solid Waste Management Rules 2021.

5.4 No Project Scenario

A 'no project' scenario would lead to magnification of the problems related to waste collection and management, soil quality, water quality, odor and air quality and drainage congestion related issues. It will also lead to development of unhygienic conditions in the Rajshahi City Corporation due to poor the waste treatment and management system, from the households and the other solid waste sources. Therefore, it will pose threat to environment and health of the residents of the municipality. Hence, this alternative is undesirable as the development will be unplanned and will lack the basic infrastructure facilities leading to pollution and contamination.

6 POTENTIAL IMPACT IDENTIFICATION AND ASSESSMENT

6.1 Introduction

This section will identify and assess the potential effects that such a project will have on its immediate surroundings upon implementation. The aim is to take account of all of the likely but important environmental/project impacts and interactions, making sure those indirect and cumulative effects, which may be potentially significant, are not inadvertently omitted.

6.1 Methodology

The significance of potential impacts was assessed using the risk assessment methodology that considers impact magnitude and sensitivity of receptors, described below.

Impact Magnitude- The potential impacts of the subproject have been categorized as major, moderate, minor and negligible based on consideration of the parameters such as: i) duration of the impact; ii) spatial extent of the impact; iii) reversibility; iv) likelihood; and v) legal standards and established professional criteria. These magnitude categories are defined in Table-6.1.

Table-6-1: Parameters for Determining Magnitude

Parameter	Major	Medium/Moderate	Minor	Negligible
Duration of potential impact	Long term (more than 35 years)	Medium Term Lifespan of the project (5 to 15 years)	Limited to construction period	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate Project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant
Legal standards and established professional criteria	Breaches national standards and or international guidelines/obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

Sensitivity of Receptor- The sensitivity of a receptor has been determined based on review of the population (including proximity/numbers/vulnerability) and presence of features on the site or the

surrounding area. Each detailed assessment has defined sensitivity in relation to the topic. Criteria for determining receptor sensitivity of the subproject’s potential impacts are outlined in Table-6.2.

Table-6-2: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very Severe	Vulnerable receptor with little or no capacity to absorb proposed changes
Severe	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Mild	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Low	Vulnerable receptor with good capacity to absorb proposed changes or/and good opportunities for mitigation

Assigning Significance- Following the determination of impact magnitude and sensitivity of the receiving environment or potential receptors, the significance of each potential impact has been established using the impact significance matrix shown below in Table-6.3.

Table-6-3: Significance of Impact Criteria

Magnitude of Potential Impact	Sensitivity of Receptors			
	Very Severe	Severe	Mild	Low
Major	Critical	High	Moderate	Negligible
Medium	High	High	Moderate	Negligible
Minor	Moderate	Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

6.3 Impacts of the Existing Baseline Condition

6.3.1 Air pollution

Open burning is commonly practiced in the dumpsite of Rajshshi City Corporation in order to reduce waste volume. The fires generally burn very slowly, lasting over substantial periods of time and allowing the quantity and concentration of pollutants to buildup. Open burning of wastes releases toxic pollutants in the air which creates greater public health hazard. In addition, indiscriminate burning in dumpsite can exacerbate soil pollution, water pollution and loss of agricultural production.

6.3.2 Water pollution

The landfill site construction works could have the following negative impacts on surface water:

- Disruption of the watercourse hydraulic system through modification of the terrain and diversion of a tributary of the river; and
- Deterioration of surface water quality by a possible increase in sedimentary loads and the infiltration of organic matter into the run-off water flowing into rivers. Excavation and foundation laying works could create groundwater pollution through the infiltration of hazardous products (hydrocarbons, oil and grease, etc.)

6.3.3 Odor

Odor pollution is a serious nuisance to the local community of resides in the vicinity of dumpsite. In spite of the low population density in the area, passengers and pedestrians passing the dumpsite experience the stinky air.

6.3.4 Biological environment

Many local and migratory birds and other animals use the dumpsite of the Rajshahi City Corporation as a feeding ground. Consumption of food from garbage can have both physical and toxicological implications on those animals. When birds feed on the site they are already drifting away from their natural diet. By eating landfill waste, they inevitably ingest plastic, aluminum, drywall and other common materials, many of which can be deadly. Cattles have been seen to consume food from the dumpsite, which may result entrance of plastic into the food chain of human being.

6.4 Screening out Areas of No Significant Impact

From the preliminary design and results of the rapid environmental assessment, it is clear that implementation of this subproject will not have major negative impacts because activities will be localized/site-specific and short in duration. Moreover, subproject construction will be conducted within a relatively small area with a short-time frame. Because of these, some aspects of the environment that are not expected to be significantly affected by the construction process have been screened out and will not be mentioned further in assessing the impacts of the construction process (Table-6.4).

Table-6-4: Fields in which the subproject is not expected to have significant impacts

Field	Rationale
Topography, geology and landforms	Required amount of materials will not cause alteration of topography and landforms.
Land use	There are no major changes in any areas to be affected by the subproject.
Tourism	Tourists mostly drive by the villages located as these are located on the highway.

6.5 Summary of Impacts

In addition to the impact identified in above for the technology's vision, design and planning, subproject's other potential impacts on the key environmental parameters have been assessed and their significance determined using the methodology described above. A summary of the potential impacts of the subproject on the key environmental parameters and significance of these impacts are presented in Table-6.5.

Table-6-5: Summary of the potential impacts other than identified in Table-6.1

Potential Impacts	Duration of Impact	Spatial Extent	Reversible or not	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance after Mitigation
Environmental Impacts During Pre-Construction Phase								
Location impacts of the plant	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Natural calamities	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Sources of materials	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Testing of water quality	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Permits, clearances, NOC etc.	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
EMP implementation training	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Environmental Impacts During Construction Phase								
Physical and cultural heritage	Short term	Local	Yes	Occasional	Minor	Low	Negligible	Negligible
Excavations	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Waste management	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Water quality	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Air quality	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Noise level	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Biodiversity	Short term	Local	Yes	Likely	Minor	Mild	Moderate	Negligible
Socio-economic status	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Livelihood Impacts	Short Term	Local	Yes	Certain	Medium	Mild	High	Negligible
Provision of worker facilities	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Worker's health and safety	Long Term	Local	Yes	Certain	Major	Severe	High	Negligible
Community health and safety	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Site Reinstatement	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Environmental Impacts During O&M Phase								

Potential Impacts	Duration of Impact	Spatial Extent	Reversible or not	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance after Mitigation
Health and safety risk of workers at plant	Long Term	Local	Yes	Certain	Major	Severe	High	Negligible
Efficient working of plant	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Water quality	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Biodiversity	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Air emission and odor	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Reuse and disposal of compost	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Traffic management	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Socio-economic aspect	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible

6.5.1 Anticipated Impacts of Pre-Construction Phase

Planning principles and design considerations will be incorporated in the site planning process whenever possible. The potential adverse impacts that are associated with planning and design are listed in Table-6.6.

Table-6-6: Anticipated Impacts of Pre-Construction Phase

Field	Impacts
Location impacts of subproject	Nearby community may be affected due to increased pollution during construction and operation.
Design of the subproject	Impacts to the livelihood of the Project affected people (Reference of Livelihood Restoration Plan)
Natural calamities	Subproject location is major flood prone and heavy storm area.
Sources of materials	Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution.
Permits, clearances, no objection certificate (NOC) etc.	Failure to obtain necessary permits and NOCs, etc. can result in design revisions and/or stoppage of works.
ESMP implementation training	Irreversible impact to the environment, workers, and community.

6.5.2 Anticipated Impacts of Construction Phase

The impacts during construction shall include generic construction related impacts associated with construction activities. In the case of this subproject (i) most of the individual elements are relatively small and involve straightforward construction, so impacts will be mainly localized and not greatly significant; (ii) most of the predicted impacts are associated with the construction process, and are produced because that process is invasive, involving excavation and earth movements. These are not expected to be significant, and can be addressed through adoption of good engineering and construction practices and construction methods. The potential adverse impacts that are associated with construction activities are listed in Table-6.7.

Table-6-7: Anticipated Impacts of Construction Phase

Field	Impacts
Physical and Cultural Heritage	Construction works will be on existing Landfill Site, thus risk for chance finds is very low.
Excavations	Potential erosion, dust generation, and accident. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.
Waste management	<ul style="list-style-type: none"> Oil, grease etc. from construction machinery; Hazardous and solid waste from waste construction material and food;
Water quality (surface and groundwater)	Trenching and excavation, run-off from stockpiled materials, and chemical contamination from fuels and lubricants may result to silt-laden runoff during rainfall which may cause siltation and reduction in the quality of adjacent bodies of water. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.
Soil disturbance	The construction activities may cause soil degradation problems in the areas of plant etc.
Air Quality	Air pollution due to construction activities. The impacts are negative but short-term, impacts within a relatively small area and reversible by mitigation measures.

Field	Impacts
Noise Level	Construction activities will be nearby settlements. Temporary increase in noise level may be caused by excavation equipment, and the transportation of equipment, materials and people. The impact is short-term and within a relatively small area and reversible by mitigation measures.
Biodiversity	<ul style="list-style-type: none"> • Clearing of existing vegetation may result in loss of associated ecological habitats and their fauna. • Noise, vibrations, and intrusive activities related to construction works may scare away animals remaining onsite after vegetation clearance.
Socio-economic status	<ul style="list-style-type: none"> • Manpower may be employed from local community during the construction and operation stage. Thus, potential impact is positive and long-term.
Provision of Worker Facilities	<ul style="list-style-type: none"> • Inconvenience to the communities due to presence of workers; • Solid waste and sanitary discharges from worker camps.
Occupational Health and Safety	Occupational hazards which can arise during work. Potential impacts are negative and long-term but reversible by mitigation measures. Health risk of construction workers due to COVID-19
Community health and safety	Construction works will impede the access of some residents in limited cases. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.
Site reinstatement	Damage due to debris, spoils, excess construction materials

6.5.7 Anticipated Impacts of Operation Phase

Rajshahi City Corporation shall be responsible for Operation and Maintenance of the subproject. In order to make the environmentally sustainable some mitigation measures are proposed to be integrated in the subproject design so that adverse impact will be minimize while on the other hand beneficial impact will be enhanced. Success of the proposed mitigation measures in the subproject's design needs to be monitored during operational stage as mentioned earlier. However. Still there are certain environmental risks from the operation of the subproject, most notably are handling of Solid waste compost plant, MRF, pyrolysis plant, leachate treatment plant etc. which can damage human health and contaminate both soil and groundwater. It will be imperative therefore that the operating agency establishes a procedure to routinely check the operation and integrity of the plant, and to implement rapid and effective repairs where necessary. However, there is also an occupational health risk to workers engaged in plant maintenance activities. The potential impacts that are associated with the operational activities are listed down in Table-6.9.

Table-6-8: Anticipated Impacts of Operation Phase

Field	Impacts
Health and safety risk of workers	Risk of health of workers working in plant operation and maintenance, workers may suffer infectious diseases due to feedstock handling. Workers/plant operators may have accident risk of operation and maintenance of Incinerator Plant.
Efficient working of the plants and MRF	Inefficient working of plant may cause poor quality of treatment and resulting under treatment of solid waste may cause environment, health and safety risk to workers and environment.
Air emission	<ul style="list-style-type: none"> • Ambient Air quality of the subproject
Traffic management	<ul style="list-style-type: none"> • Random parking of vehicles and unplanned loading / unloading areas can lead to traffic congestion for distilled water transport
Socio-economic aspect	<ul style="list-style-type: none"> • Visual impacts. • Impacts on community health. • Employment.

6.6 Cumulative Impact Assessment

The cumulative impact assessment examined the interaction between the subproject's residual effects (i.e., those effects that remain after mitigation measures have been applied) and those associated with other past, existing, and reasonably foreseeable future projects or activities. The interaction of residual effects associated with multiple projects and/or activities can result in cumulative impacts, both positive and negative. The project's potential cumulative effects were considered with respect to valued components in environmental and socioeconomic categories, in four areas:

- of any potential residual project effects that may occur incrementally overtime;
- consideration of other known relevant projects or activities within the specified study area boundaries, even if not directly related to the project;
- potential overlapping impacts that may occur due to other developments, even if not directly related to the proposed subproject; and
- future developments that are reasonably foreseeable and sufficiently certain to proceed

The project has identified the valued components as water quality, air quality, acoustic environment, socioeconomic and socio-community components, and human health and safety. There are no foreseeable projects that will overlap with the subproject. The spatial boundary of the subproject are the areas where the facilities (transfer stations, composting plant, associated medical waste management facilities, faecal sludge management facilities and controlled landfill) is located. The temporal boundary can be considered as the whole Rajshahi City Corporation area.

The infrastructures will be (i) designed to the current best practice standard and in line with the current LGED guidelines for a 10-year design period;(ii) built that the floods do not damage them; and (iii) drains of the facilities are to be kept free from wastes and siltation.

Water quality. Due to nature of the subproject, there is risk of contaminating ground water and nearby bodies of water during O&M phase. However, the infrastructures have been designed ensuring impermeability of surfaces by having concrete surfaces for the transfer stations and composting plant while HDPE/clay liners for the controlled landfill. Drains within the facilities will also ensure wastewater generated during operations will be treated and diverted away from any channel leading to agricultural lands, water bodies, and water sources/tube wells. Short-term negative impacts are possible but can be mitigated through design and implementation of ESMP. Potential residual effects is considered to be negligible.

Air quality. Emissions of common air contaminants and fugitive dust may be elevated in proximity to active work sites during construction and O&M phases; these impacts will be short-term and localized to the immediate vicinity of controlled landfill site. Greenhouse gas (GHG)emissions may increase as a result of the subproject activities (i.e., vehicle and equipment operation, concrete production, disposal of excavated material, land filling of residual wastes). Given the subproject's relatively minor contribution to common air contaminants and GHG emissions during construction, the overall significance rating of both these potential residual effects is considered to be negligible.

Acoustic environment. Noise levels during construction and O&M activities in immediate proximity of work sites are expected to increase. The duration of exposure will be relatively brief and imperceptible. The exposure represents a temporary, localized, adverse residual effect of low significance for affected receptors. While building damage due to ground vibrations is unlikely, there may be annoyance to spatially located receptors during construction and O&M activities. The overall significance rating of potential residual effects is considered to be negligible.

Socioeconomic and socio-community. Concerns on existing provisions for pedestrians, other forms of transport, and over-all impact on livability particularly nearby the transfer stations and composting plant will occur spatially during construction and O&M activities. Traffic movement will be improved once the construction activities are completed. Since the subproject involves small-scale facilities, it will not conflict with existing or planned land use. O&M manuals for the facilities, comprehensive capacity building, and community involvement to be provided under ISWMIP will ensure efficient operation of the facilities and acceptability by the stakeholders. However, following improvement in infrastructures and services, added residential developments, commercial, and business facilities and increased densities are expected to develop and enhance Rajshahi City Corporation area. This can be considered a long-term cumulative benefit of the subproject.

Given the scale of the project it is likely that a number of local people will obtain at least temporary socio-economic benefits, by gaining employment in the construction workforce, and thus raising their levels of income. In addition, a significant number of employments will be generated associated with the O&M of the facilities to be developed under the subprojects. These benefits can bring wider social gains if they are directed at vulnerable groups.

Community and workers health and safety. No adverse residual effects to human health will occur as a result of construction or O&M activities, and mitigation measures are in place to ensure public and worker safety, and will be closely monitored. While exposure to elevated noise levels, fugitive dust and common air pollutants will occur in proximity to worksites, due to their short-term and localized nature, these effects are expected to be minor and insignificant with no measurable effects on human health.

Upon completion of the subproject, the socio-community will be the major beneficiaries of this subproject. With the improved solid waste management facilities, additional vehicles and workers PPE, they will be provided with reliable and climate-resilient municipal services. In addition to improved environmental conditions, the subproject will reduce occurrence of diseases and people would spend less on healthcare and lose fewer working days due to illness, so their economic status should also improve, as well as their overall health. These are considered a long-term cumulative benefit.

Therefore, the project will benefit the public by contributing to the long-term improvement of municipal services and community livability in Rajshahi City Corporation area.

7 INFORMATION DISCLOSURE, STAKEHOLDER ENGAGEMENT

7.1 Introduction

The information disclosure, consultation and stakeholder engagement process for this subproject is to disclose, inform, consult, engage, collaborate and empower the communities and other local stakeholders from the planning to implementation at the Rajshahi City Corporation. Consultation and participation have been undertaken to achieve specific objectives at subproject identification, planning, design, implementation and evaluation stages. Disclosure, consultation and participation (DCP) of the affected persons and beneficiaries in project planning and implementation are the keys to success of any project. The DCP creates opportunities for them to voice their opinions and concerns and offers opportunities to participate in the project design, planning and implementation processes. The Safeguard Policy of AIIB emphasizes upon ensuring formulation and execution of development projects in compliance with environmental and social safeguards, which requires the executing agency to conduct meaningful consultation with displaced persons, their host communities, and civil society organizations. Consultation process encompasses timely disclosure of relevant and adequate information to the project stakeholders and thereby promotes transparency, sustainability and opportunities for amicable conflicts management reducing the risks of project implementation delays.

7.2 Objective of Stakeholder Engagement

The objectives of engaging stakeholders during the ESIA process as well as throughout the subproject implementation includes:

- **Ensuring Understanding:** An open, inclusive and transparent process of engagement and communication will be undertaken by the IPDC (Inclusive Participation, Discloser, and Consultation) to ensure that stakeholders are well informed about the proposed development. Information will be disclosed as early and as comprehensively as possible.
- **Involving Stakeholders in the Assessment:** Stakeholders were included in the scoping of issues, the assessment of impacts, and management/mitigation measures defined in the ESIA report. They also played an important role in providing local knowledge and information for the social baseline and informing the social impact assessment.
- **Building Relationships:** Through supporting open dialogue, engagement will help to establish and maintain a productive relationship between the IPDC team and stakeholders. This supported not only an effective ESIA, but also will strengthen the future relationships between the IPDC and stakeholders.
- **Managing Expectations:** It is important to ensure that the proposed subproject does not create, or allow, unrealistic expectations to develop among stakeholders about potential Project benefits. The engagement process will serve as a mechanism for understanding and managing stakeholder and community expectations, by disseminating accurate information in an easily understandable manner.
- **Ensuring Compliance:** The process is designed to ensure compliance with both local regulatory requirements and international best practice.

7.3 Approach and Methodology of Stakeholder Engagement

The stakeholder engagement activities will provide stakeholder groups with relevant information and opportunities to voice their views on issues that matter to them/affect them. The mechanism of information dissemination should be simple and be accessible to all. Two of the important means that have been followed until now include briefing material and organization of community consultation sessions. The briefing material (all to be prepared in local language) can be in the form of

- (a) Brochures (including project information, details of entitlements including compensation and assistance to be given to the paps; grievance mechanism) that can be kept in the offices of local self-government (gram parishad office) and project office;
- (b) Posters to be displayed at prominent locations and
- (c) Leaflets that can be distributed in the subproject areas.

Consultation meetings should also be organized at regular intervals by the project to acquaint the communities, target group beneficiaries and affected persons of the following:

- Timeline and progress of the subproject by components.
- Information on beneficiary participation.
- Information of involuntary displacement, compensation and entitlements.
- Information of participation of small ethnic communities.
- Timeline for acquisition of land using voluntary donation, direct purchase and any other voluntary approach.

In addition, opinion and consensus of the community needs to be sought for livelihood transformation, relocation of any community assets and involuntary resettlement management. Information disclosure procedures are mandated to provide citizen eccentric information as well as all documentation necessary for addressing any queries. Disclosure of information will enhance governance and accountability specifically with respect to strengthening of monitoring indicators to help the AIIB monitor compliance with the agreements and assess impact on outcomes. However, it is to be noted that only digital, internet, social media etc. will be followed where face to face interaction can be conducted by following the COVID-19 protocols until COVID -19 situation improves. Other on-line based platforms can also be used, such as web-conferencing, webinar presentations, web-based meetings, Internet surveys/polls etc. especially dueto COVID -19 related restrictions.

The stakeholder engagement activities that Rajshahi City Corporation authority will undertake for their project. The activity's types and their frequency are adapted to the three main project stages: project preparation (including design, procurement of contractors and supplies), construction, and operation and maintenance. The methods used would vary according to the target audience and would include:

- Public/community meetings, separate meetings for women and vulnerable
- Face-to-face meetings
- Focus Group Discussions/Key Informant Interviews
- Workshop with the Experts
- Surveys, polls etc.
- Interviewing stakeholders and relevant organizations
- Mass/social media communication (as needed)
- Disclosure of written information: brochures, posters, fliers, Rajshahi City Corporation and LGED website

7.4 Stakeholder Engagement Plan

The consultation should continue throughout the project cycle to achieve highest scale of effectiveness of resettlement implementation. Several additional rounds of consultations with affected persons will be required during RP implementation. The next round of consultations will be required prior to start of compensation payment and assistance. For the benefit of the community in general and affected persons in particular, the RP should be made available at LGED local offices and at city corporation. For continued consultations, the following steps are envisaged:

- Key features of the ESIA particularly the Environmental and Social awareness and institutional arrangements for grievance redress should be summarized in a leaflet and distributed among the DPs and their communities along the subproject corridor.
- LGED will conduct information dissemination sessions at major intersections and solicit the help of the local community leaders to encourage the participation of the APs in ESIA implementation.
- Attempts should be made to ensure that vulnerable groups understand the process and take their specific needs are considered.
- Final safeguard documents will be placed in LGED and AIB websites before implementation of the subproject, whose reference link has to be shown in the summarized leaflet.

The stakeholder engagement plan is listed in Table 7.1 below.

Table 7.1 Stakeholder Engagement Plan of the RCC Subproject

Stakeholders	Category of stakeholder	Brief profile	Overall influence on Subproject	Basis of Influence Rating
Subproject Management				
Rajshahi City Corporation Subproject	Primary	Rajshahi City Corporation is the primary Subproject proponent own a controlling stake of 100% in the Subproject	Highest	<ul style="list-style-type: none"> ▪ Primary Subproject proponents ▪ Responsible for operation of this Subproject ▪ Primary financial beneficiaries ▪ Responsible for all the Subproject related risks and impact liabilities
Community				
Local Community	Primary	Primarily includes adjacent community to the Rajshahi City Corporation subproject area.	Medium	<ul style="list-style-type: none"> ▪ No major restrictions around the Subproject site especially with respect to grazing land ▪ Subproject bring development to the area ▪ in employment opportunities and preference in job ▪ Minimize impact

Stakeholders	Category of stakeholder	Brief profile	Overall influence on Subproject	Basis of Influence Rating
Regulatory/Administrative Authorities & Agencies				
Local Government Engineering Department (LGED)	Primary	LGED is the primary government executing authority for the construction of all ISWMIP subprojects	High	<ul style="list-style-type: none"> ▪ Primary Subproject executing authority ▪ Responsible for construction of this Subproject ▪ Responsible for all the Subproject related risks and impact liabilities of construction stage
Department of Environment, Bangladesh	Primary	The Department of Environment is the primary government regulatory authority for Environmental protection in Bangladesh.	High	<ul style="list-style-type: none"> ▪ Responsible for monitoring Subproject's Environmental compliance throughout the Subproject lifecycle
Other Regulatory & Permitting Authorities	Primary	DAE, DOF	High	<ul style="list-style-type: none"> ▪ Agencies required for obtaining permits and licenses for operation of the Subproject ▪ Primary involvement during operation phases
Political Administration				
Thana (sub-District Level) Political Administration	Secondary	Elected representative of people at sub-district level for a fixed tenure	Medium	<ul style="list-style-type: none"> ▪ Key linkage between the community and the Subproject proponent
Ward Councilor/ leaders & local representatives	Secondary	Elected representative at union level i.e., village level for a fixed tenure	Medium	<ul style="list-style-type: none"> ▪ Plays important role in providing public opinion and sentiment on the Subproject ▪ Empowered to provide consent and authorization for establishment of Subproject on behalf of the community

Detail of FGDs, KIIs and Stakeholder Consultation meeting are listed in Table 7.2.

Table 7.2 FGDs, KIs and Stakeholder Consultation Meeting details of Rajshahi CC

Sl. No.	Meeting Type	Group Identity	Discussed Issue	Meeting Venue	Meeting Date	No. of Participants
1	Individual discussion with the affected people	Affected people of the community	Loss of livelihoods (Inside the buffer zone)	Spot discussion inside the buffer zone.	18 and 19 January 2023	6
2	Individual Interview	Income loser group (Waste picker inside the landfill)	Loss of income	Spot discussion inside the landfill.	18 and 19 January 2023	12
3	Individual discussion	Waste picker inside the town	Income survey	Spot discussion inside the town.	18 and 19 January 2023	3
4	Individual Interview	Income loser group (Vangari shop located beside the landfill)	Loss of income	Spot discussion beside the landfill.	18 January 2023	2
5	Individual interview	Vangari shop located inside the town)	Income survey	Spot discussion inside the town.	19 January 2023	10
6	Individual interview	Affected Van Driver (inside the town	Income Survey	Spot discussion inside the town.	19 January 2023	9
7	Individual interview	Ferriwala group	Income survey	Spot discussion inside the town.	19 January 2023	6
8	Individual interview	Income loser group (Whole seller shop located beside the landfill)	Loss of income	Spot discussion inside the town.	18 January 2023	4
9	Individual interview	Broker group	Income survey	Spot discussion inside the town.	18 and 19 January 2023	3
10	FGD	Male and Female group (Enlisted Street sweeper of the Rajshahi city corporation)	Development of livelihood	Sweeper Colony		17

One Focus Group Discussion (FGD) was conducted with 17 sweepers in the sweeper colony of Sathmatha, Rangpur City Corporation, besides the landfill area. Among them, six were female, and 11 were male. All of them are from the Harizon community. Their age group is 23-65. The average family size is 4. They live in the city corporation's Sweeper Colony.. Additionally interviews were conducted with individual groups in the project areas. The participants were from different groups like businessmen, NGOs, housewives, teachers, and service holders. Apart from the participants above, Municipality officials and the members of the consultant team were present. Figure below show the photographs of the meetings. Detailed documentation including attendance sheets are provided in the Livelihood Restoration Plan.

Photographs of Focus group discussions and Consultation Meeting of Stakeholders



7.5 Public Consultation Meetings

In the FGDs and Stakeholder Consultation meeting, maximum efforts have been given to get feedback from the participants on their views on the nature of environmental (physical, ecological and social) impacts. Subsequently, their suggestions about the ways to mitigate the adverse impacts and enhance beneficial impacts for the proposed Rajshahi City Corporation ISWMIP's subproject were also recorded. People who participated in the public consultations were found to be enthusiastic in sharing their views. The participants expressed their opinions and concerns regarding the different issues including the socioeconomic condition of people in their localities, possible impact of the proposed Rajshahi City Corporation subproject on the existing local environment and in their lives and livelihood. They also suggested mitigation measures to address the adverse impacts. The major findings of the Stakeholder Consultations, FGD & KIIs for the Rajshahi CC subproject are summarized below:

(i) General opinion regarding the proposed ISWMIP's Subproject

- ✓ Most of the participants know the ISWMI Subproject at their locality before interaction with the field ESIA team, which indicates that proper information has been disseminated to them, though the upcoming interventions are unknown to them.
- ✓ Most participants displayed their supportive attitude for ISWMIP with some concerns such as
 - Waste to Gas generation and raw materials of road construction;

- Noticed the positive and negative sides of the Subproject from their perspective. For example, people's life and livelihood have changed, new employment opportunities have come up, air, noise and water pollution potential have increased, etc.
- ✓ Local Representatives believes that more participation could be possible in various ways such as
 - Administrative / institutional support as and when necessary,
 - Worker safety during road crossing,
- ✓ Ward councilor opined that public awareness should be increased to educate the households about the waste segregation at source as well as appropriate disposal of the wastes at the allocated waste bins or Secondary Transfer Stations.

(iii) Expectation of Local People

- ✓ Ensure local recruitment as per skill & non-skill qualifications.
- ✓ Ensure pollution (Air, Noise, Water, Solid Waste) free safe environment in and around the Subproject area.

7.6 Public Disclosure

Distribution of the disclosure materials will be through making them available online under the COVID-19 situation. Upon improvement of the situation, distributions of the disclosure materials will be through making them available at venues and locations frequented by the community and places to which public have unhindered access in the usual manner. Free printed copies of the executive summary of the ES documents in Bangla and English will be made accessible for the general public at the following locations:

- LGED Headquarters, Agargaon, Dhaka
- Affected District Administration office
- Rajshahi City Corporation Office
- Local NGO offices;
- Other designated public locations to ensure wide dissemination of the materials.
- Newspapers, posters, radio, television.
- Information centers and exhibitions or other visual displays.
- Brochures, leaflets, posters, nontechnical summary documents and reports.
- Official correspondence, meetings

The final ESIA report should be made available at accessible places stated above, and the executive summary should be translated into local language (Bangla) and posted in the LGED and AIIB websites. The final ESIA document will be shared with AIIB for clearance and disclosure according to its procedure. As a part of the disclosure, all versions (Bangla and English) should be made available at the subproject office in addition to LGED's website.

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 Introduction

The primary objective of the environmental and social management plan (ESMP) is to record environmental and social impacts resulting from the sub-project activities and to ensure implementation of the identified “mitigation measures”, in order to reduce adverse impacts and enhance positive impacts. Besides, it would also address any unexpected or unforeseen environmental impacts that may arise during construction and operational phases of the sub-projects.

8.2 Mitigation Measures For E&S Impacts

8.2.1 During Preconstruction

Based on the possible impacts during pre-construction phase, mitigation measures have been suggested for the proposed subproject. A set of mitigation measures against possible environmental and social impacts due to an improvement project at its pre-construction phase is proposed in the following table 8.1.

Table 8-1: Proposed mitigation/enhancement measures during pre-construction phase of construction, rehabilitation and maintenance of infrastructure project under LGED.

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Supervision
Commercial Structures	<ul style="list-style-type: none"> ▪ Loss of commercial structures; ▪ Dust pollution; ▪ Loss of income and livelihoods. 	<ul style="list-style-type: none"> ▪ Avoid the housing and commercial structure during the finalization of the alignment and location of the bridge; ▪ Proper compensation should be given before starting the removal or dismantling works; ▪ Create job opportunities for the PAPs. ▪ Water spraying on the bear surface or dust pollution source; 	Contractor	LGED
Loss of vegetation/tree	<ul style="list-style-type: none"> ▪ Accident risk during removal of trees/vegetation's in the project sites; ▪ Birds and others species can migrate from the trees/vegetations; ▪ Impacts on the local climatic condition. 	<ul style="list-style-type: none"> ▪ Prior to start construction, all vegetation should be removed from the proposed construction sites with the consultation of the local relevant authorities; ▪ Avoid disturbance and careful during construction vehicle and equipment movement; ▪ Proper H&S measures (use of appropriate PPE such as hand gloves, safety shoes and helmet) for the workers should be taken during removal of trees, bushes & crops; ▪ To mitigate the ecological impact, tree plantation plan can be considered in the design & accordingly tree plantation will be done in an appropriate location to be determined by the LGED after 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Supervision
		<p>consultation with the concerned authority;</p> <ul style="list-style-type: none"> ▪ Proper H&S measures (use of appropriate PPE such as hand gloves, safety shoes and helmet) for the workers should be taken during removal of trees, bushes & crops; ▪ To mitigate the ecological impact, tree plantation plan can be considered in the design & accordingly tree plantation will be done in an appropriate location to be determined by the LGED after consultation with the concerned authority; ▪ The engineer shall approve such felling; only when the proponent secures receive a “clearance” for such felling from the LGED, as applicable; ▪ Tree felling, if unavoidable, shall be done only after compensatory plantation of at least two saplings for every tree cut is done; ▪ During the tree removal from the proposed construction sites diameter at best height (DBH) of the trees is 6 inches, only such trees should be considered by the contractor for compensation and plantation; ▪ Tree plantation at the suitable locations after completion of the construction activities. 		
Removal of Utilities	<ul style="list-style-type: none"> ▪ Vulnerable for workers health and safety; ▪ During movement of heavy Construction machineries equipment's can damage the utility services if not previously removed; ▪ Due to carelessness or incautiousness death from sudden 	<ul style="list-style-type: none"> ▪ Prior to start construction, the utility services (electrical cables, telephone line, water supply pipeline, gas supply pipeline and internet line) if applicable should be shifted with the consultation of the relevant organizations; ▪ Inform the local community before starting removal or demolishing work; ▪ Carefully remove the utilities that are connected to any structures; ▪ Proper Health and safety measures for the workers should be taken during shifting of these lines to avoid any incidents. 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Supervision
	electric shocks may occur.			
Dismantling	<ul style="list-style-type: none"> ▪ Dust pollution in the construction site; ▪ Health hazard for the workers and community during dismantling works; ▪ Noise level increase; ▪ Vibration effects on the structures on the surrounding of the project area; ▪ Surface water contamination, blockage of navigation and drainage, impacts on aquatic animal; ▪ A detail of the dismantling plan is also given in the Annex-C. 	<ul style="list-style-type: none"> ▪ Notify the adjacent community before starting the demolishing work; ▪ During the removal or demolition of existing structures if required will be fully removed by the contractor; ▪ Spraying of water in the dry land or from where there is a possibility to generate dust; ▪ Banned fishing, swimming, boat movement activities in the construction sites, if applicable; ▪ Proper H&S measures for the workers such as using of appropriate PPE (helmet, Earplug, musk, safety shoes, hand gloves etc.) should be taken to avoid any accidents; ▪ Construct noise barrier around the dismantling site; ▪ Stop the engine when it is not required; ▪ Monitor Noise level as per DoE guidelines; ▪ Impact wise mitigation measures are given. 	Contractor	LGED
Setting up labour camps	<ul style="list-style-type: none"> ▪ Land encroachment; ▪ Solid and liquid waste from the labour camp 	<ul style="list-style-type: none"> ▪ Labour camp should be constructed at a distance from the water bodies; ▪ Avoid productive land and away from the settlement during the selection of land for the setup of labour camp; ▪ No solid and liquid waste discharge into the water bodies; ▪ Instruct workers to maintain clean environment in the camps. 	Contractor	LGED

8.2.2 During Construction

Possible environmental impacts during construction phase from the project construction, rehabilitation and maintenance activities have been identified. For mitigating the possible environmental impacts during construction phase mitigation measures are given in the following table 8.2.

Table 8-2: Proposed mitigation/enhancement measures during Construction phase of project construction, rehabilitation and maintenance program under LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
Air Pollution	<ul style="list-style-type: none"> ▪ Construction vehicular traffic: Air quality can be affected by vehicle exhaust emissions and combustion of fuels ▪ Construction equipment: Air quality can be adversely affected by emissions from construction machineries and combustion of fuels; ▪ Construction activities: Dust generation from earth excavation, earth & sand stockpiles during dry period. 	<ul style="list-style-type: none"> ▪ Fit vehicles with appropriate exhaust systems and emission control devices; ▪ Maintain vehicles and construction equipment in good working condition including regular servicing; ▪ Operate the vehicles in a fuel-efficient manner; ▪ Impose speed limits at 30 km/hour on vehicle movement at the worksite to reduce dust emissions; ▪ Control the movement of construction traffic in the access road; ▪ Focus special attention on containing the emissions from generators; ▪ Construction equipment causing excess pollution (e.g. visible smoke) will be banned from construction sites immediately prior to usage; ▪ Water spray to the dry earth/material stockpiles, access roads and bare soils as and when required to minimize the potential for environmental nuisance due to dust; ▪ Increase the watering frequency during periods of high risk (e.g. high winds); ▪ Stored materials such as: excavated earth, dredged soil, gravel and sand shall be covered 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
		<p>and confined to avoid their wind drifted;</p> <ul style="list-style-type: none"> ▪ Restore disturbed areas as soon as possible by vegetation; ▪ Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations; ▪ The Air quality monitoring should be carried out by the contractor following the National Air Quality Standard ▪ (Schedule-I Standards for Ambient Air Quality, Air Pollution (Control) Rules 2022. . 		
Noise Pollution	<ul style="list-style-type: none"> ▪ Construction vehicular traffic: Vibration and Noise quality will be deteriorated due to vehicular traffic. ▪ Construction equipment: Noise and vibration will have an impact on adjacent surrounding residents. ▪ Construction activity: Noise will have an impact on adjacent residents. 	<ul style="list-style-type: none"> ▪ Strict measures for noise pollution control need to be undertaken during construction activities; ▪ Create noise barrier and consider the minimum noise levels at sensitive receptor sites (e.g. dense residential area, schools, mosques, health centers etc.); ▪ Stone breaking machine should be confined within a temporary shed so that noise pollution could be kept minimum; ▪ Protection devices (ear plugs or ear muffs) shall be provided to the workers operating in the vicinity of high noise generating machines during construction; ▪ Construction equipment and vehicles shall be fitted with 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
		<p>silencers and maintained properly;</p> <ul style="list-style-type: none"> ▪ Instruction to the drivers to avoid unnecessary horn; ▪ The Noise level monitoring should be carried out by the contractor following the National Noise Quality Standard (Noise Pollution (control) rules 2006). ▪ Vibration monitoring should be carried out by the contractor. 		
Ground Water Pollution	<ul style="list-style-type: none"> ▪ Contamination of groundwater due to Pollution lack of septic tanks or mobile toilets; ▪ Accidental spillage of hazardous liquid from the construction camps. 	<ul style="list-style-type: none"> ▪ The contractor will make arrangement for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected; ▪ Handling and storage of the potential contaminants has to be organized under strict condition to avoid water pollution during construction; ▪ Handling of hazardous liquid should be done carefully by the designated experienced person; ▪ Handling and storage of the potential contaminants should be done by the experienced workers. Proper monitoring should be done by the experienced person; ▪ The Ground water quality monitoring should be carried out by the contractor following the National Water Quality Standard 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
		(Schedule-2 (kh): Standards for Potable Water, ECR, 2023).		
Surface Water Pollution	<ul style="list-style-type: none"> ▪ Construction & general wastes from the construction sites; ▪ Oil spill from the construction vehicles and construction camp can affect on fishes and aquatic wildlife (such as snakes, frogs etc.) 	<ul style="list-style-type: none"> ▪ Contractor should prepare Waste Management Plan and follow it properly during the construction period; ▪ Any wastes should not be throwing into the river/khal/canal other than dump into the designated waste dumping area; ▪ Store the oil and petroleum product in a separate location cover by a concrete structure; ▪ Handling of hazardous liquid should be done carefully by the designated experienced person; ▪ Monitor the surface water by testing in designated Laboratory should be done by the Contractor following the National Water Quality Standard (Schedule-2 (ka (1))): Standards for Inland Surface Water, ECR, 2023). 		
Land/ Soil Pollution	<ul style="list-style-type: none"> ▪ Decrease the production capacity of agricultural land; ▪ Land or soil erosion from water or wind; ▪ Sediment pollution and increase the turbidity; ▪ Reduction the microorganism. 	<ul style="list-style-type: none"> ▪ Avoid the productive land, agricultural land, archaeological sites, protected area, forest area, natural habitat etc.; ▪ Land/soil quality should be ensured by the contractor to fill the abutment area and approach road; ▪ Soil from fallow land should be used in earthwork in approach road; 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> ▪ Re-vegetation the exposed area as early as possible to reduce the soil erosion; ▪ Create barrier for reducing the sedimentation into the water bodies; ▪ The Land or soil quality test should be carried out by the contractor. 		
<p>Waste (Solid, Liquid and Hazardous) Pollution</p> <p>Organic waste: remaining foods, leafs, papers, straw, fruit cover etc.</p> <p>Inorganic waste: Polythene, Glasses, Synthetic paper, plastic etc.</p> <p>Hazardous waste: Paint, fuel, chemicals, oil, petroleum products, bitumen etc.</p>	<ul style="list-style-type: none"> ▪ Improper storage and handling of construction & general liquid waste such as fuels, lubricants, chemicals and hazardous liquid onsite, and potential spills from these liquid materials may harm the environment and health of construction workers. ▪ Improper storage and handling of construction & general solid wastes. 	<ul style="list-style-type: none"> ▪ The contractor will minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes); ▪ Any wastes should not be throwing into the river/khal/canal other than dump in to the designated waste dumping area; ▪ Handling of hazardous liquid should be done carefully by the designated experienced person; ▪ Organic waste should be managed by composting method. A concrete chamber with 3 rooms is needed to be provided. In one room organic waste should be dumped and another room inorganic waste will be dumped. When the room will be filled then covered by earth. Then dump to the third room. After 6- month organic waste will be converted into fertilizer and will be used by the farmers; 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> ▪ Inorganic waste should be given to the authorized vendor for free of cost for recycling; ▪ Accidental spillage of hazardous waste should be managed by spreading wood powder on the surface of the oil and this powder mixed with oil must store in a designated concrete room; ▪ Provide appropriate PPE to the construction personnel for handle construction materials; ▪ Make sure all containers, drums and tanks that are used for storage are in good condition; ▪ Take all precautionary measures when handling and storing fuels and lubricants, avoiding environmental pollution; ▪ Waste water monitoring should be carried out by the contractor, following the national standard (Schedule-10: Standard for waste from Industrial units or Projects waste). 		
Hydrological Regime	<ul style="list-style-type: none"> ▪ Drainage congestion and flood at the site. 	<ul style="list-style-type: none"> ▪ A detailed hydrological and morphological study of the site (in case of landfill and waste to energy plant) should be conducted; ▪ Proper design and construction accordingly to accommodate flood level; 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> Wastes should not be disposed near any water body. All waste depending on its characteristics, should be disposed of in a controlled manner. 		
Drainage Congestion	<ul style="list-style-type: none"> Construction of diversion road on the river/ Khal/canal create drainage congestion; Stockpiling of construction materials in the river/khal/canal also create drainage congestion. 	<ul style="list-style-type: none"> Immediately remove all the construction debris from the construction site as well as from the water bodies in a planned way; Duration of stockpiling should be minimized as much as possible; Avoid the encroachment of the water bodies; Protect water bodies from sediment loads by silt screen or bubble curtains or another barrier; Construction activity should be recommended during the dry season; Construction workers shall be instructed to protect water resources; 	Contractor	LGED
Erosion and Siltation	<ul style="list-style-type: none"> Bank erosion at the project site will loss of lands; Vulnerable for the structures; Increase turbidity and impact on aquatic life; Loss of productive land, structures, resources. 	<ul style="list-style-type: none"> Introduce bank protection activities; Use of geo-bag, stone and concrete to construct the protection wall; Plantation more vegetation to reduce surface soil erosion and enhancement of the soil compactness and stability. 	Contractor	LGED
Road Traffic and Accidents	<ul style="list-style-type: none"> Increased traffic use of narrow access road by construction vehicle will affect the movement of 	<ul style="list-style-type: none"> Proper Traffic Management Plan (TMP) should be prepared by the contractor during 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
	normal road traffics and the safety of the road users specially the students	<p>starting of construction & follow it strictly;</p> <ul style="list-style-type: none"> ▪ In this TMP, the road safety measures such as speed breakers, warning signs/lights, road safety signs, flagman etc. should be included to ensure uninterrupted traffic; ▪ Movement specially at nearby the educational (Schools, colleges, Madrasha etc.), community infrastructure (mosques, graveyards, Prayer Ground etc.) and health complex; ▪ In addition, BRTA traffic rules and regulations should be strictly followed; ▪ Divert traffic to follow alternative routes to avoid traffic jams; ▪ Avoid talking with mobile during driving. 		
Quarries and Borrow Pits	<ul style="list-style-type: none"> ▪ Increased noise level caused by blasting, movement of construction vehicles; ▪ Increased noise level will be impacted on the local community; ▪ Air pollution due to diesel fumes and dust generation resulting from the presence of construction machinery and site cleaning activities. 	<ul style="list-style-type: none"> ▪ Create noise barrier around the construction site; ▪ Stop unnecessary engine operation in the construction site; ▪ Maintain vehicles and construction equipment in good working condition including regular servicing; ▪ Control the movement of construction traffic in the access road; ▪ Construction equipment causing excess pollution (e.g. visible smoke) will be banned from construction sites immediately prior to usage; 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> ▪ Water spray to the dry earth/material stockpiles, access roads and bare soils as and when required to minimize the potential for environmental nuisance due to dust; ▪ Stored materials such as: excavated earth, dredged soil, gravel and sand shall be covered and confined to avoid their wind drifted; ▪ Restore disturbed areas as soon as possible by vegetation. 		
Landscape and Aesthetics	<ul style="list-style-type: none"> ▪ Excavation of borrow pits, stock piling of construction materials, placing of construction equipment and parking of construction vehicles; ▪ Presence of construction camps, equipment and their activities; ▪ Movement of construction vehicles on the existing road network and temporary haul roads; 	<ul style="list-style-type: none"> ▪ Parking of construction vehicles and stockpiling of construction materials/excavated earth should be done in systematic way to avoid the damaging of aesthetics of the site; ▪ Duration of stockpiling should be minimized as much as possible; ▪ Vegetation plantation after complete of the construction work; ▪ Completely remove the construction on camp facilities, equipment's and their activities; ▪ Limit the speed of the vehicles and cover the vehicles during the movement or transportation of materials on the existing road network and temporary haul road; ▪ Plantation of trees at the construction site after completion of the construction activities immediately. 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
Occupational Health and Safety	<ul style="list-style-type: none"> Campsites for construction workers and Safety are the important locations that have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities. 	<ul style="list-style-type: none"> Construction workers camp shall be located at least 500 m away from the nearest habitation; Consider the location of construction camps away from communities in order to avoid social conflicts; Create awareness among the camp users on health and safety requirements to be maintained and code of conduct. 	Contractor	LGED
	<ul style="list-style-type: none"> Lack of proper infrastructure facilities, such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards 	<ul style="list-style-type: none"> Adequate housing for all workers should be provided avoiding over crowing; Safe and reliable water supply; Hygienic sanitary facilities and sewerage system. 	Contractor	LGED
	<ul style="list-style-type: none"> Management of wastes is crucial to minimize impacts on the environment. 	<ul style="list-style-type: none"> Ensure proper collection and disposal of solid wastes within the construction camps; Insist waste separation by source; organic wastes in one container and inorganic wastes in another container at sources; Dispose organic wastes in a designated safe place on daily basis; The organic wastes should be always covered with a thin layer of sand so that flies, mosquitoes, dogs, cats, rats, etc. are not attracted; Locate the garbage pit/waste disposal site 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
		minimum 500m away from the resident area so that people are not disturbed with the odor likely to be produced from anaerobic decomposition of wastes at the waste dumping places.		
	<ul style="list-style-type: none"> There will be a potential for diseases to be transmitted including malaria, exacerbated by inadequate health and safety practices. 	<ul style="list-style-type: none"> Provide adequate health care and sanitation facilities within the construction sites; 	Contractor	LGED
	<ul style="list-style-type: none"> There will be an increased risk of work crews spreading sexually transmitted infections and HIV/ AIDS. 	<ul style="list-style-type: none"> Train all construction workers in basic sanitation and health care issues and safety matters and on the specific hazards of their work; Provide HIV awareness programming, including STI (sexually transmitted infections) and HIV information, education and communication for all workers on regular basis; Regular mosquito repellent spraying during monsoon periods. 	Contractor	LGED
	<ul style="list-style-type: none"> Health risk of construction workers due to COVID-19 	<ul style="list-style-type: none"> Prepare the health and safety guidance for COVID-19 at work sites and get approval from MWMU; Strictly follow and implement the H&S guidance for COVID-19 at worksite; Everyone entering the worksite must wear a 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
		<p>mask, gloves and hard shoes.</p> <ul style="list-style-type: none"> ▪ At the entrance of the worksite/camp site every personnel must wash their hands for 20 second with maintaining a distance of at least 1m (3 ft) from each other; ▪ Discourage site personnel to gather and gossip at any time, rather encourage physical distance while chatting/discussing. ▪ Ensure sufficient stock of soap, sanitizer, washing facility and safe water at the workers' dwelling (both camp site and home). ▪ Encourage frequent hand washing and social distancing at campsite. ▪ Ensure personal distance at least 1 meter (3 feet), preferably 2m (6ft) during lunch, dinner and prayer. ▪ Train workers on how to properly put on, use/wear, and take off protective clothing and equipment. Make these trainings mandatory at worksites and provide 10-15 minutes of a workday for such 'training and encouragement' activities. 		
	<ul style="list-style-type: none"> ▪ Construction work may pose health and safety risks to the construction workers and site visitors leading to severe injuries and deaths. 	<ul style="list-style-type: none"> ▪ Provide the workers a safe and healthy work environment; ▪ Provide appropriate PPE for workers, such as safety boots, helmets, masks, gloves, protective clothing, goggles, full-face eye 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
		<p>shields and ear protection;</p> <ul style="list-style-type: none"> ▪ Maintain the PPE properly by cleaning dirty ones and replacing them with the damaged ones; ▪ Appoint an environment, health and safety manager to look after the health and safety of the workers; ▪ Inform the local authorities responsible for health, religious and security before commencement of civil works and establishment of construction camps so as to maintain effective surveillance over public health, social and security matters. 		
	<ul style="list-style-type: none"> ▪ Lack of first aid facilities and health care facilities in the immediate vicinity will aggravate the health conditions of the victim. 	<ul style="list-style-type: none"> ▪ Provide health care facilities and first aid facilities are readily available; ▪ Document and report occupational accidents, diseases, and incidents and actions taken; ▪ Identify potential hazards to workers, particularly those that may be life threatening and provide necessary preventive and protective measures; ▪ Provide awareness to the construction drivers to strictly follow the driving rules; ▪ Provide adequate lighting in the construction area and along the roads in the construction site. 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
Community Health and Safety	<ul style="list-style-type: none"> ▪ Accidents on the approach road and construction site; ▪ Noise and dust pollution; ▪ Communicable diseases can spread among the local community. 	<ul style="list-style-type: none"> ▪ Prior to start the construction activities contractor will be informed the local community; ▪ Instruct the drivers and limit the speed of the vehicles; ▪ Regular health checkup of the workers and awareness training about the communicable diseases; ▪ Proper lighting at the project site during the night time; ▪ Avoid unnecessary noise pollution; ▪ Spraying water in the dry surface to reduce the dust pollution ▪ Provide proper access control to the project site and unauthorized entry to the project site will be controlled. 	Contractor	LGED
Impacts on Archaeological/ Historical/ Social/ Cultural/ Religious Sites	<ul style="list-style-type: none"> ▪ Air and dust pollution; ▪ Noise level may create discomfort; ▪ Vibration can affect social/cultural/ religious sites. 	<ul style="list-style-type: none"> ▪ Create temporary barrier around the project site; ▪ Regular spraying of water in the construction site and approach road to reduce the dust emission; ▪ Control the speed limit about 30 km/hour in the construction site and approach road; ▪ Construction activities should be continued during day time only; ▪ Carefully handling of construction machineries and equipment's near the sensitive receptors near the project site. 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
Housing and Commercial Structures	<ul style="list-style-type: none"> ▪ Air and dust pollution; ▪ Noise level may create discomfort; ▪ Loss of income and employment; ▪ Mental stress; ▪ Resettlement or removal due to realignment of approach road; ▪ Vibration can affect on structures. 	<ul style="list-style-type: none"> ▪ Spraying water on the dry surface to reduce dust pollution; ▪ Create noise barrier around the construction sites; ▪ Limit the speed of vehicles in the construction site; ▪ Prior notice to the local inhabitants for resettlement issues if required; ▪ Compensation should be given to the PAPs in-time according to RP; ▪ Realignment of approach road if required; ▪ Job opportunities for the PAPS and priority should be given; ▪ Plantation of trees in an appropriate location will be determined by the LGED after consultation with the concern authority (Forest Department). 	Contractor	LGED
Flora and Fauna	<ul style="list-style-type: none"> ▪ Dust will be generated during earthwork and deposited on the leaves of nearby trees; this will abduct the growth of trees. ▪ Construction activities will increase sediment loading of streams and changes in turbidity will impact adversely upon fishes and aquatic animals. ▪ Diversion at bridge site will act as barriers to the migration of fishes 	<ul style="list-style-type: none"> ▪ Proper construction management plan should be introduced in the Contractor LGED construction sites; ▪ Regular water spraying in the dry area from where there is a possibility to dust pollution; ▪ Proper management plan for the waste management in the construction sites; ▪ Construction work should be preferred during dry season; ▪ No disturbance for aquatic animal and keep provision for the fish movement; 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
	<p>and aquatic animals.</p> <ul style="list-style-type: none"> Noise generation from the construction vehicles and equipment's can create disturbance for the birds and wildlife; 	<ul style="list-style-type: none"> Diversion road should be removed properly as soon as possible; Construction activities should be continued during day time only; Create noise barrier and avoid unnecessary machineries and equipment's operation; Vegetation plantation after completion of the construction work; Construction workers shall be instructed to protect natural resources, flora and fauna, including wild animals and aquatic life, hunting and unauthorized fishing are prohibited; Natural river/khal/canal will be reinstated after completion of construction works; Fingerling (fish) can be released to the river/khal/canal near the bridge site to boost up the fish resources. 		
Disturbance to Wildlife Movement	<ul style="list-style-type: none"> Noise from construction machineries and vehicles, movement of workers likely to be disturb the movement of wildlife; Permanent migration may occur from the area; Increase of mortality due to collision with vehicles; 	<ul style="list-style-type: none"> Instruct workers and contractors to avoid harassment and Contractor LGED disturbance of wildlife; Schedule activities to avoid disturbance of wildlife during critical periods of the day (e.g., night) or year (e.g., periods of breeding, nesting); Turn off all unnecessary lighting at night; Maintain noise-reduction devices (e.g., mufflers) in good working order on vehicles and 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
		<p>construction equipment;</p> <ul style="list-style-type: none"> ▪ Temporary fencing around the construction site during construction period; ▪ Educate workers regarding the occurrence of important resources in the area and the importance of their protection, including the appropriate regulatory requirements; ▪ Regular monitoring of the death and disturbance of wildlife in the construction site. 		
Fisheries and other Aquatic Animals	<ul style="list-style-type: none"> ▪ Increase turbidity and siltation can spawning beds for fish; ▪ Noise from pile driving activities, aquatic animals including fishes will be affected; ▪ Turbid water can reduce the infiltration of sunlight into deep water. 	<ul style="list-style-type: none"> ▪ Construction activities is preferred during the dry season; ▪ Careful handling of construction waste in the construction site; ▪ Introduction of land/soil erosion and dust control practices in the construction site; ▪ Provide adequate space for movement and safe passage of fishes and other aquatic animals; ▪ Schedule activities to avoid disturbance of fish and aquatic animals during critical periods of the day (e.g., night) or year (e.g., periods of breeding); ▪ Turn off all unnecessary lighting at night to avoid attracting and disturbance of fishes; ▪ Maintain noise-reduction devices (e.g., mufflers) in good working order on vehicles and 	Contractor	LGED

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigate Measures	Responsibility	
			Implementation	Supervision
		construction equipment; <ul style="list-style-type: none"> ▪ Regular monitoring the fish death and disturbance of fish and aquatic animals in the construction site; ▪ Fingerling (fish) can be released to the river/khal near the bridge site to boost up the fish resources 		

8.2.3 During Operation

Based on the possible environmental impacts identified, a list of mitigation measures has been suggested for operation phase in table 8.3 in order to reduce the negative effects.

Table 8-3: Proposed mitigation/enhancement measures during Operation phase of the project construction, rehabilitation and maintenance program under Rajshahi City Corporation.

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Supervision
Air Pollution	<ul style="list-style-type: none"> ▪ Dust emission from the increasing number of vehicles in the site area; ▪ Vehicular emission from burning fuels. ▪ GHG emission from the landfill sites ▪ Moving wastes, by-and end-products (such as composts, and reyclables) may create dusts during dry season. 	<ul style="list-style-type: none"> ▪ Establish the speed breaker to limit the speed of the vehicle near the site; ▪ Increase number of plantations by adding new species of trees on the appropriate locations after consultation with the concern authority. ▪ Use bin covers and/or tarpaulins during transport of wastes, by-, and end products (compost) ▪ Use tarpaulin to cover soils, sand and other loose material that will be used in the controlled landfill. ▪ Green belt will be developed around the facilities to act as a barrier for dust pollution. ▪ Minimum amount of organic waste will be sent to controlled landfill so that landfill gas formation is minimum. ▪ Use the gas vent pipe for the extraction of GHG emission; ▪ In the design of the pyrolysis plant it must ensure the exhaust treatment. 	Rajshahi Corporation	Rajshahi City Corporation

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Supervision
Surface Water Pollution	<ul style="list-style-type: none"> ▪ Remaining construction materials may be washed by the rainfall into the water sources and lead to sedimentation and increase turbidity; ▪ Hazardous materials spilled by accidents; ▪ Soil erosion during rainy season can contaminate nearby surface water. ▪ Unmanaged leachate can contaminate the surface water ▪ Run-off from stockpiled wastes and end-products of composting which may cause siltation and reduction in the quality of adjacent bodies of water. 	<ul style="list-style-type: none"> ▪ Remaining construction materials will be completely removed from the proposed project site after completing of the construction activities; ▪ Cover the bare surface by plantation of trees/vegetation to reduce the surface soil erosion; ▪ Speed control measures close to the site to reduce the occurrence of accidents; ▪ Bank protection work can be done at the site; ▪ Avoid rainy season for continuing any development activities. ▪ Take all precautions to prevent entering of run-off into streams, water courses, or irrigation system. Install temporary silt traps or sedimentation basins along the channels leading to the water bodies. ▪ Remove all wastes, by-,and end-products immediately. ▪ Monitor discharge of leachate including review of ECC conditions. Parameters to be monitored include suspended solids, dissolved solids (inorganic), pH, ammoniac nitrogen (as N), total nitrogen (as N), biochemical and chemical oxygen demand, arsenic mercury, lead, cadmium, total chromium, copper, zinc, nickel, cyanide, chloride, fluoride, phonemic compounds and others as per, Solid Waste Management Rules 2021. ▪ Monitor compost quality. Visual inspection to ensure that glass, plastic and other physical inerts and fragments are absent in compost and it has no offensive smell. Also testing of compost to meet standards for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, pH and other parameters as prescribed by the relevant National policy of the Government. 	Rajshahi Corporation	City Rajshahi City Corporation
Acoustic environment	<ul style="list-style-type: none"> ▪ Increase in noise level due to presence of workers and movement of vehicles. 	<ul style="list-style-type: none"> ▪ Plan activities in consultation with the LGED so that activities with the greatest potential to generate noise are conducted during periods of the day which will resulting least disturbance. 	Rajshahi Corporation	City Rajshahi City Corporation
Health and safety risk of workers	<ul style="list-style-type: none"> ▪ Risk of health of workers working in plant 	<ul style="list-style-type: none"> ▪ Provide all the personal protective equipment like gum boots, nose mask, gloves etc. for the protection of workers. 	Rajshahi Corporation	City Rajshahi City Corporation

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Supervision
	<ul style="list-style-type: none"> operation and maintenance, workers may suffer infectious diseases due to feedstock handling. Workers/plant operators may have accident risk of operation and maintenance of Incinerator Plant. 	<ul style="list-style-type: none"> The workplace will be equipped with fire detectors, alarm systems and fire-fighting equipment. The equipment will be periodically inspected and maintained in good working condition. Providing adequate personnel facilities, including washing areas and areas to change clothes before and after work. Medical check-up will be conducted on regular basis and the health conditions will be monitored. First aid facilities required to attend immediately for meeting emergency situations will be made available at the facility. Maintaining good housekeeping in waste processing and storage areas. Fire extinguisher and firefighting facilities should be established during operation 		
Efficient working of the landfill and resource recovery facility	<ul style="list-style-type: none"> Inefficient working of plant may cause poor quality of treatment and resulting under treatment of solid waste may cause environment, health and safety risk to workers and environment. 	<ul style="list-style-type: none"> Procedure for each step of operation shall be documented and all workers/operators shall be trained on the proper operation of each component of the plant. Although impact is likely to be minimal due to new and well-designed efficient system, it must be ensured that the facility is operating properly at all times. 	Rajshahi Corporation	Rajshahi City Corporation
Efficient working of Sanitary Landfill & Resource Recovery Facility	<ul style="list-style-type: none"> Inefficient working of the Sanitary Landfill & resource recovery facility may cause environment, health and safety risk to workers and environment. 	<ul style="list-style-type: none"> Procedure for each step of operation shall be documented and all workers/operators shall be trained on the proper operation of each component of the facility. 	Rajshahi Corporation	Rajshahi City Corporation
Traffic management	<ul style="list-style-type: none"> Random parking of vehicles and 	<ul style="list-style-type: none"> A well-defined schedule and route will be followed by the waste carrying trucks; 	Rajshahi Corporation	Rajshahi City Corporation

Issues/ Activities	Potential Environmental Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Supervision
	unplanned loading / unloading of wastes in the subproject areas can lead to traffic congestion	<ul style="list-style-type: none"> ▪ Proper signage will put up near the proposed facility giving route directions; ▪ Vehicles will be parked inside the facility premises in the designated slots; ▪ Entry and exit routes from the premises will be clearly marked; ▪ Adequate lighting and reflective boards will be put up for night time safety; ▪ A proper traffic management plan will be implemented to mitigate adverse impacts; ▪ All routes will be planned to cause minimal disturbance to local community; ▪ The vehicles will be allowed to move in the site only through dedicated entry and exit points within the site; ▪ Dedicated parking area will be provided in the facility for parking of vehicles; ▪ The speed limit of vehicles will be restricted to 20 km/hr. 		
Community health and safety	<ul style="list-style-type: none"> ▪ Possible accumulation of waste causing health problems for community. Pests and vermin. 	<ul style="list-style-type: none"> ▪ Wet/biodegradable wastes will be emptied directly from the bins to primary collection vehicles daily and dry/non-biodegradable wastes once in a week. The number and type of bins and vehicles to be procured under the project is sufficient to ensure no accumulation of wastes in the community. ▪ Wastes will be collected regularly to prevent pests and vermin. 	Rajshahi Corporation	Rajshahi City Corporation
Socio-economic aspect	<ul style="list-style-type: none"> ▪ Visual impacts. ▪ Impacts on community health. ▪ Employment. 	<ul style="list-style-type: none"> ▪ Good Solid Waste handling practices will be implemented which will greatly reduce foul smell and reduce impact from odors; ▪ Vehicles moving through community roads will be covered and the operations will be restricted to day time; ▪ Maximum efforts will be made to provide job opportunities to local residents during construction and operation phase. ▪ Awareness campaigns should be organized emphasizing the need of sorting at source, waste collection and participatory role of Citizens in Solid waste management in the City Corporation Area. 	Rajshahi Corporation	Rajshahi City Corporation

8.3 Environmental and Social Unit of Rajshahi City Corporation

For Rajshahi City Corporation sub-project to be implemented by LGED, a Project Management Unit (PMU) headed by the Project Director (PD) of this project will be formed who will oversee the project activities. An “Environmental and Social Management Unit (ESU)” within the PMU will oversee the environmental and social management issues associated with the Rajshahi City Corporation subproject. The ESU should be manned by personnel competent in undertaking environmental and

social screening and monitoring and will report directly to the PD. The ESU with support from relevant Rajshahi City Corporation/local communities (if necessary) will carry out “Environmental/Social Screening” and “Analysis of Alternatives” of sub-projects, following the guidelines contained in the Environmental and Social Management Framework (ESMF). For second batch of the project, the project consultants (environmental and social specialists) will carry out these screening activities.

The ESU, as required, will carry out further environmental and social assessment of the sub-projects. The PMU of LGED will be responsible for implementation of EMP and preparation of quarterly reports, with support from “Environmental and Social Unit” (see Figure-8.1).

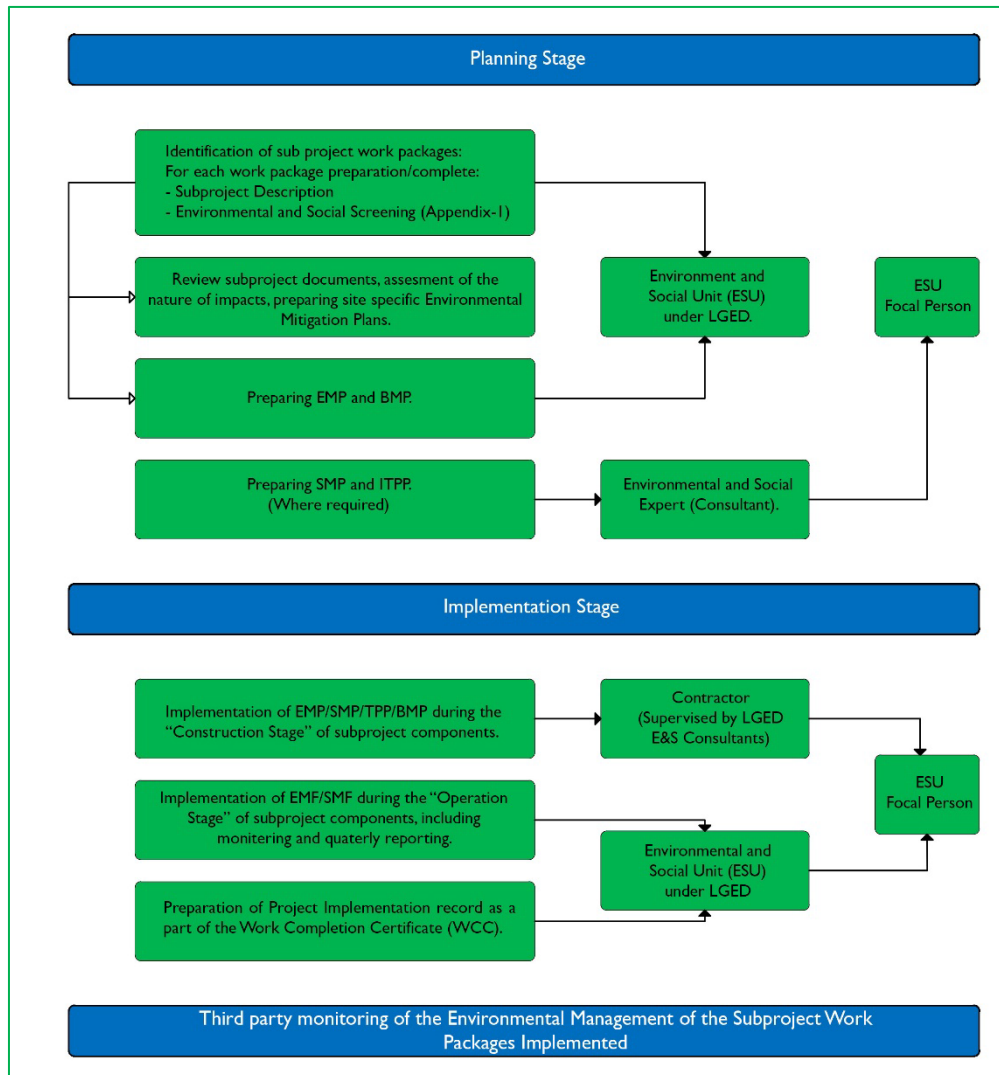


Figure 8-1: Institutional Arrangement of ISWMP

Capacity Building. Given a new ESU will be set up for the project with staff lack familiarity with E&S requirements especially international good practice those working on the project will need trainings on environmental and social safeguards in general and the specifics of management and monitoring requirements for the project. The contractors’ staff would also need some training and awareness raising to ensure they fully understand the ESMP requirements. Thus, a training program will be implemented. Training modules will be developed by PMU with support from consultants and same

will be agreed with AIIB. The training modules will be delivered by the supervision consultant and will be a part of the project cost that includes institutional strengthening, capacity building and training for safeguards.

8.4 Environmental & Social Management Plan (ESMP)

8.4.1 Scope of the ESMP

The primary objective of the environmental and social management plan (ESMP) is to record environmental and social impacts resulting from the sub-project activities and to ensure implementation of the identified mitigation measures, in order to reduce adverse impacts and enhance positive impacts. Besides, it would also address any unexpected or unforeseen environmental impacts that may arise during construction and operational phases of the sub-projects.

The ESMP have developed to lay out: (a) the measures to be taken during preconstruction, construction and operation phases of a sub-project to eliminate or offset adverse environmental impacts, or reduce them to acceptable levels; (b) the actions needed to implement these measures; and (c) a monitoring plan to assess the effectiveness of the mitigation measures employed.

The environmental management program should be carried out as an integrated part of the project planning and execution. It must not be seen merely as an activity limited to monitoring and regulating activities against a pre-determined checklist of required actions. Rather it must interact dynamically as a sub-project implementation proceeds, dealing flexibly with environmental impacts, both expected and unexpected. For all sub-projects to be implemented under the ISWMIP, the ESMP should be a part of the Contract Document.

The major components of the ESMP include:

- Mitigation and enhancement measures
- Monitoring plan
- Estimation of Cost of ESMP
- Institutional arrangement for implementation of ESMP

8.4.2 Work Plan & Schedule

The contractor and operator will be primarily responsible for preparing the Site-Specific Environmental Management Plan (SEMP). During construction, contractor will be guided by the SEMP. This shall be based on the subproject's ESMP with details on staff, resources, implementation schedules, and monitoring procedures. The agreed SEMP will be the basis for monitoring by ESU and supervision consultant. Inclusion in construction contract documents the provisions requiring the contractor to submit a SEMP is important since the contractor will be legally required to allocate a budget for mitigation measures implementation. The SEMP will allow ESU, construction supervision engineer to focus on what are specific items expected from the contractor regarding environmental safeguards on a day-to-day basis. With the SEMP, ESU can easily verify the associated environmental requirements each time the contractor will request approval for work schedules.

Table 8-4 Environmental Management and Monitoring Plan for the Integrated Solid Waste Management Improvement project of Rajshahi City Corporation

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
I. Pre-Construction Phase							
1.1 Location impacts of the plant	Nearby community may be affected due to increased pollution during construction and operation.	The site should be selected in such a way that nearby community may have no or minimum impact such as dust, noise and access limit at construction phase and air emission and odor during operation phase due to proposed works.	Final design drawings	Prior to award of contract	Consultant	ESU	No additional cost required
1.2 Incorporation of all mitigation measures in the design	Efficiency of the plant operation.	<ul style="list-style-type: none"> ▪ It must be ensured that contractor's design of the plant includes all proposed mitigation measured in Chapter 8 of this ESIA report. 	Final design drawings	Before start of construction	Consultant	ESU	No additional cost required
1.3 Natural calamities	Plant location is in the tidal flood zone, thus, there is a threat of inundation due to tidal flood during monsoon.	<ul style="list-style-type: none"> ▪ Highest flood level has been considered in the design. ▪ Planning of landfill at a suitable elevation above high flood level (utilizing accurate topographic survey). 	Final design drawings	Prior to award of contract	Consultant	ESU	No additional cost required
1.4 Sources of materials	Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	<ul style="list-style-type: none"> ▪ Prioritize a site which already permitted by the authority. ▪ If other sites are necessary, it is contractor's responsibility to verify the suitability of all material sources and to obtain the approval of ESU and consultants. ▪ If additional quarries will be required after construction is started, 	<ul style="list-style-type: none"> ▪ Bid document to include requirement for verification of suitability of sources and permit for additional quarry sites if necessary 	During construction phase, as necessary in discussion with ESU, and Consultant.	Contractor	Consultant and ESU	No additional cost required

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
		construction contractor will obtain a written approval from ESU.					
1.5 Permits, clearances, no objection certificate (NOC) etc.	Failure to obtain necessary permits and NOCs, etc. can result in design revisions and/or stoppage of works.	<ul style="list-style-type: none"> ▪ Obtain NOC from Ward#14&16 member Rajshahi City Corporation prior to start of civil works. ▪ Acknowledge in writing and provide report on compliance all obtained permits, clearance, NOCs, etc. ▪ Include in detailed design drawings and documents all conditions and provisions if necessary. 	Incorporated in final design and communicated to contractors.	Prior to award of contract	Consultant	ESU	No additional cost required
1.6 Preparation of SEMP	Expecting minor impacts, during construction period only and mitigation measures are addressed.	<ul style="list-style-type: none"> ▪ Contractor will prepare site specific environmental management plan which should be reviewed and approved by the employer at least 10 days before commencement of construction. ▪ Relevant information disclosed. 	SEMP prepared, approved and disclosed	Upon completion of layout plan by contractor	Contractor	Consultant and ESU	No additional cost required
1.7 SEMP implementation training	Irreversible impact to the environment, workers, and community	Project manager and all key workers of contractors will be required to undergo EMP implementation including spoils management, Standard operating procedures (SOP) for construction works; health and safety (H&S), core labor laws, applicable environmental laws, etc.	(i) Proof of completion (ii) Posting of EMP at worksites	Before start of construction	Consultant	ESU	Cost of the training to contractor is responsibility of ESU
2. During Construction Phase							

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
2.1 Physical and Cultural Heritage	Construction works will be on existing Landfill Site, thus risk for chance finds is very low.	<ul style="list-style-type: none"> ▪ Stop work immediately to allow further investigation; ▪ Prevent workers or any other persons from removing and damaging of archaeological remains. 	Records of chance finds	Visual inspection by ESU on regular basis	Contractor	Consultant and ESU	Included in civil works contract
2.2 Excavations	Potential erosion, dust generation, and accident. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	<ul style="list-style-type: none"> ▪ The excavated earth shall always be dumped on the designated areas to be reused as needed. ▪ In the event that excavations are to be kept open overnight, lights, high visibility warning signs, and barricades shall be provided. 	Contractor's safety and security program; Location of stockpiles; Number of complaints from stakeholders;	Inspection by ESU on a regular basis;	Contractor	Consultant and ESU	Included in civil works contract
2.3 Waste management	Oil, grease etc. from construction machinery; Hazardous and solid waste from waste construction material and food; The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	<ul style="list-style-type: none"> ▪ Wastes must be placed in the designated bins which must be regularly emptied. These shall remain within demarcated areas and shall be designed to prevent wastes from being blown out by wind. ▪ Recycling is to be encouraged by providing separate receptacles for different types of wastes and making sure that staff is aware of their uses. ▪ All waste must be removed from the site and transported to a disposal site. 	Complaints from community; Regular inspection of waste management activity.	As work progresses	Contractor	Consultant and ESU	Included in civil works contract

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
2.4 Water quality (surface and groundwater)	Trenching and excavation, run-off from stockpiled materials, and chemical contamination from fuels and lubricants may result to silt-laden runoff during rainfall which may cause siltation and reduction in the quality of adjacent bodies of water. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	<ul style="list-style-type: none"> ▪ Every effort shall be made to ensure that any chemicals or hazardous substances do not contaminate the soil or water on-site. ▪ Care must be taken to ensure that runoff from vehicle or plant washing does not enter the surface/ground water. ▪ Site staff shall not be permitted to use any stream, river, other open water body, or natural water source adjacent to or within the designated site for them for disposing wastes. ▪ All concrete mixing must take place on a designated, impermeable surface. ▪ All substances required for vehicle maintenance and repair must be stored in sealed containers until they can be disposed of from the site. ▪ Hazardous substance/ materials is to be transported in sealed containers or bags. ▪ Monitor water quality according to the environmental management plan. 	(i) Areas for stockpiles, storage of fuels and lubricants and waste materials; (ii) No visible degradation to nearby drainages, <i>khals</i> or water bodies due to construction activities	Visual water quality inspection during construction	Contractor	Consultant and ESU	Included in Civil works contract
2.5 Soil disturbance	The construction activities may cause soil degradation problems in	<ul style="list-style-type: none"> ▪ Precautions to be taken at any time of year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecast, and actions to be 	Complaints from community; Vegetation cover;	As work progresses	Contractor	Consultant and ESU	Included in civil works contract

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
	the areas of the plant, access road etc.	<p>taken during or after rainstorms shall be developed by the Contractor.</p> <ul style="list-style-type: none"> ▪ Slope protection measures through turfing; ▪ The earthwork sites where exposed land surface is vulnerable to runoff shall be consolidated and/or covered. ▪ The material stockpile sites shall be far away from surface water bodies and areas prone to surface run-off. Loose materials shall be bagged and covered. ▪ Channels, earth bunds, netting, tarpaulin and or sand bag barriers shall be used on site to manage surface water runoff and minimize erosion. ▪ The overall slope of the works areas and construction yards shall be kept to a minimum to reduce the erosive potential of surface water flows. 	No visible degradation to nearby drainages, <i>khals</i> or water bodies due to soil erosion.				
2.6 Air Quality	Air pollution due to construction activities. The impacts are negative but short-term, impacts within a relatively small area and reversible by mitigation measures.	<ul style="list-style-type: none"> ▪ Water spraying for dust control; ▪ Construction materials with potential for significant dust generation shall be covered; ▪ No smoke belchers equipment; and ▪ Limiting speed of construction vehicles in access roads and work sites to maximum of 20 kph. 	Location of stockpiles; Number of complaints from stakeholders;	Visual air quality inspection during construction	Contractor	Consultant and ESU	Included in civil works contract

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
2.7 Noise Level	Construction activities will be nearby settlements. Temporary increase in noise level may be caused by excavation equipment, and the transportation of equipment, materials and people. The impact is short-term and within a relatively small area and reversible by mitigation measures.	<ul style="list-style-type: none"> ▪ Consultation with affected people; not to operate noisy equipment during night time (22:00 – 06:00); ▪ Sound suppression for equipment; ▪ Ear protection for workers. ▪ Conduct noise quality monitoring as per EMP. 	Number of complaints from stakeholders; Use of silencers in noise-producing equipment and sound barriers; Noise Quality, Equivalent Sound Pressure Level	Inspection by ESU and supervision consultants on monthly basis;	Contractor	Consultant and ESU	Included in civil works contract
2.8 Biodiversity	<ul style="list-style-type: none"> ▪ Clearing of existing vegetation may result in loss of associated ecological habitats and their fauna. ▪ Noise, vibrations, and intrusive activities related to construction works may scare away animals remaining onsite after vegetation clearance. 	<ul style="list-style-type: none"> ▪ Plantation will be done at the ratio of 1 (cut): 2 (new planting) for each tree felling (if any). ▪ No trees, shrubs, or groundcover will be removed or vegetation stripped without the prior permission of the environmental specialist; ▪ While clearing vegetation it must be ensured that no wildlife injure and/or die. ▪ Harming and/or killing of any types of wildlife by the workers of the project must be prohibited. 	ESU to report in writing the number of trees cut and planted twice; Number of complaints from stakeholders on disturbance of vegetation, poaching, fishing, etc.	Visual inspection by ESU and supervision consultants on monthly basis	Contractor	Consultant and ESU	Included in civil works contract

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
2.9 Socio-economic status	Manpower may be employed from local community during the construction and operation stage. Thus potential impact is positive and long-term.	<ul style="list-style-type: none"> ▪ Employ at least 50% of labor force from communities in the vicinity of the site. This will have the added benefit of avoiding social problems that sometimes occur when workers are imported. ▪ Secure construction materials from local market. 	<ul style="list-style-type: none"> (i) Employment records; (ii) Records of compliance to Bangladesh Labor Law and other applicable standards. 	Visual inspection by ESU and supervision consultants on monthly basis	Contractor	Consultant and ESU	Included in civil works contract
2.10 Provision of Worker Facilities	Inconvenience to the communities due to presence of workers; Solid waste and sanitary discharges from worker camps.	<ul style="list-style-type: none"> ▪ Provide suitable housing, adequate supplies of potable water, and toilet and bathing facilities within the housing area. Onsite facilities for preparing food need to be provided, or food service contracted; ▪ Provide means for disposing of wastewater from toilets, baths and food preparation areas either through a septic tank and soak away, or holding tank with removal by vacuum truck. ▪ Solid waste should be collected at waste bins and disposed of properly offsite. 	Site-specific H&S Plan; Records of supply of uncontaminated water; Record of H&S orientation trainings; Condition of sanitation facilities for workers	Visual inspection by ESU and supervision consultants on monthly basis	Contractor	Consultant and ESU	Included in civil works contract
2.11 Occupational health and safety	Occupational hazards which can arise during work. Potential impacts are negative and long-term but reversible by mitigation measures.	<ul style="list-style-type: none"> ▪ Comply with requirements of Government of Bangladesh Labor Law and all applicable laws and standards on workers H&S. ▪ Ensure that all site personnel have a basic level of environmental awareness 	<ul style="list-style-type: none"> ▪ Equipped first-aid stations ▪ Number of accidents ▪ Records of supply of uncontaminated water. 	Visual inspection on regular basis	Contractor	Consultant and ESU	Included in civil works contract

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
		<p>training. If necessary, the environmental safeguard specialist will help further capacity building.</p> <ul style="list-style-type: none"> ▪ Ensuring all workers are provided with and required to use personal protective equipment (reflectorized vests, footwear, gloves, goggles and masks) at all times; ▪ Arrange for readily available first aid unit including an adequate supply of sterilized dressing materials and appliances. ▪ Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas; ▪ Ensure moving equipment is outfitted with audible back-up alarms; ▪ Disallow worker exposure to noise level greater than 85 dBA for a duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively. 	<ul style="list-style-type: none"> ▪ Condition of eating areas of workers ▪ Record of H&S orientation trainings ▪ Use of PPE; ▪ % of moving equipment outfitted with audible back-up alarms ▪ Permanent sign boards for hazardous areas ▪ Signage for storage and disposal areas ▪ Condition of sanitation facilities for workers 				
	Health risk of construction workers due to COVID-19	<ul style="list-style-type: none"> ▪ Prepare the health and safety guidance for COVID-19 at work sites and get approval from MWMU; ▪ Strictly follow and implement the H&S guidance for COVID-19 at worksite; 	<ul style="list-style-type: none"> ▪ Record of COVID-19 protocol; ▪ Record of medical check-up; 	Visual inspection on monthly basis	Contractor	Consultant, ESU	Included in civil works contract

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
		<ul style="list-style-type: none"> ▪ Everyone entering the worksite must wear a mask, gloves and hard shoes. ▪ At the entrance of the worksite/camp site every personnel must wash their hands for 20 second with maintaining a distance of at least 1m (3 ft) from each other; ▪ Discourage site personnel to gather and gossip at any time, rather encourage physical distance while chatting/discussing. ▪ Ensure sufficient stock of soap, sanitizer, washing facility and safe water at the workers' dwelling (both camp site and home). ▪ Encourage frequent hand washing and social distancing at campsite. ▪ Ensure personal distance at least 1 meter (3 feet), preferably 2m (6ft) during lunch, dinner and prayer. ▪ Train workers on how to properly put on, use/wear, and take off protective clothing and equipment. Make these trainings mandatory at worksites and provide 10-15 minutes of a workday for such 'training and encouragement' activities. 	<ul style="list-style-type: none"> ▪ Awareness meeting records. 				

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
2.12 Community health and safety	Construction works will impede the access of residents and businesses in limited cases. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	<ul style="list-style-type: none"> ▪ Adequate lighting, temporary fence, reflectorized barriers and signage at active work sites; ▪ Contractor's activities and movement of staff will be restricted to designated construction areas. ▪ Contractor's preparedness in emergency response; ▪ Project Affected Persons need to be made aware of the existence of the complaints book and the methods of communication available to them. The contractor must address queries and complaints by: (i) documenting details of such communications; (ii) submitting these for inclusion in complaints register; (iii) bringing issues to the environment management specialist's attention immediately; and (iv) taking remedial action as per environment management specialist's instruction. ▪ Adequate dissemination of the GRM and Contractor's observance/implementation of the GRM. 	<ul style="list-style-type: none"> ▪ On-site record book ▪ Complaints from stakeholders ▪ GRM records 	Visual inspection on monthly basis	Contractor	Consultant and ESU	Included in civil works contract
2.13 Site reinstatement	Damage due to debris, spoils, excess construction materials	<ul style="list-style-type: none"> ▪ Remove all spoils wreckage, rubbish, or temporary structures which are no longer required; 	ESU report in writing that (i) worksite is restored to original	Prior to turn-over of completed works	Contractor	Consultant and ESU	Included in civil works contract

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
		<ul style="list-style-type: none"> Request ESU to report in writing that worksite has been vacated and restored to pre-project conditions before acceptance of work. 	<p>conditions; (ii) worker shed has been vacated and restored to pre-project conditions; (iii) all construction related structures not relevant to O&M are removed; and (iv) worksite clean-up is satisfactory.</p>				
3. Operation Phase							
3.1 Health and safety risk of workers	Risk of health of workers working in plant operation and maintenance, workers may suffer infectious diseases due to hazardous waste Worker's operators may have accident risk of operation and maintenance of the subproject activities.	<ul style="list-style-type: none"> Provide all the personal protective equipment like gum boots, nose mask, gloves etc. for the protection of workers. The workplace will be equipped with fire detectors, alarm systems and fire-fighting equipment. The equipment will be periodically inspected and maintained in good working condition. Providing adequate personnel facilities, including washing areas and areas to change clothes before and after work. Medical check-up will be conducted on regular basis and the health conditions will be monitored. First aid facilities required to attend immediately for meeting emergency 	<ul style="list-style-type: none"> Regular inspection and testing of all safety features and hazard control measures and personal protective features; Ensure proper training of newly deployed worker. Record of regular health check-up for the epidemic disease and illness of related workers. 	Regular monitoring weekly at the plant.	ESU	Rajshahi City Corporation	Included in O&M cost

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
		<p>situations will be made available at the facility.</p> <ul style="list-style-type: none"> ▪ Maintaining good housekeeping in waste processing and storage areas. ▪ Fire extinguisher and firefighting facilities should be established during operation 					
3.2 Efficient working of Integrated Solid waste management activities	Inefficient working of integrated Solid waste management activities may cause poor quality of treatment and management of solid waste and may cause environment, health and safety risk to workers and environment.	<ul style="list-style-type: none"> ▪ Procedure for each step of operation shall be documented and all workers/operators shall be trained on the proper operation of each component of the Integrated Solid waste management activities. ▪ Although impact is likely to be minimal due to new and well-designed efficient system, it must be ensured that the facility is operating properly at all times. 	<ul style="list-style-type: none"> ▪ Check the Integrated Solid waste management activities regularly. ▪ Record of regular inspection of Integrated Solid waste management activities. ▪ Proper training to the operator. 	Regular monitoring daily at plant.	ESU	Rajshahi City Corporation	Included in O&M cost
3.3 Water Quality	Run-off from stockpiled wastes and end-products of composting which may cause siltation and reduction in the quality of adjacent bodies of water.	<ul style="list-style-type: none"> ▪ Take all precautions to prevent entering of run-off in to streams, watercourses, or irrigation system. Install temporary silt traps or sedimentation basins along the channels leading to the waterbodies. ▪ Remove all wastes, by and end-products immediately. ▪ Monitor discharge of leachate including review of ECC conditions. Parameters 	<ul style="list-style-type: none"> ▪ Check the Run off from Stock Piled wastes and end product of composting ▪ Test the leachate, compost quality ▪ Tests at the minimum includes measurement of 	<ul style="list-style-type: none"> ▪ Regular monitoring daily at plant. ▪ Daily inspection of leachate by operation and monthly inspection for 	ESU	Rajshahi City Corporation	Included in O&M cost

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
		<p>to be monitored include suspended solids, dissolved solids (inorganic), pH, ammoniac nitrogen (as N), total nitrogen (as N), biochemical and chemical oxygen demand, arsenic, mercury, lead, cadmium, total chromium, copper, zinc, nickel, cyanide, chloride, fluoride, phenolic compounds and others as per Solid Waste Management Rules 2021.</p> <ul style="list-style-type: none"> ▪ Monitor compost quality. Visual inspection to ensure that glass, plastic and other physical inerts and fragments are absent in compost and it has no offensive smell. Also testing of compost to meet standards for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, pH and other parameters as prescribed by the relevant National policy of the Government. ▪ Monitor treated wastes quality as per Medical Wastes Rules and conditions of the ECC. 	temperature, pressure, contact time, spore tests, and other routine tests (visual).	<p>first 3 years of operation.</p> <ul style="list-style-type: none"> ▪ Leachate Quality monitoring to be done twice a year for first three years of operation 			
3.4 Acoustic environment	Increase in noise level due to presence of workers and movement of vehicles. The impacts are negative but short-	<ul style="list-style-type: none"> ▪ Plan activities in consultation with Rajshahi City Corporation so that activities with the greatest potential to generate noise are conducted during 	▪ Noise level will be monitored	▪ Monthly inspection at the Landfill Area	ESU	Rajshahi City Corporation	Included in O&M cost

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
	term, site-specific within a relatively small area and reversible by mitigation measures.	periods of the day which will result in least disturbance.					
3.5 Air Quality	Ambient Air quality of the landfill Area.	<ul style="list-style-type: none"> Ambient Air quality will be monitored once by direct measurement from different locations of landfill area. 	<ul style="list-style-type: none"> Ambient Air quality will be monitored once by direct measurement of sensitive air pollution parameters like particulate matters (PM10, PM2.5), and SO_x, NO_x, CO, CH₄, VOC. 	Monthly inspection at the Landfill Area	ESU	Rajshahi City Corporation	Included in O&M cost
3.6. Quality of compost	Compost quality of the produced compost from the compost plant	<ul style="list-style-type: none"> Monitore the Physical Properties and Chemical Properties of compost 	<ul style="list-style-type: none"> Color, Physical condition, Odour, Moisture content, Inert materials pH, Organic Carbon, N, C:N , P, K, S, Zn, Cu, Cr, Cd, Pb, Ni 	Once in every month	ESU	Rajshahi City Corporation	Included in O&M cost
3.7 Quality of Diesel (pyrolysis Oil)	Bad quality fuel burning may impact the ambient air	<ul style="list-style-type: none"> Ensure the good quality of diesel 	<ul style="list-style-type: none"> Sulphur content, Flash point, Higher heating value, Lubricity 	Monthly	ESU	Rajshahi City Corporation	Included in O&M cost
3.8 Air emission	Air quality of exhaust air from Incineration Plant.	<ul style="list-style-type: none"> Air quality will be monitored once by direct measurement of sensitive air pollution parameters like particulate 	<ul style="list-style-type: none"> Stack emission: particulate matters 	Stack emission: once a year in 1st year and	ESU	Rajshahi City Corporation	Included in O&M cost

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
		<p>matters (PM10, PM2.5), and SO_x, NO_x, HCl, CO.</p> <ul style="list-style-type: none"> In the design of the plant, it must ensure the exhaust treatment. 	<p>(PM10, PM2.5), SO_x, NO_x, CO_x, HCl.</p> <ul style="list-style-type: none"> Complaints from communities. 	<p>occasionally as necessary after the 1st year.</p> <p>Daily inspection at the plant site.</p>			
3.9 Ash disposal	Environmental hazard and health risk to workers and other people.	<ul style="list-style-type: none"> Ash quality control should be ensured. It can be brought to a designated area at the landfill for the disposal. 	<ul style="list-style-type: none"> Regular visual inspection at plant and disposal site 	Daily	ESU	Rajshahi City Corporation	Included in O&M cost
3.10 Socio-economic aspect	<ul style="list-style-type: none"> Visual impacts. Impacts on community health. Employment. 	<ul style="list-style-type: none"> Good waste handling practices will be implemented which will greatly reduce foul smell and reduce impact from odor; Vehicles moving through community roads will be covered and the operations will be restricted to day time; Maximum efforts will be made to provide job opportunities to locals. Awareness campaigns should be organized emphasizing the need of sorting at source, waste collection and participatory role of Citizens of the Rajshahi City Corporation. 	<ul style="list-style-type: none"> Regular inspection at plant site. Proper training to the driver. Record of awareness campaign. 	Weekly monitoring.	ESU	Rajshahi City Corporation	Included in O&M cost
3.11 Traffic management	<ul style="list-style-type: none"> Random parking of vehicles and unplanned loading / unloading areas can lead to traffic 	<ul style="list-style-type: none"> A well-defined schedule and route will be followed by the waste carrying trucks; Proper signage will put up near the proposed facility giving route directions; 	<ul style="list-style-type: none"> Check the vehicle pool. Record of regular inspection. 	Regular monitoring weekly at vehicle pool.	ESU	Rajshahi City Corporation	Included in O&M cost

Project Activity/ Field	Impacts	Mitigation Measures	Monitoring Indicator	Frequency of Monitoring	Responsibility		Cost and Source of Funds
					Implementation	Supervision	
	congestion for distilled water transport	<ul style="list-style-type: none"> ▪ Vehicles will be parked inside the facility premises in the designated slots; ▪ Entry and exit routes from the premises will be clearly marked; ▪ Adequate lighting and reflective boards will be put up for night time safety; ▪ A proper traffic management plan will be implemented to mitigate adverse impacts; ▪ All routes will be planned to cause minimal disturbance to local community; ▪ The vehicles will be allowed to move in the site only through dedicated entry and exit points within the site; ▪ Dedicated parking area will be provided in the facility for parking of vehicles; ▪ The speed limit of vehicles will be restricted to 20 km/hr; 	<ul style="list-style-type: none"> ▪ Proper training to the driver. ▪ Record of accidents/incidents. 				

8.5 Environmental Management and Monitoring Plan Implementation Cost (Indicative)

The contractor's cost for site establishment, preliminary activities, construction, defect liability activities, and environmental mitigation measures related to ESMP implementation before construction and construction are to be incorporated into the contractual agreements and engineer's costs, which will be binding on him for implementation. The survey will be conducted by the contractor.

The operation phase mitigation measures are again of good operating practices, which will be the responsibility of the implementing agency (Rajshahi City Corporation). The activities identified in the ESMP mainly include site inspections and informal discussions with workers and local community, and this will be the responsibility of ESU with the assistance of consultant, costs of which are part of project management.

Most of the costs associated with environmental mitigation and enhancement measures are included in the EMP budget. In consideration to the environmental impacts and their mitigation measures for this subproject, some items need to be incorporated in the Bill of Quantity of this subproject. A substantial part of environmental costs shall be covered under civil works contract. However, exact figures of environmental costs under civil works contract are not included in this EIA. Costs of these items will be dealt elsewhere in the respective subproject component document. The environmental costs presented in Table-8.4 are tentative provisions and suggested to be incorporated in the bill of quantities of bid documents. These figures are estimated based on experience of undertaking similar works under different LGED projects and the assumption of an average of \$10,000 per annum as cost of implementing ESMP mitigation measures. For the details of environmental costs under civil works contract, individual contract package bid document may be consulted. It is assumed that the environmental cost under civil works contract for each contract package will be more or less same.

Table 8-5: Tentative EMP Budget for BOQ

(The following items need to be incorporated in the Bill of Quantity of this subproject)

Cost Estimates for Environmental Management

Sl. No.	Description of Items	Unit	Quantity	Unit Rate (Tk)	Item Total (Tk)	Costs covered by
1	Environmental Monitoring (i) Air Quality, (ii) Noise level, (iii) Water quality, (iv) Sediment at work site to the entire satisfaction of engineer-in-charge.	LS			6,00,000.00	Cost included in the BoQ as Provisional sum item (non-competitive item)
2	Dust suppression measures (excluding watering for compaction) to the entire satisfaction of the engineer-in-charge.	LS			1,50,000.00	
3	Rehabilitation of ancillary sites including stockpile sites, brick crushing sites, borrow areas, workforce camp, to the entire satisfaction of the engineer-in-charge.	LS			1,00,000.00	
4	Proper disposal of camp site wastes to the entire satisfaction of the engineer-in-charge.	LS			1,00,000.00	
5	Maintain First aid box at camp site to the entire satisfaction of the Engineer-in-charge.	LS			20,000.00	
6	Miscellaneous	LS			30,000.00	
Sub-Total:					10,00,000.00	

Sl. No.	Description of Items	Unit	Quantity	Unit Rate (BDT)	Total Amount (BDT)	Costs covered by
7	Prevention of spillage, leakages of polluting materials to the entire satisfaction of the engineer-in-charge.					Contractor
8	Providing and maintaining adequate potable water supply facilities (Shallow Tube well) at camp site and work site to the entire satisfaction of engineer-in-charge.	Nos	4			Contractor
9	Providing and maintaining adequate sanitation facilities (both for male and female) at camp site and work site to the entire satisfaction of engineer-in-charge.	Nos	4			Contractor
10	Traffic Management Maintaining traffic management at worksite from time of commencement of construction activities to time of completion activities, including ensuring that the road is safe for users (this includes providing necessary barricades, warning signs/lights, guide signs, flagmen, maintaining diversion roads by cutting, filling, constructing, etc. or by any other means) in accordance with the full satisfaction of the Engineering-in-charge.					Contractor
11	Installation of signboards/billboards Precautionary signboards/billboards/danger signals in appropriate places to notify people about the project	sqm	10.80			Item included in the BOQ
12	Working labor shed: Construction of Labor shed with C.I sheet Roofing, fencing and brick soling floor as per approved plan and to the entire satisfaction of the engineer-in-charge.					Contractor
13	Personal Protection Equipment for Workers Providing and maintaining appropriate (safe design, fit and comfort) personal protection equipment (PPE) to ensure the highest possible protection for employees in establishing and maintaining a safe and healthful working environment at workplace.					Contractor

Sl. No.	Description of Items	Unit	Quantity	Unit Rate (BDT)	Total Amount (BDT)	Costs covered by
14	Removal of equipment/ surplus materials/ rubbish/temporary structures/fully reinstate On completion of the Contract, Contractor shall remove the equipment, surplus materials, slope erosion, canal sedimentation, rubbish and temporary structures of all types and shall leave sites in clean condition to the entire satisfaction of the engineer-in-charge and local people					Contractor
15	Occupational Health and Safety To ensure safety of health and hazards for construction workers including -Adequate housing for all workers -Safe and reliable water supply; -Hygienic sanitary facilities and sewerage system					Contractor
16	Community Health and Safety To ensure safety of health and hazards on local resources and infrastructures of nearby communities					Contractor
17	COVID-19 Health and Safety Washable cloth face mask, disposable hand gloves, wash basin & water container, soap, alcohol-based sanitizer, pump spray, disinfectant, tissue papers, garbage bin, plastic bag, contactless temperature reader etc.					Contractor
19	Training on Environmental Management Plan, Health & Safety and COVID-19 related threat for the contractor's workforce					Consultants

The cost for Environmental Quality Tests of Various Components –Water (surface and underground), Ambient air and Noise level, and Soil quality is given in Table-8.6 below.

Table 8-6: Indicative Costs for Environmental Quality Tests (Part of EMP Budget in BOQ)

Sl. No.	Environmental Parameters	Analytical Parameter	Unit cost (BDT)	Frequency (times) /Sampling Location	Total cost (BDT)
I	Ambient Air Quality	Suspended Particulate Matter (SPM), Particulate Matter (PM 2.5), Particulate Matter (PM 10), Oxides of Sulphur (Sox), Oxides of Nitrogen (NOx), Carbon Monoxide (CO),	40,000	6 times / (Once at two locations during pre-construction and semi-annually at two locations during construction phase)	40,000x6=2,40,000

Sl. No.	Environmental Parameters	Analytical Parameter	Unit cost (BDT)	Frequency (times) /Sampling Location	Total cost (BDT)
2	Stack Emission	Stack emission monitoring (SPM, SO _x , NO _x , HCl, CO _x)	40,000	Quarterly during the operation	160,000 (per annum)
2	Noise Quality	Noise Level (dB) in selected busy areas at and around the subproject road/bridge/khal site (under Normal Condition and with Traffic)	10,000	12 times / (Once at two locations for day and night time during pre-construction and semi-annually at two locations for day and night time during construction phase)	10,000×12=1,20,000
3	Groundwater Quality	pH, Total suspended solids (TSS), Total dissolved solids (TDS), Dissolved oxygen (DO), Arsenic (As), Iron (Fe), Chloride (Cl), Electrical Conductivity (EC), nitrate-N (NO ₃ -N)	20,000	6 times / (Once at two locations during pre-construction and semi-annually at two locations during construction phase)	20,000×6=1,20,000
4	Surface Water Quality	pH, Total suspended solids (TSS), Total dissolved solids (TDS), Turbidity, Dissolved oxygen (DO), Biological oxygen demand (BOD _{5days}), Chemical oxygen demand (COD), Arsenic (As), Iron (Fe), Chloride (Cl), Electrical Conductivity (EC), nitrate-N (NO ₃ -N, fecal and total coli-form	20,000	6 times / (Once at two locations during pre-construction and semi-annually at two locations during construction phase)	20,000×6=1,20,000
5	Total Cost:				7,20,000.00

8.6 Monitoring and Reporting

ESU will monitor and measure the progress of ESMP implementation. The monitoring activities will correspond with the project's risks and impacts, and will be identified in the ESIA for the subproject. In addition to recording information on the work and deviation of work components from original scope ESU, and Consultant will undertake site inspections and document review to verify compliance with the ESMP and progress toward the final outcome.

Contractor will submit monthly monitoring and implementation reports to ESU, who will take follow-up actions, if necessary. ESU will submit quarterly monitoring reports to DoE. Subproject budgets will reflect the costs of monitoring and reporting requirements.

ESU will carry out the following monitoring actions to supervise project implementation:

- (i) conduct periodic site visits for projects with adverse environmental or social impacts;
- (ii) conduct supervision with detailed review for subproject with significant adverse social or environmental impacts;
- (iii) prepare the periodic monitoring reports for DoE to ensure that adverse impacts and risks are mitigated;
- (iv) work with PMU to rectify to the extent possible any failures to comply with their safeguard commitments, as covenanted in the legal agreements, and exercise remedies to re-establish compliance as appropriate; and
- (v) prepare the subproject completion report for the AIIB-ISSWMIP team that assesses whether the objective and desired outcomes of the safeguard plans have been achieved, taking into account the baseline conditions and the results of monitoring.

External E&S Monitoring. Considering the sensitivity of the project (E&S Category A), LGED will recruit an independent consultant/consulting firm (ToR to be agreed with AIIB) under the Project. This independent consultant/consulting firm will undertake independent monitoring of E&S implementation and will submit periodic (semi-annual) reports to AIIB and PMU on independent monitoring of E&S aspects.

8.7 Gender and Social Inclusion Action Plan (GAP)

8.7.1 Background

Bangladesh is one of the most populous and densely populated countries in the world. Rapid urbanization in recent years has added governance and service challenges. During the last thirty-year (1991-2021), the urban population increased by three times and total waste generation increased by 3 times as well. With rapid urbanization, particularly in municipalities and city corporation, there is even greater pressure exerted on basic urban services such as water supply, sanitation, sewage and drainage, solid waste management and urban transport. Municipality and city corporations commonly referred to as Pourashava or Urban Local Body (ULB).

Solid Waste Management (SWM) has been one of the major urban challenges in the country given its rapid urban growth. The principal objective of the Integrated Solid Waste Management Project (ISWMP) supported by the AIIB intends to improve Solid waste management system in selected municipality and city corporation areas of the country. The support aims at (i) improving public health and quality of life by reducing exposure to pollutants and diseases associated with solid waste; (ii) strengthening the government's capacity to plan for implement effective waste management services; and (iii) improving SWM practices in the country, encouraging waste minimization, recycling, and segregation at source.

Initiating urban governance improvement, LGD and LGED with financial support of AIIB commenced a project named Integrated Solid Waste Management Project (ISWMIP) in 30 Pourashava and City Corporations.

LGED will play its key role in the implementation as well as monitoring of this project. LGED is committed and giving emphasis to mainstream gender considerations in all projects and sectors of LGED. Therefore, development of Gender Action Plan (GAP) is mandatory for each project under LGED. ISWMIP also emphasizes mainstreaming gender for ensuring gender equity. For this purpose, GAP will be introduced as an effective tool for gender mainstreaming in this project.

8.7.2 Basis for Gender Action Plan under ISWMIP

Based on the National Women Development Policy 2011, the Gender Equity Strategy of the LGED developed four (4) separate gender equity action plans for 2013-2015, covering the following sectors: 1) LGED core gender equity action plan (GES); 2) Urban sector gender equity action plan

(USGEAP); 3) Rural Sector Gender Equity Action Plan (RSGEAP); and 4) Water Resource Sector Gender Equity Action Plan (WRSGEAP).

The guidelines for the preparation of the GAP will assist the ULB to understand the strategic issues, goal and objectives, preparation procedures, and implementation modality of the GAP. In order to mainstream the gender issue in urban development, it is necessary to continue the support as part of the project.

Justification: Mainstreaming a gender perspective is the process of assessing the implications for women and men of any planned action, including legislation, policies or programmes, in all areas and at all levels. It is a strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and program in all political, economic and societal spheres so that women and men benefit equally and inequality is not perpetuated.

In addressing the inequality between men and women in the sharing of power and decision-making at all levels, Governments and other actors should promote an active and visible policy of mainstreaming a gender perspective in all policies and programmes so that before decisions are taken, an analysis is made of the effects on women and men, respectively. Gender Action Plan of ULB has followed National Women Development Policy 2011 and Strategy of Gender Equity adopted by LGED. Therefore, to mainstream the gender at all level of works in ULB, Gender Action Plan development and implementation is necessary by each ULB.

8.7.3 Tasks of Gender Action Plan

Gender mainstreaming is essential at the ULB level for gender equity. Gender action plan is the tool for gender mainstreaming. The following are initial steps and tasks to prepare and implement the Gender Action Plan.

Task 1: Assign specific responsibilities to Standing Committee of Women Development for preparation of Gender Action Plan (GAP)

Task 2: One relevant officer nominated by mayor to perform the secretarial work of the standing committee.

Task 3: ULB allocates budget for GAP implementation.

Task 4: The standing committee follows TOR as below until a regulation is prepared by the ministry

Activities:

- a) Hold meeting once in a month and prepare minutes on a regular basis.
- b) Follow the instruction of PCO (Project Coordination Office) to prepare the Gender Action Plan (GAP) and prepare the draft GAP.
- c) Review indicative Summary Gender Action Plan prepared under the project, discuss issues related / relevant to gender mainstreaming and assist ULB in the Gender Action Plan (GAP) preparation exercises.
- d) Identify issues related to gender equity and ULB's role including role of community, government organization, NGOs, etc. in relation to gender and GAP activities.
- e) Present the draft of GAP in the ULB, and finalize. Support implementation and monitoring of all relevant activities.

Action By:

- Gender Committee
- Standing Committee on Social Welfare and Community Center Issues

Performance Indicators:

1st Performance Indicators (PRI): GAP being fully implemented and quarterly report prepared

2nd Performance Indicator (PR2): GAP prepared and endorsed by CSCC (Civil Society Coordination Committee). GAP being fully implemented and quarterly report prepared

Time Schedule:

Task 1, 2: by mid of 1st year

Task 3: by end of fiscal year

Task 4: regularly

8.7.4 Gender Action Plan for ISWMIP's Subproject Implementation

The ISWMIP has strongly emphasized the positive impacts on women and children, and no adverse impacts on women and children are expected. The positive impacts of the project on women and children can be identified as follows.

- Employment opportunities will be created for poor women through development and maintenance of infrastructures.
- Women's participation will be enhanced through:
 - Adequate representatives of women in the Civil Society Coordination Committees (CSCCs) and Ward Level Committees (WLCCs) will be ensured in all participating ULBs.
 - Gender committees headed by the Female Ward Councilors will be formed in all participating ULBs.
 - The GAP will be prepared and included in Project Development Plans (PDPs) in all participating ULBs.
 - Necessary budget will be allocated to the GAP implementation in all participating ULBs.

8.7.5 Goal and Objectives of GAP

The goal of the GAP is to achieve equity between women and men and to support urban sustainable development through improved waste management in participating ULBs.

The specific objectives of the GAP are:

- To advance women's equal participation with men as decision makers in the ULB development;
- To mainstream a gender perspective in the work of the ISWMIP through the formation of Gender Committee; and
- To reduce gender inequalities in access to and control over the resources and benefits of development in the areas pertinent to the work of the subprojects.

In ISWMIP, the member of Project Implementation Unit (PIU) should include one Chief Social Welfare/Slum Development Officer who is in charge of implementation, monitoring and reporting on activities in Poverty Reduction Action Plan (PRAP) and GAP.

Gender mainstreaming is essential at the city corporation level for gender equity. GAP is the tool for gender mainstreaming. The following initial steps and tasks will be followed to prepare and implement the GAP:

8.7.6 Role for Gender Action Plan

- a) Hold meeting once in a month and prepare minutes on a regular basis.
- b) Follow the instruction of PCO to prepare GAP and prepare the draft GAP.
- c) Review indicative Summary Gender Action Plan prepared under the project, discuss issues related / relevant to gender mainstreaming and assist ULB in GAP preparation exercises.

- d) Identify issues related to gender equity and ULB's role including role of community, government organization, NGOs, etc. in relation to gender and GAP activities.
- e) Present the draft of GAP in the ULB, and finalize.
- f) Support implementation and monitoring of all relevant activities.

8.7.7 Relevant Organizations, Stakeholders and their role

Role of ULBs:

- a) To assign specific responsibilities to Women Development Standing Committee (WDSC)
- b) To nominate one relevant officer by Mayor as a Gender Focal point (GFP) to perform the secretarial work of the standing Committee
 - a) To allocate the budget for GAP implementation

Roles of Women Development Standing Committee (Assigned for Gender related Activities):

- To prepare GAP of City Corporation;
- To follow the instruction of PCO, GES and USGEAP of LGED during GAP preparation;
- To prepare meeting agenda or select discussion topics for GAP and organize quarterly meeting;
- To produce meeting minutes;
- To investigate and take necessary actions for any gender related harassment issue according to the law; and
- To assist to implement and monitor of all gender related activities as per GAP

8.7.8 Necessary Tasks and Procedures

Contents of GAP:

In view of mainstreaming the "Gender Equity" issue and achieving the above goal and objectives in various ULB activities under the project, the GAP will be prepared in line with the GES (Gender Equity Strategy) and USGEAP of the LGED, and the National Women Development Policy 2011.

The GAP to be prepared under the P will cover nine (9) issues as laid down in the LGED's Gender Equity Strategy. The GAP shall ensure the issue of equal contribution of male and female at all levels (planning, implementation, operation & maintenance) of urban sector projects.

The GAP consists of two (2) parts: 1) the Gender Strategy; and 2) the Gender Action Plan. The former will be prepared in Phase 1 while the latter will be prepared in Phase 2.

Gender Strategy

In ISWMIP, the participating ULBs will prepare a gender strategy to find ways of enhancing women's participation. The following are strategic issues that may be considered by the ULB in developing its gender strategy.

1) Policy Adoption

- Preparation of gender action plan of the ULB based on the gender action plan of urban sector of LGED, which was prepared following the national women development policy.
- Follow this guideline for gender action plan of the ULB and implement accordingly.
- Review of the ULB gender strategies subject to any amendments of national women development policy.
- Review, evaluate and update the gender action plan of the ULB and implementation guideline as applicable.

Urban sector gender equity action plan of Local Government Engineering Department is given as [Appendix IV](#).

2) Institutional Arrangement

- Selection of Gender Focal Point to follow-up gender issues.
- Formation of Gender Committee at ULB level.
- Assist in preparation of the bylaws of ULB gender development committee.

3) Data/Information Collection

- Collection of male-female segregated data/information through the format as provided by Project Management Office (PCO) and PIU.
- Assembling of collected data/information.
- Send the assembled data/information to PCO and PIU.
- Assist in preparation of format containing significant indicators.

4) Monitoring and Evaluation

- Contribute in monitoring and evaluation of gender issues of ULB development
- Assist PCO and PIU in preparation and publication of annual and other reports and plan in this regard.

5) Infrastructure Development

- Pursue to include necessary facilities required for women in preparation of plan and design in order to ensure women friendly infrastructure and facilities most essential for women are implemented under the projects.
- Ensure preparation of design and implementation, operation & maintenance considering necessary facilities (toilet, waiting room, ticket counter etc.) for women in bus terminal and markets.
- Keep places reserved for shops for women in the kitchen and other markets.

6) Employment and working environment

(a) Employment

- Assist in preparation of future recruitment plan of ULB.
- Reduce the existing discrimination of male-female ratio in all works under the ULB and projects under ULB
- Engage women in construction and maintenance of ULB infrastructure
- Create opportunities to implement 'equal-wage' for equal work in case of male and female labors.
- In order to increase women employment, identify income generating activities suitable for women to engage in.

(b) Working Environment

- Keep provision of women friendly facilities (separate shades, toilets, day-care Centre) for the female laborers engaged in infrastructure construction.
- Ensure women friendly facilities (e.g. waiting room, toilets, day-care Centre etc.) in other work places.
- Maintain discipline/social safety/sexual harassment prevention.

7) Training for ULB Representatives

- Organize orientation programme on gender issues for ULB elected representatives and other officers.

- Assess training needs consisting with ULB activities.
- Assist in preparation of gender related appropriate training programmes & manual and arrange training coordinating with PCO and PIU.
- Undertake income generating training for women working under the ULB projects.

8) Participation of Females

- Ensure participation of female councilors and female officers/staff in preparation of plans for ULB development activities.
- Ensure effective participation of women at all levels of preparation and implementation of project/sub-projects.
- Ensure participation of women in CSCC and WLCC activities.
- Ensure participation of women in income generating activities.

9) Women Empowerment

- Identify the areas of women empowerment at all levels of project/sub-projects implementation.
- Provide the assistance to include one third women in formation of CSCC and 40% in formation of WLCC.
- Involve women at equal ratio in social development plan preparation, implementation and monitoring.
- Add supportive facilities for women laborers in tender documents.
- Monitor the issue of reservation of at least one post in ULB Mayor Panel for female councilor.
- Give directions by the project regarding inclusion of women in various committees of ULB
- Allocate particular places to women traders in kitchen markets and other markets constructed by the ULB.

10) Financing

- Undertake projects considering gender related activities and provision of necessary funds in this area.
- Ensure allocation of required budget considering gender related activities in level of ULB activities.

Gender Action Plan

In line with the Gender Strategy, prepared by the ULB of ISWMIP, the ULB will prepare and implement a GAP for enhancing the women's participation. The GAP of the ULB will consist of the activities under each issue of the gender strategy, indicators against each activity, timeframe for implementation of the activity and section/unit responsible for implementation of the activities. In preparation of the GAP, the PCO and the project consultants will assist ULB.

If the activities under the GAP are properly implemented, the following benefits are expected to be achieved at ULB level to achieve the goal and objectives as mentioned earlier.

- Increase positive participation of women in local administrations and decision-making process.
- Increase investment for poor and disadvantaged population (most of which are women) in target ULBs.
- Improve the lifestyle of poor citizens, particularly women and disadvantaged communities.

It is anticipated that development and implementation of appropriate GAP by the target ULBs will greatly contribute to gender mainstreaming.

The sample format of the GAP is enclosed as [Appendix V](#). This format is prepared based on the experiences of Urban Governance and Infrastructure Implementation Project (UGIIP). However, each ULB will add necessary modifications to the format according to its socioeconomic situations.

1) Gender Equality

Gender equality is the measurable equal representation of women and men. Gender equality does not imply that women and men are the same, but that they have equal value and should be accorded equal treatment.

The United Nations regards gender equality as a human right. It points out that empowering women is also an indispensable tool for advancing development and reducing poverty.

Equal pay for equal work is one of the areas where gender equality is rarely seen. All too often women are paid less than men for doing the same work. Gender equity strategy of Local Government Engineering Department (LGED) is stated in [Appendix III](#).

2) Gender Diversity

Diversity means variety. The word commonly refers to the cultural differences of social groups within the society. Diversity is also about recognizing, valuing and taking account of people's different backgrounds, skills, and experiences. But it doesn't mean the superiority of one over the other.

3) Gender Discrimination

Discrimination is an action or behavior that treats a person or group unfairly on the basis of race, minority or sex, especially against women. Gender discrimination, also known as sexual discrimination, is any action that specifically denies opportunities, privileges, or rewards to a person (or a group) because of gender. Gender discrimination denies social participation or human rights to categories of people based on injustice.

4) Women Empowerment

Empowerment refers to increasing spiritual, political, social, economic strength of individual and communities. Empowerment is the process of marginalized people -both women and men- gaining resources, confidence, self-dignity and opportunity to take control over their lives and properties. Empowerment means being able to negotiate with and influence people and institutions with power. It is also important as an individual process, but it is most powerful for collective action. Women's empowerment is essential to end gender discrimination, reduce poverty and also achieve sustainable development.

8.7.9 Preparation process of GAP

The preparation process of GAP is presented in below.

Phase I

Step 1: Formation of Gender Committee and Selection of Gender Focal Point (GFP) as described in section 8.27.13-8.27.15.

Step 2: The Gender Committee at ULB level will jointly prepare ULB Gender Strategy in line with the outline explained in section 2 of this guideline document. The draft will be reviewed and approved by the Women and Children Affairs Standing Committee of the ULB Council.

Step 3: Approval of the ULB Gender Strategy by the CSCC and the Council, and inclusion of the Gender Strategy in the PDP (Project Development Plan).

Phase 2

Step 1: Gender Committee at the ULB level will prepare the draft GAP matrix after necessary additions, exclusions and amendments with justifications in favour of revisions based on the GAP matrix as shown in [Appendix VII](#). The draft GAP matrix will be reviewed by the Women and Children Affairs Standing Committee.

Step 2: Approval of GAP by the Council and CSCC, and inclusion of the GAP in the PDP.

Step 3: The GAP to be implemented through ULB Gender Committee with assistance of project facilitators according to this guideline document. The member secretary of the Gender Committee will be responsible for operation and maintenance of the files of GAP implementation as per instructions of the mayor.

Step 4: The ULB will allocate necessary budgets for implementation of GAP and the ULB will continue such budget allocation after completion of the project.

It is worthwhile to mention that this GAP may be further updated by the ULB as and when required harmonizing with the government policy.

8.7.10 Women Development Standing Committee (WDSC)

In order to ensure women’s participation and implementation and monitoring of GAP activities, each target ULB will form a Gender Committee headed by a female Ward Councilor. The committee will coordinate gender related issues and will perform its GAP work as per the terms of reference (TOR). The Gender Committee is expected to continue its work even after the completion of the project.

The composition of the Women Development Standing Committee is presented in Table 8.7.

Table 8.7 Composition of the Gender Committee

Member	Position	Description
Female Ward Councilor	Chairperson	Subject to replacement after one or two years according to number of reserved councilors
All other female Ward Councilors	Member	
2 or 3 male Ward Councilors	Member	Subject to replacement after one or two years by rotation
Health officer/ slum development officer/ other concerned staff	Member Secretary	To be nominated by the mayor

8.7.11 Tasks of Gender Committee

- Hold regular monthly meetings and prepare minutes of the meeting.
- Monitor GAP activities, discuss problems concerned with gender mainstreaming, and assist the ULB in preparation of GAP and its inclusion in the PDP.
- Identify the issues related to gender equality, and identify the role of ULB including community, government organizations, NGOs regarding gender and GAP activities.
- Presentation of the activities of the Gender Committee in the concerned forums.
- Assist ULB in implementation and monitoring of all concerned activities described in the PDP.
- Recommend budget allocation to gender issues.

The notification about the formation of the Gender Committee including terms of reference (TOR) shall be well circulated to all the members of the committee.

8.7.12 Selection Process of Gender Focal Point (GFP)

WDSC will select a Gender Focal Point (GFP) in consultation with the mayor. The GFP should be a person with vast knowledge and experience in gender issues and women empowerment. GFP will be a member of WDSC. It should be noted that GFP should be a well-respected person regarding to his or her attitudes and polite behavior.

8.7.13 Terms of Reference of GAP

- To take a lead role for GAP preparation and follow up implementation of GAP accordingly
- To organize regular meetings of Women Development Standing Committee and preserve the meeting minutes as per GAP.
- To take initiative to observe national and international days like 8th March and Human Rights Day etc.
- To ensure gender related agenda in ULB meetings
- To ensure women representation of existing committees of ULB
- To deal with harassment issues in legal and neutral way
- To ensure the budget allocation for implementation of GAP activities

Follow-up ensuring female representation in Ward Level Coordination Committee (WLCC) and Civil Society Coordination Committee (CSCC). The gender committee shall follow-up the issue of ensuring female representatives in WLCCs and CSCC both existing and those to be established. Ensure inclusion of one third women in formation of CSCC and 40% in formation of WLCC.

8.7.14 Follow-up ensuring female representation in standing committees

The ULB shall ensure adequate representatives of women in standing committees, while such committee will be established. The ULB shall also keep provision of at least one female in the list of Panel Mayor.

8.7.15 Implementation Schedule

All activities of GAP would be included in the implementation schedule, such as, Selection of GFP, Progress sharing/quarterly meeting, Monitoring and Assessment report and Annual Report Submission. The report format is attached in **Appendix VI**.

8.7.16 Process of GAP preparation

- WDSC will collect the basic data of men women ratio by department, representation of women in decision making process, harassment issues, promotion of women staff, equalwages, representatives of different committees, maternity leave, day care Centre/ breast feeding facilities etc.
- After analyzing the data, WDSC will organize a general meeting with the head of the departments, representatives of the Standing Committees and NGO representatives. Mayor will play an advisory role for this meeting.
- Based on the data analysis, appropriate initiatives will be undertaken in the GAP in accordance with the instruction of PCO, GES and USGEAP of LGED which is attached in Appendix I and 2. Attached sample format of GAP will be followed as prescribed format.

8.7.17 Development of Gender Action Plan

Each ULB will continue to develop annual Gender Action Plan after the completion of project period. Attached GAP Matrix format will be followed during the development of action plan as shown in **Appendix VII**.

8.7.18 Allocation of Budgets

The ULB will allocate required budgets and continue to make the budget allocation for the GAP activities after completion of the project. A sample budget format attached in **Appendix VIII**.

8.7.19 Preparing progress and final report

WDSC will prepare the quarterly and annual report and meeting minutes to ULB. In this regard, GFP will play a lead role to prepare the reports. A sample report structure is attached here as **Appendix IX**.

8.8 Occupational Health and Safety Management Plan (OHSMP)

8.8.1 Health and Safety Measures During Construction

8.8.1.1 General Safety for the Workers

The contractor independently of any liability arising from the legislation shall undertake all measures, as required, to prevent accidents during construction works, as well as for the health protection and provision of first aid to employees on site. The contractor will also comply with all the relevant local regulations and provisions for ensuring health and safety during the construction phase. The works will be carried out safely and in accordance with the laws, directives and other provisions relating to health and safety of the staff.

During the construction all measures will be taken to prevent accidents to personnel and all third parties and to provide first aid to them. More specifically:

- All working positions will be equipped with drinking water and sanitation facilities (showers, toilets etc.)
- First aid stations must be available
- Positioning of signs and glowing signs which inform, warn or forbid certain actions regarding dangers in the site
- Dispensation to all staff working in the site of appropriate Personal Protection Equipment (PPE) such as helmets, goggles, masks etc.
- In case of works taking place during night, adequate lighting must be ensured in the relevant areas.

8.8.1.2 Fire Protection

For fire protection and effective response at the construction site installations and other working places, the following provisions are to be made:

- ❖ Installation of appropriate fire-fighting equipment
- ❖ Regular cleaning of sites from potentially flammable materials and proper disposal.
- ❖ No welding or other open fire activities near areas for fuel or other flammable materials storage (belonging to the worksite or other neighbouring activities).
- ❖ Safe storage of explosive materials, in accordance with relevant permits from local authorities.
- ❖ In case the use of explosives is permitted during excavation, measures are to be taken to avoid damage and accidents from the use of explosives, such as controlled blasts, explosion alarms, protective measures for adjacent installations / properties etc.

8.8.1.3 Safety Signage of Transport

Signage will be provided for works in public spaces, bearing reflecting signs. During night there will also be light signals, which will be noticeable from a distance equal to the maximum breaking distance of vehicles at the public place where the site is located. Appropriate first aid materials will be available on site.

8.8.2 Health and Safety Measures During Landfill Operation

Health and safety of workers is essential and a crucial parameter of proper landfill operation. The workers must be vaccinated as necessary (hepatitis, tetanus etc.). A work physician must be appointed by the project owner to treat workers regularly. Hot and cold water will be available at the sanitation areas, sinks and showers. Internal spaces of the administration building will be protected by appropriate screens and disinfecting mats will be placed on entrances, to avoid transfer of infectious agents by the workers' footwear. Workers will wear special clothing during work; shoes, galoshes, raincoats, helmets, gloves, masks etc., which will be washed and ironed at the site. A fully equipped first aid kit and a stretcher will be available at the locker rooms. All workers will be informed about disposal practices and operation of the landfill, including contingency situations, mainly accidents relating to biogas and leachate management.

During construction or maintenance of the AD management system, the following measures have to be taken:

- a) Workers must wear gas masks
- b) Entrance of unauthorized persons and animals must be forbidden
- c) Smoking should be prohibited in the vicinity of works

Machinery operators must take the following measures:

- Wear a safety belt.
- Avoid excessive speed.
- Keep machinery clean.
- Do not crush sealed containers.
- Do not leave machinery unattended.
- Keep the steps of the machinery clean.
- Use steps and handles of the machinery.
- Avoid driving on the side surfaces of the landfill.
- Never get on or off the machine during movement.
- Not moving over get the machinery to get off it
- Clean machinery before repair and maintenance.
- Keep a daily record of the machinery's operation.
- Always inspect machinery before the commencement of works.
- Inspect the place of works before the commencement of works.
- Keep the buckets and blades of machinery close to the ground.
- Lower buckets and blades of machinery to the ground during parking.
- Begin to operate machinery only after they are seated at the driver's seat.

Danger of explosion from Methane: During all operations in the waste front which involve digging in the waste (landfilling, drillings etc.) the area around the working front must be monitored for methane concentrations higher than the Lower Explosive Limit (LEL). LEL for any gas is the lowest concentration of that gas in air that can result in an explosion if an ignition source is present. The LEL for methane is 4.4% in air (by volume). When this critical concentration of methane is reached, we say that 100% of the LEL has been reached and that there is immediate concern that an explosion could occur, particularly if the concentration develops inside a building or other confined space where ignition sources could be present. Ignition sources could be e.g., the hitting of the blade of the

compactor on a metallic object. Usually, all operations in the landfill are stopped far below 4.4 % is reached.

8.9 Gender Based Violence (GBV) Prevention Plan

8.9.1 Introduction

Gender-based violence is a general term used to capture any type of violence that is rooted in exploiting unequal power relationships between genders. This can include gender norms and role expectations specific to a society as well as situational power imbalances and inequities. Gender-based violence can impact anyone, and can include intimate partner and family violence, elder abuse, sexual violence, stalking and human trafficking.

8.9.2 Country and Sector contexts

Women have been working in the solid waste management process for a long time. Which starts from clean houses, shopping malls, roads, bazaars, cities to rural areas. So, excluding them is almost impractical in the solid waste management process. Women have been working in the sector for a long time which is directly or indirectly enriching the economy of the country. Horizon women from the lower caste Hindu community work as sweepers in municipalities. Due to their tireless work, we urban dwellers live in a clean, pollution and odor free city. Yet we do not value them socially. Their children do not get jobs even after studying. This discrimination runs almost in the society and the country. They should be associated with gender mainstreaming. Which will play a role in the development of the project and the country's economy.

8.9.2.1 Female Labor Force Participation in Bangladesh

Bangladesh's female labor force participation (FLFP) has risen substantially yet, FLFP and quality of jobs for females are still lagging. There have been remarkable improvements in FLFP made in Bangladesh in recent decades, raising the FLFP rate from 26 percent in 2002 to 35.6 percent in 2016, benefiting from the expansion of garment manufacturing industries. Yet, by comparison, male labor force participation is much higher at over 80 percent. Moreover, the improvement in FLFP rates has hit a plateau, remaining at 36 percent in 2017. This gender disparity can be attributed to structural barriers including women's domestic burden, sex segregation in educational subject and occupation, employer discrimination, restricted mobility, limited access to trainings, lack of female friendly facilities, sexual harassment at work, limited childcare provisions. Social norms that influence and limit women's choices as well as a lack of a supportive policy environment also stunts FLFP. Moreover, female employment tends to be more concentrated in low-paid and low-productivity occupations, which are more vulnerable to technology innovation and automation in the production process. Increasing women's labor force participation and improving the quality of female employment will require more significant support for women's access to employment opportunities and high-quality skills development programs.

8.9.2.2 Gender Based Violence in Bangladesh

Violence against women (VAW) is one type of GBV which is very prevalent in Bangladesh and is often rooted in gender inequalities and harmful gender norms. VAW in Bangladesh is still very high. Report on Violence against Women (VAW) Survey 2015 jointly conducted by the Bangladesh Bureau of Statistics (BBS) and UNFPA found that 73% of married women in Bangladesh have experienced forms of violence from their husband, 55% reported forms of violence in the past 12 months, and 50% reported physical violence in their lifetime. More than 10 million Bangladeshi women experience physical or sexual violence every year. The numbers may be higher but societal stressors often prevent victims of rape and domestic abuse to step forward. Cybercrimes have added a new element to VAW. The Counter Terrorism Unit of Bangladesh Police reported a rapid rise in cases filed with their Cyber Crime Unit, (845 in 2018 up from 566 in 2017) of which 70% of the victims were women and children. The worst manifestation or existing forms of GBV is child marriage, also known as early marriage.

Child marriage and the dowry system puts girls at particular risk of sexual, physical and psychological violence throughout their lives. Bangladesh has one of the highest early marriage rates in the world at 59 percent in 2018 (UNFPA, 2019). Early marriage nearly always results in school drop-outs or from to pursuing higher education and early child birth, and is often used as a way for trafficking young girls. This is hazardous from a health perspective and is a hindrance to academic and economic development.

8.9.2.3 Status of Gender Based Violence (GBV) in subproject

Rajshahi City Corporation covers an area of 97.18 square kilometers. 520,254 peoples live in the city corporation. Gender based violence is very less here as people living now are educated, religious and aware. After discussing with the man and women sweepers of Rajshahi City Corporation and different levels of people in different parts of the city, I came to know that gender-based violence is very less here. City dwellers are also law abiding.

However, during the construction work in the landfill area, there is a possibility of sexual harassment of women workers and women of the host area due to the arrival of new workers from neighboring areas or outside areas. At that time the construction company should be aware and orientation of the new workers about the laws of Bangladesh regarding sexual harassment and its remedies.

8.9.2.4 Legal and Institutional Environment for GE and GBV Prevention

Existence of laws and regulations as well as mechanisms helps to address SEA/SH risks. Bangladesh has the following mechanisms for SEA/SH/GBV/VAC mitigation, prevention and response.

The National Women's Development Policy (NWDP), 2011 seeks to reduce violence; eliminate discrimination; increase access to education, health and employment; and address the special needs of older women, women with disabilities and women from indigenous and marginalized communities;

In early 2017, the Parliament of Bangladesh reviewed the Child Marriage Restraint Act 2016 to permit under-18 girls to be married under "special circumstances". This has raised serious concerns among women's groups and legal NGOs working in the country;

The Multi-Sectorial Program on Violence against Women (MSPVAW) is being implemented jointly by the Government of Bangladesh and Government of Denmark under the Ministry of Women and Children Affairs. The project is being carried out in collaboration with the Ministry of Law, Justice and Parliamentary Affairs, Ministry of Information, Ministry of Social Welfare, Ministry of Home Affairs, Ministry of Health and Family Welfare, Ministry of Education, Ministry of Religious Affairs, Ministry of Youth and Sports and Ministry of Local Government, Rural Development and Cooperative. One of the significant components of the program is the OCC in the Medical College Hospitals (MCHs). The OCCs provides health care, police assistance, DNA test, social services, legal assistance, psychological counseling and shelter service etc. A training module for combating VAW was developed for OCC staffs, teacher, students, health assistant, family planning officers and other professions. Another intervention set up by the MSPVAW is the National Helpline Center for violence against women, a 24-hour helpline that can be accessed from land lines and mobile numbers;

A High Court decision declared in 2009 that the sexual harassment of girls and women is illegal, and issued a set of guidelines defining sexual delinquency to prevent any kind of physical, mental or sexual harassment of women, girls and children at their workplaces, educational institutions and other public places including roads across the country;

Bangladesh's laws do address the use of corporal punishment in school settings; and in 2010 the Ministry of Education released an education circular that forbids corporal punishment in class rooms and schools. This same ban does not, however, extend to alternative care institutions, penitentiary settings or as punishment for specific criminal offenses;

Bangladesh legislated an 'ICT Act' in 2006 to combat cybercrime and online harassments. However, the provisions of this Act are quite insufficient to undertake legal measures appropriately as it does

not address gender-based violence online in a clear and effective manner. The country has also formed a 'Cybercrime Tribunal' that addresses cyber violence;

Other than NWDP, the government has enacted a number of stringent laws and policies to protect men and especially women from gender based violence (GBV) including sexual exploitation and abuse/sexual harassment (SEA/SH): The Criminal Procedure Code, 1889; The Penal Code 1860; The Evidence Act 1972; Child Marriage Restraint Act 1929; Citizenship Act 1951 (Amended 2009); Muslim Family Laws Ordinance 1961; Dowry Prohibition Act 1980; Immigration Ordinance 1982; Immigration Ordinance 1982; Family Court Ordinance 1985; Women and Children Repression Prevention Act 2000 (2003); Women and Children Repression Prevention Act 2000 (2003); Women and Children Repression Prevention Act 2000 (2003); Women and Children Repression Prevention Act 2000 (2003); Women and Children Repression Prevention Act 2000 (2003); Acid Crime Prevention Act, 2002; Acid Control Act 2002; The Bangladesh Labor Act 2006; Domestic Violence (Prevention & Protection) Act 2010; Human Trafficking Deterrence and Suppression Act, 2012; The Pornography Control Act, 2012; The Hindu Marriage Registration Act 2012. Multi-Sectorial Program on Violence against Women is being implemented jointly by the Government of Bangladesh and Government of Denmark under the Ministry of Women and Children Affairs. One of the significant components of the program is the OCC (One Stop Crisis Centre) in the Medical College Hospitals (MCHs). The OCCs provide health care, police assistance, DNA test, social services, legal assistance, psychological counseling and shelter service etc.

8.9.2.5 Potential SEA/SH Risks Assessment in the subproject Areas

Considering the cluster type of project, the project is expected to have minor labor influx. Rajshahi city corporation landfill area will construct around 16 acres. It is expected that total labor including the skilled and unskilled will not be more than 200(approx.). The number of labors is estimated maximum 100 and among the 50% will be unskilled labor. However, based on the social assessment, few GBV risk are identified as below:

- Labor/workers have lack of knowledge on national laws and policies, and actions in case of GBV issues;
- Contractors have lack of experience in management of GBV issues;
- There is significantly more male labor than female labor in the construction sector;
- Job opportunities of local women and girls are generally limited. However, with civil work in the neighborhood, they may avail job opportunities in the project area and as a result be victims of SEA and workplace SH;
- Higher wages for workers in the local community can lead to an increase in transactional sex including incidents of sex between laborers and minors;
- Civil work projects can cause shifts in power dynamics between community members and within households. Male jealousy, a key driver of GBV, can be triggered by labor influx on a project when workers are believed to be interacting with community women, or community women are getting better wages than their male members of the family. This may lead to abusive behavior within the homes of those affected by the project; and
- A male worker is sexually abused by his male or female boss or senior worker.

8.9.3 Gender Based Violence (GBV) Prevention Plan for Rajshahi City Corporation

The GBV Prevention Plan takes a comprehensive approach to include both prevention and mitigation measures as the existing policies and measures on mitigation are limited to address GBV. The proposed project involves construction work in the project implemented areas which may have the potential GBV risks, etc. sexual exploitation and abuse, workplace sexual harassment, and non-sexual exploitation and abuse. Therefore, the purpose of this action plan is to identify the issues, stakeholders, possible service providers and assess their capacity that aid in accessing grievance redressal. The action plan will focus on some corresponding mitigation measures sensitizing the communities and other stakeholders, strengthening the institutional capacities to mitigate project related potential risk of GBV in the project affected population. A survivor centric approach will be followed all through, victim/survivors' care and providing access to different referral mechanisms are considered key aspects of this plan. The approach aims to create a supportive environment in which each survivor's rights are respected and in which the person is treated with dignity and respect. The project will include a general Code of Conduct (CoC) as well as a Labor Code of Conduct (sample given in **Appendix X**), covering the GBV/SEA/SH related risks for the contractors, sub-contractors, and laborers who will be employed under the project.

Table 8.8 Table Gender Based Violence Prevention Plan

Action	Activities	Indicator	Responsibility	Risk Management
Awareness raising campaign on SEA/SH in project and trainings.	<p>Prepare relevant communication materials on GBV/SEA/SH and dissemination of these materials. Conduct 4 awareness raising workshop in the project areas:</p> <ul style="list-style-type: none"> • Develop content and conduct targeted training and orientation session; • Training/orientation sessions to sensitize on importance of addressing GBV/SEA/SH risks on the project and the mechanisms that will be implemented; • Training/orientation session to sensitize other stakeholders on the importance of addressing GBV/SEA/SH risks including cyber bullying; and • The training will be targeted at stakeholders identified in SEP. 	Communication material related to GBV/SEA/SH disseminated awareness raising campaign on GBV/SEA/SH conducted among all stakeholder's number of project actors trained and oriented on GBV/SEA/SH.	PIU, GBV/Gender specialist(s).	Monitor the activities and provide additional guidance as necessary.

Action	Activities	Indicator	Responsibility	Risk Management
Capacity building for labors, contractors, sub-contractors and stakeholders on anti GBV/harassment policies.	<p>Basic ethics and CoC; Contractors, consultants, labor, sub-contractors and community people's rights and responsibilities, positive discipline.</p> <ul style="list-style-type: none"> • Prepare Code of Conduct (CoC); • Measures for dealing with GBV, complaints and reporting mechanisms, services for survivors, referral mechanisms and redress procedures; and • Topics to be covered under the trainings can be determined through consultations on training needs. 	<ul style="list-style-type: none"> • CoC is prepared; and • All contractors, labor and relevant stakeholders are aware of the CoC. 	PIU, GBV/Gender specialist(s).	Monitor the activities and provide additional guidance as necessary.
Sensitize the LGED and PIU to the importance of addressing GBV on the project, and the mechanisms that will be Implemented.	Develop deep-dive trainings to build capacity of LGED on safeguarding mechanisms including CoC, GRM, GBV response protocols on and reporting and procedures to handle cases.	Deep-dive trainings conducted.	PIU, GBV/Gender specialist(s).	Monitor the activities and provide additional guidance as necessary.
Organize stakeholder consultations with project actors and community members to inform them properly about the potential GBV risks and project activities to address GBV related issues.	Consultations carried out with different stakeholders and local communities. Share the GBV risk of the project with the relevant stakeholders. Visibly display signs around the project site (if applicable) that signal to workers and the community that the project site is an area where GBV is prohibited.	Project actors and community members sensitized.	Contractor and PIU, GBV/Gender specialist(s).	Monitor the implementation of Stakeholder Engagement Plan.

Action	Activities	Indicator	Responsibility	Risk Management
Functionalize effective GBV GRM.	As the SEP explicitly entails addressing GBV/SEA/SH, ensure beneficiaries, community members and labor are informed of GBV grievance mechanisms. Train personnel to operate GRM i.e., proper documentation for complaint registration and management; and confidential reporting with safe and ethical documenting of GBV cases. Communicate with local service provider to provide referral and support services to survivors as per Grievance Mechanism guidance on SEA/SH.	Availability of an effective GRM with multiple channels to initiate a complaint / parallel GBV.	PIU, GBV/Gender specialist(s).	Ongoing monitoring and reporting on GRM to verify it is working as intended.
Clearly define the GBV requirements and expectations in the bidding documents for contractor.	Formulate and adopt GBV informed bidding document. Inform the contractors and provide orientation Include GBV costs in the bill of quantities.	GBV requirement and expectation are adapted in bid document.	PIU-LGED and GBV/Gender specialist(s).	Review by AIIB.
Codes of Conduct (CoC) signed and understood by all those engaged in the project directly receiving project financing.	CoC finalized and agreed on. (See Annex I for sample of code of conduct) Sensitize project related staff about CoC requirements and obligations. Ensure requirements in CoCs are clearly understood by those signing. Have CoCs signed by all those with a physical presence at the project site. Disseminate CoCs (including visual illustrations) and discuss with employees and surrounding communities.	Project-related staff trained and oriented on CoC; Project-related staff who signed CoCs.	PIU-LGED and GBV/Gender specialist(s).	Review implementation during supervision missions.
Codes of Conduct (CoC) for all laborers signed and understood.	CoC finalized and agreed on. (See Annex I for sample of code of conduct) Sensitize project related workers about CoC requirements and obligations. Ensure requirements in CoCs are clearly understood by those signing. Have CoCs signed by all those with a physical presence at the project site. Disseminate CoCs (including visual illustrations) and discuss with employees and surrounding communities.	Project-related staff trained and oriented on CoC; Project-related staff who signed CoCs.	Contractor and PIU, GBV/Gender specialist(s).	Review implementation during supervision missions.
Accountability and response framework for SEA/SH allegations related to CoC in place.	Have separate, safe and easily accessible facilities for women and men working on the site. Include security measures such as ensuring adequate security personnel. Locker rooms and/or latrines should be located in separate areas, well-lit and include the ability to be locked from the inside. Visibly display signs around the project site (if applicable) that signal to	Documentation of measures taken to reduce GBV risks.	Contractor and PIU, GBV/Gender specialist(s)	Ongoing reporting

Action	Activities	Indicator	Responsibility	Risk Management
	workers and the community that the project site is an area where GBV is prohibited.			
Undertake regular M&E of progress on GBV activities.	Conduct M&E field visits. Review quarterly the action plan and progress against indicators listed Provide quarterly report.	Successful implementation of agreed GBV Action Plan (Y/N). Quarterly report.	Contractor and PIU, GBV/Gender specialist(s).	Ongoing reporting.
Improve safety of project related civil works for labor to reduce GBV risks during construction works.	<ul style="list-style-type: none"> • Improve lighting around project area; and • Follow up refurbishment construction activities (Safely demarcated (appropriate signage, lighting) 	Clearly demarcated and well-light spaces.	PIU and contractors.	Monitor the activities and provide additional guidance as necessary.

8.9.3.1 Grievance Redress Mechanism

The PIU will use the existing GRM system with due consideration for confidentiality in case management of GBV issues. The GBV/SEA/SH allegations can be reported, just like any other project-related grievance, using a regular project-level GRM channel (**Appendix XI** for illustration). The GRM focal person of the PMU will link the complainant with the selected service provider (**Appendix XII**) who will be given responsibility to make the link between the survivor and other local service providers with the consent of the complainant, special emphasis will be given to those who are mainly active remotely in COVID situation. To make the GRM more responsive to SEA/SH and GBV issues, an information sharing protocol with GBV service providers will be developed so that survivor related information is carefully managed, and confidentiality is maintained. A response protocol, reporting of allegation procedures and response framework of the GRM is attached (**Appendix XIII**), which follow a six-step value chain (1) uptake; (2) sort and process; (3) acknowledge and follow up; (4) verify, investigate, and act; (5) monitor and evaluate; and (6) provide feedback to the complainant. To respond the COVID situation, GRM will incorporate hotlines, place community leaders and facilitate community 'help.

8.10 Waste Management Plan (WMP)

8.10.1 Introduction

Waste is inevitable because it is generated by daily human activities through discarded materials from domestic chores, agriculture, business, industry, natural and semisynthetic disasters, medical services, etc. consistent with the Bangladesh Environment Conservation Act, 1995, waste is, “any solid, liquid, gaseous, radioactive substance, the discharge, disposal, and discard of which can cause injurious changes to the environment”. Management of waste is comprised of the gathering, carrying, treating or disposal of discarded materials and substances (Unnisa & Rav, 2012).

A waste management plan is a vital roadmap for businesses across all sectors. By following a well-prepared waste management plan, businesses can cut costs and reduce their environmental impact by diverting waste from landfill. Construction and demolition businesses benefit from a plan the most.

8.10.2 Objectives

- To assess the activities involved for the proposed and determine the type, nature and estimated volumes of solid waste to be generated by the subproject activities.
- To identify any potential environmental impacts from the generation of waste in the industries and industrial zone.
- To recommend appropriate solid waste handling and disposal measures/routings in accordance with the current legislative and administrative requirements
- To reduce the generation of wastes in the first place and to re-purpose and or reuse the materials for a longer time
- Recycle the solid wastes. Wastes are resources if they are properly recycled to produce other resources like water, energy, and or other materials
- To achieve higher monetary success but not at the expense of the environment. As natural resources are used for business growth, utmost care for nature is ought to be taken.
- To improve the quality-of-life people like you and me will be able to live in a much safer environment.

8.10.3 Waste Management Plan (WMP)

A WMP initially identifies key project information such as responsible figures; clients and principle contractor, and project specifics such as cost and location. Information about waste includes:

- A description of the waste types predicted to be produced over the project, such as hazardous or controlled waste.
- An estimate of the volume of waste produced over the project.
- Description of measuring methods, i.e. X number of skips, X tonnes of waste.
- The waste management method for each waste type, from how the waste will be responsibly stored to whether waste will be reused, recycled, recovered or disposed of.
- Records of waste quantities, management and collections.

A WMP should also outline how responsible people will ensure waste is handled in effective ways and in accordance with their duty of care.

8.10.4 Waste Management Plans Required by Law

The Solid Waste Management Rules 2021 were published in Bangladesh on December 23, 2021, under the Bangladesh Environmental Protection Act, 1995 of Department of Environment (DoE). The Rules define the responsibilities of businesses involved in solid waste management and impose collection, recycling, and disposal obligations according to Extended Producer Responsibility (EPR) on manufacturers of non-biodegradable products such as glass, plastic, and bottles. The Regulations also include provisions for the treatment of solid waste such as composting and energy recovery. The Munshiganj subproject should abide by the regulation when all the Integrated Solid Waste Management Improvement activities start constructing/operating.

The main provisions of the Solid Waste Management Rules 2021 are as follows.

- When recovering resources from waste, the principles of management that consider the waste hierarchy, such as the 3Rs, segregation, and reduction, must be followed at all stages from waste generation to the final disposal.
- Responsibilities of waste generators, consumers, and users:
 - Dispose of the waste following the regulations of authorities including local government.
 - Dispose of waste separately.
 - Do not dump, store, or burn waste outdoors.
- Responsibilities of manufacturers (*not defined) and importers of products
- Collect non-biodegradable products such as glass, plastic, polyethene, multi-layered packaging, bottles, and cans from consumers and recycle or dispose of them if appropriate.
- Determine work plans and implementation procedures for recycling and disposal.
- Ensure that EPR is properly implemented.
- Submit an annual report to the Department of Environment (DOE) on the amount of plastic recycled.
- Raise public awareness of proper waste management.
- In the case of recovery from waste, taking into account the waste hierarchy, the steps of waste management should be followed in order of rejection, waste reduction, reuse, recycling, recovery, purification, and residue management.

Any violation of the above provisions shall be subject to imprisonment for not more than two years or a fine not exceeding 200,000 BDT, or both. The Regulations also include provisions for the treatment of solid waste such as composting and energy recovery.

8.10.5 Waste Management Plan Benefits

There are many advantages to having a waste management plan, especially for construction/operational subproject. Here are some of the top benefits:

Environmental consideration

When the subproject proponent and contractors know what waste will be created and how much, they can plan recycling and reuse services accordingly, ensuring waste that can be better processed,

is. This is far preferable to landfill in which greenhouse gases are created, contributing to climate change.

Effectiveness

By assessing waste volume and type prior to and continually throughout a subproject, changes can be made to orders and processes to ensure the amount of waste created is reduced. Not only will materials be used more effectively, but also less time is spent on excess materials.

Save Money

Disposing of waste at landfill can be costly, especially large amounts, so alternative management methods of recycling, reusing and recovery can save money. Additionally, by using materials more effectively and reducing the amount of waste, money is saved.

Reduce Fly-Tipping

If an effective WMP isn't in place, construction businesses or contractors may become complacent or try to cut corners in regard to waste management. Fly tipping, although a serious offence with possible fines and even prison sentences, is common for construction waste. This can have negative environmental impacts and should be avoided with proper waste management by licensed providers.



Figure 8-2: Types of Color-Coded Waste Bins

8.10.7 Proposed Solid Waste Management (SWM)

Collecting, treating, and disposing of solid material that has served its purpose or is no longer useful is discarded. SWM is also an essential service for maintaining the quality of life in Munshiganj Subproject

and for ensuring better standards of health and sanitation. If properly collected from the source, SWM would reduce the number of downstream problems related to transportation and disposal of the same.

Solid waste (SW) generated in the subproject can be broadly categorized as non-hazardous waste and hazardous waste. Munshiganj subproject will keep space for solid waste disposal and will segregate waste based on type and subproject components.

- **Construction wastes:** Plastic and paper waste, chemical & oil empty drums and cartons, glass, machine scrap, wood pieces, metal and electrical waste.
- **Domestic wastes:** kitchen and wood waste, plastic, paper, floor sweepings, etc. Road sweeping & sanitary waste: human waste, etc. Garden & agriculture waste: leaves, branches, plants etc. Roads/building construction waste: earth, asphalt, concrete, brick, plaster, wood, glass, stones etc.
- **E-Waste:** Computer systems, peripheral equipment, mobile phone sets, TVs, audio sets and also household appliances biomedical waste.

WMP of Munshiganj Subproject contains the following

- A Transfer, Storage, and Disposal Facility (TSDf) of appropriate size will be constructed within the Subproject construction area. Adequate containers will be placed in different places in each of the subproject sites for segregation and then transported to the TSDf area. It is noteworthy that only the bio-degradable wastes can be treated in the Solid Waste treatment facility.
- The entire SWM is planned to be collected and treated in the composting plant within subproject and the rejects shall be disposed to the subproject's landfill site i.e. Landfill Site of Munshiganj Municipality. A suitable area has been earmarked to handle the solid waste. All these activities are to be carried out in the TSDf area.
- Proper labelling of waste and segregation of waste needs upgrading.
- Separating store hazardous waste for disposal in hazardous waste landfills or handed over to the DoE licensed contractor for appropriate processing and disposal.
- Ensuring that waste which can be processed for recovery of material and energy does not become co-mixed with undesirable elements.
- Upgrade waste management procedures' development and proper training for the workers concerning health & safety and environmental issues (First aid, health safety, chemical handling and storage of dangerous substances) in the subproject works.
- Ensure 3R Principal and regulatory compliance.
- Waste minimization efforts based on the monitoring and analysis of segregated waste. Recycle/ reuse options after waste minimization efforts may be explored.

Table 8-9: Potentially significant Environmental Impacts during the Operational Phase and their mitigation measures

Activity/ concerned issues	Potentially significant Impacts	Proposed Mitigation Measures	Responsible Authorities	Monitoring
Disposal of waste	Improper disposal of industrial waste and raw materials may cause various hazards to the environment including a. exposure to biodegradable materials	Proper disposal of waste: The designated site should be at least 1 km away from the locality and the river bank, avoiding the area with natural vegetation. Prior permission is needed from the respective authority before selecting the site	Munshiganj Municipality	DoE

Activity/ concerned issues	Potentially significant Impacts	Proposed Mitigation Measures	Responsible Authorities	Monitoring
	<p>can produce untoward odor & bad smell that can pollute natural air, facilitate the spreading of diseases</p> <p>b. contamination of water (surface water, groundwater)</p> <p>c. waterlogging</p> <p>d. increased breeding of mosquito</p>	<ul style="list-style-type: none"> ▪ segregation of the wastes prior to disposal ▪ should be dumped in different designated landfill/pits at the dumping site after segregation of different construction materials/solid wastes ▪ all kinds of dumped waste products should be covered ▪ Proper drainage facilities should be ensured to prevent waterlogging ▪ Proper disposal of wastes and drainage of water and ensuring the cleanliness of surrounding environment ▪ water storage pool for prevention of mosquito breeding 		

8.11 Contractor Management Plan (CMP)

8.11.1 Introduction

This CMP is intended to outline the relationship between Rajshahi Subproject and the Contractors, and to describe how the overall contract will be managed (i.e. describe the Contractor management processes that will be implemented by the subproject).

In further detail, the purpose of the CMP is to:

- Summarize the Contractors' and Subcontractors' engagement and management processes, procedures and systems used;
- Define roles and responsibilities for the Beneficiary and the Contractors and its Subcontractors, as well as the relationship and cooperation between all parties, with regards to all subproject activities;
- Outline the applicable subproject Standards relevant to the Contractors and its Subcontractors;
- Set out the processes to ensure the implementation, by the Contractors and its Subcontractors, of all requirements, project commitments, conditions, methods (work statement for the construction phases), and procedures applicable to them, intended to assure the execution of the Project;
- Define training requirements;
- Establish a Grievance Mechanism about other Construction Environmental and Social Management Plans (CESMPs);
- Define monitoring and reporting procedures, including Key Performance Indicators (KPIs), to monitor the performance of the Contractors and its Subcontractors; and
- Define intervention procedures, i. e. the way LGED will liaise with the Contractors to sort out any issues, namely related with non-compliance and/or environmental and social performance.

- Contractors’ environmental, social, cultural heritage management of contractors.

Any subsequent changes to the Contractor Engagement processes may result in changes to this CMP.

8.11.2 Links to Rajshahi Subproject’s HSE Management System

The Contractors will be required to align their own HSE-MS with the subproject’s one, and to develop their own detailed Contractor’s Environmental and Social Management Plan (CESMP), including detailed topic and/or activity-specific CESMPs, based on the ESMPF and reminder Management Plans provided by LGED. This will be done through “Work statement documents”, which will be agreed with all Contractor, for each site, where will define the special conditions.

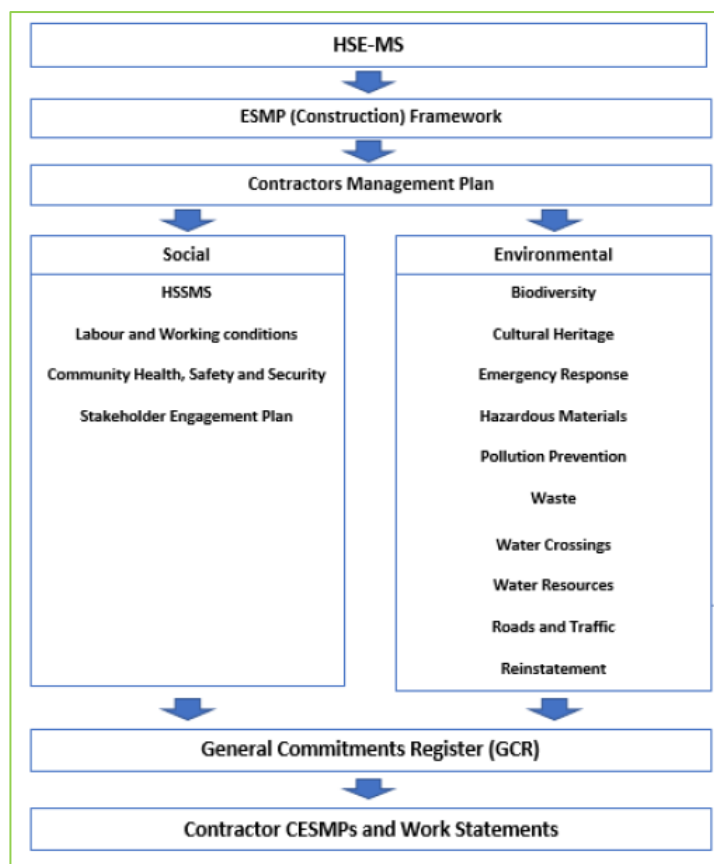


Figure 8.3 Linkage between subproject HSE-MS

8.11.3 Policies and Standards Related to Environmental and Social Safeguards

All contractors and its subcontractors are subject to the conditions and obligation set out in the national legislative framework, AIIB regulations, the Environmental and Social Safeguards (ESS), and country’s norms and procedures.

8.11.4 Application to the subproject contractors

Successful projects that involve contractors all exhibit similar characteristics. They all have clear and unambiguous contracts established that include a Statement of Work. The efforts of all contractors integrated into a cohesive project plan with all contractors understanding where their efforts fit into the overall picture. The formal and informal interfaces between the beneficiary and the contractors are documented. Before starting specific work, the contractors are granted authorization to proceed. This authorization is received, in writing, via a Work Authorization form. A formal team building process is established and implemented. These practices all contribute to reducing the risk of

misunderstandings or isolationism. Each contractor will have a legally binding, written contract that defines the following items. The legal names of the parties involved in the contract will be specified.

The scope of the contracted work (contained in an attached Statement of Work), will be described on terms of:

- ❖ a clear definition of the services to be provided by the Contractor;
- ❖ responsibilities and authority limits of each party to the contract;
- ❖ a clear definition of the deliverables and minimum content to be provided by the contractor;
- ❖ any and all constraints imposed on the Contractor by LGED., such as schedule constraints; budget constraints, specific tools to be used; and
- ❖ a clear statement of requirements for quality of deliverables and services including the requirement to allow independent quality inspections of materials and processes.

Appropriate terms and conditions, which will be impose on both LGED and the contractor, will be identified. The acceptance process will be clearly identified.

Each CESMP outlines tasks to be undertaken by both LGED and its Contractors. The Contractors themselves will be required to develop their own detailed management plans/action plans, which will reflect the commitments in this CMP and which demonstrate how they will meet these commitments. The Beneficiary will nominate the obligation of Contractor to draws the Plan and indicate models for CESMPs on “Work statement document” which will be closed with all Contractor for each site, where will define the special conditions and procedures.

8.11.5 Document Management

The LGED will provide the Contractors Management Plan with attributes for all parts, requirements for Contractors and also a Work Statement for construction phases, including models for standard documents. Contractors enter into a business partnership with Rajshahi City Corporation after bidding procedures, and will provide in legal time the integrated solution for execution phases, including the economic, environmental and social approach. Contractors will present the information for all subcontractors and the procedures for verification and validation services.

8.11.6 Contractors Engagement and Management

The CMP Plan will highlight all responsibilities, requirements and work statements that are expected of the contractors and how they will be delivered to the beneficiary. The Parties will establish contacts points to monitor actions and to correct any non-conformances. All the proposed solutions will be reported to Project Management Unit, management of change structure. This structure is responsible for decisions, under Project manager- management services approval, for drawing procedures able to be applied on all sites or on specific sites, and for updating the CESMP documents.

The approach to managing the subproject will be based on the following guiding principles:

PMU will establish on the bidding documents the conditions and obligation for Contractors;

- A Statement of Work will be drawn by the team, jointly with each Contractor taking responsibility for the services outlined in its areas of responsibility;
- Effective channels of communications will be clearly defined and established within the Statement of Work document;
- Each Contractor/Subcontractor will have its responsibilities and authority limits clearly defined in the Statement of Work;
- Each Contractor will have its deliverables and execution time identified in the Statement of Work;
- Each Contractor will have the services it is responsible for providing clearly identified and described in the Statement of Work;
- All constraints imposed on the Contractor will be clearly identify in the Statement of Work, including schedule and budget constraints;

- All environmental, social, health and safety and cultural heritage constraints imposed on the Contractor will be clearly identify in the Statement of Work;
- Each Contractor will have requirements for quality clearly identified within the Statement of Work, including the requirement to allow independent quality inspections of materials and work processes;
- All products and services provided by the subcontractor (partners of Contractor) will be subject to the acceptance of PMU;
- Each subcontract will contain appropriate terms and conditions;
- adequate facilities will be provided to meet the needs of the Contractors, and the Contractors will support subcontractors in processing invoices and payments, subject to the invoices being delivered to LGED in an acceptable format. To this end, PMU will establish format requirements for invoices in list of Standard Documents;
- the Contractors will be directly responsible for their part of the contract in relation with the subproject, even for the subcontracted parts;
- the Contractors will be obliged to contract only with solvable and reliable subcontractors, and only with the written approval issued by PMU, and
- ESU is responsible, for project management, for control and monitoring activities regarding constructors' actions and has overall responsibility for environmental, social, health and safety, and cultural heritage aspects of the project

8.11.7 Roles and Responsibilities

Delivery of the project commitments referenced in this CMP is the responsibility of both LGED and its Contractors. The specific responsibilities for implementation of the specific actions identified in the individual CESMPs are clearly distinguished between LGED and relevant Contractors in the Appendices to the CEMPs.

Table 8.10 Mapping of Functional Elements Between LGED and Contractors

Functional Element	LGED	Contractors	Subcontractors
Project Management	X		
HSSE management	X	X	
Management of change	X	X	
Technical monitoring	X	X	
Quality assurance	X	X	
Human resources ((HR) and training	X	X	X
Economic	X	X	X
Legal	X	X	
Information technology	X	X	
Communication and Public relations	X	X	
Audit	X	X	

8.11.8 Contractors' Roles and Responsibilities

Contractor's predominant responsibility will be to ensure that all their work and staff activity is compliant with the legal provision for environment, social, safety, health and the permits provided by Rajshahi City Corporation. Their responsibilities include the management of specific activities and for the surveillance of all activities on the site.

The Contractors will prepare work plans in compliance with the Project's requirements.

CESMPs to be produced by the appointed Contractor-

- ✚ Waste Management Plan (Include Hazardous Management Plan)
- ✚ Road and Traffic Management Plan
- ✚ HSSMS

- ✚ Pollution Prevention Management Plan
- ✚ Labour and Working Conditions Management Plan
- ✚ Emergency Response Management Plan
- ✚ Community Health and Safety Management Plan
- ✚ Reinstatement Management Plan

The contractors will be responsible for the Health and Safety Plan and Measures, regarding their own employees and sites conditions, as well workers' accommodation, under a risk analyze procedure, in accordance with legal provisions, advised by city corporation.

Contractors shall nominate the following employees:

- representative for site coordination;
- representatives for HSSE responsibilities;
- representatives for technical execution, budget, Project phases;
- first aid competent person;
- representative for waste management;
- team for guarding the site; and
- team responsible for intervention on accidental pollution events

Other details about Contractor's obligations related standard documents, which have to be drawn, will be nominate on bidding documentation.

Organizational Design/Human Resources. Contractors are also responsible for developing organizational and human resource elements of the solution recommended by the subproject.

8.1.1.9 Methods for Successful Contractor Management

8.1.1.9.1 Management Practices

Successful projects that involve contractors all exhibit similar characteristics. They all have clear and unambiguous contracts established that include a Statement of Work.

The efforts of all Contractors are integrated into a cohesive project plan with all Contractors understanding where their efforts fit into the overall picture.

The formal and informal interfaces between the beneficiary and the contractors will be documented.

Before starting specific work, the contractors will receive an "authorization to proceed". This authorization will be provided in writing, via a Work Authorization form. Authorization will be dependent on the completion of all necessary pre-construction surveys, the approval by LGED of Contractor CESMPs, all associated method statements relevant to the respective section and any further works LGED deem necessary prior to construction. Auditing requirements will be detailed and addressed in the plans listed in the Framework Management Plan.

A formal team building process is established and implemented.

These practices all contribute to reducing the risk of misunderstandings or isolationism.

8.1.1.9.2 Environmental and Social and Health and Safety Reporting

Each week, the Contractors will prepare and deliver to the ESU weekly progress reports on environmental, social and health and safety performance. The report is to be delivery by noon on Fridays. The report will identify:

- (i) performance against KPIs
- (ii) incidents within the period and investigation findings
- (iii) planned activities

- (iv) a textual description of progress,
- (v) a list of internal milestones attained,
- (vi) a brief description of any problems encountered

8.12 Labor Management Plan (LMP)

8.12.1 Overview of labour use on the subproject

Under the AIIB Environmental and Social Standards (ESSs), on Labor and Working Conditions Labor Management Procedures (LMP) are required to be produced. The purpose of the LMP is to facilitate planning and implementation of the project. The LMP identify the main labor requirements and risks associated with the project, and help determine the resources necessary to address project labor issues. The LMP is a living document, which is initiated early in project preparation, and is reviewed and updated throughout development and implementation of the project. The project aims at responding to urgent and critical environmental issues and minimizing/mitigating public health and environmental risks. The interventions, more specifically designed towards the management and disposal of demolition waste generated from the damaged buildings and asbestos contaminated waste, rehabilitation of damaged solid waste infrastructure and technical assistance measures for their sustainable operation. In addition to the Project Management Unit (PMU) staff who will be recruited on a part-time or full-time basis throughout the Project duration, it is estimated that around 70 workers (contracted through third parties) will be employed for implementing various Project subprojects. These workers will be local and international migrants above the age of 18. Worker distribution by activity, type, skill level and location can be found in .

Table 8.11. As for Primary supply workers, defined as those suppliers who, on an ongoing basis, provide directly to the project goods or materials essential for the core functions of the project, none have been identified at this stage. However, should any be identified at a later stage during Project implementation, this LMP should be updated accordingly.

Local Government Engineering Department (LGED) under Ministry of Local Government, Rural Development and Cooperatives (MLGRDC) has taken up a project for implementation of improved waste management “Integrated Solid Waste Management Improvement Project (ISWMIP)” at Rajshahi City Corporation funded by the Government of Bangladesh (GoB) and Asian Infrastructure Investment Bank (AIIB).

8.12.2 Subproject construction related activities

Waste Collection and Transportation. This will help improve and optimize solid waste collection and transport services in Rajshahi City Corporation, including collection containers and fleet, mechanical cleaning equipment, and transfer stations etc.

Waste Processing and Disposal Systems. This will finance prioritized waste processing and disposal infrastructure, including closure of polluted landfill sites, management of legacy waste, construction and rehabilitation of engineered sanitary landfills (standalone or regional/ clustered), and provision of facilities related to composting, resource recovery, and waste-to-energy.

8.12.3 Potential labours to be used in the subproject

Direct workers, contracted workers and community workers will be employed for the project. Two contractors may be engaged for the implementation of the project. One contractor will be engaged for construction of substations and another contractor for the construction of transmission lines. It is assumed that contractors will not start all the construction activities at the same time. Rather contractor will start work in a site and after completing each site he will start another site. Moreover,

due to the linear type of project, it is not expected that there will be high concentrate of workers at the same place and at the same time. So, no severe labor influx is expected. It is assumed that 20 labors will be required during normal operations and 30 labors will be required during peak operations. The nationality of labors during construction phase comprises of Foreign (maximum 4) and remaining from domestic. During operation phase, maximum 16 nos. of manpower would be of local (PGCB). So, it is expected that the total number of labors may not exceed 50 at any sub-project areas due to the phase wise activities. As the unskilled labors will be hired locally, no severe labor influx is expected at any time of the construction. It is assumed that about 50% of the labor will be migrant, for which accommodation will be required. The migrant workers and staff will be accommodated on-site at temporary labor camps or in rented houses in surrounding villages of the Project. Local workers will be employed for carrying out civil works and other masonry works. Setting up of labor camps is not envisaged during the construction phase of the Project. Moreover, temporary tent would be made near the towers and substations area to provide the security of construction machineries.

Table 8.11 Estimated Subproject Workers

Activity	Type of Workers	Skill Level	Estimated Number	Type/Characteristics	Location
Project Management (PMU)	Direct	Skilled	6	Supervisory Consulting / national	Landfill site
Sub-component 1.1 Waste Collection and Transportation					
Management of contaminated debris on site	Contracted	Skilled	5	Supervisory Consulting / national	Landfill site
Identification and preparation of disposal site for contaminated Construction and Demolition Waste (CDW)	Contracted	Skilled & Unskilled	15	Supervisory Consulting/ national Manual, national and international migrant Transportation (drivers) national	Quarry site
Recycling of uncontaminated CDW	Contracted	Unskilled & Skilled	20	Supervisory, national Manual, national and international migrant Transportation (drivers), national	To be decided
Sub-component 1.2 Waste Processing and Disposal Systems (Rehabilitation of severely damaged solid waste management facilities serving at landfill area)					
Assessment and rehabilitation of damaged solid waste management facilities	-	-	0	-	-
Rehabilitation process for the damaged waste management facilities	Contracted	Unskilled & Skilled	20	Supervisory, national Manual, international migrant	Facilities of landfill site
Develop a detailed rehabilitation and operational plan for landfill site facilities	-	-	0	-	-
Implementation of demonstration	Contracted	Unskilled & Skilled	10	Supervisory, national	Landfill site

Activity	Type of Workers	Skill Level	Estimated Number	Type/Characteristics	Location
pilot(s) on integrated solid waste management (ISWM)				Manual, international migrant	
Technical assistance for capacity development and public awareness	-	-	0	-	-

8.12.4 Key Labour Risk

The main labor risks identified in this subproject are associated with the Rehabilitation of Damaged Solid Waste Management Infrastructure and Management of contaminated Debris. These include:

- Disturbance of asbestos contaminated waste such as demolition work, rubble moving operations and heavy vehicular movements over contaminated waste is likely to expose operatives undertaking this work, and those in close proximity (within 20m) to the management site. Inhalation of dust, gaseous substance or aerosols from removal and transportation of asbestos material can cause serious health risks to workers.
- Occupational accidents and injuries to workers from several management activities (use of crushers and other machinery and equipment)
- Working conditions, such as excessive work hours, delayed or inadequate payment of wages and insufficient insurance coverage
- Health risks related to exposure to waste for collection, sorting, recycling and composting workers
- Accidents during removal, transportation and disposal of asbestos-contaminated waste.
- Discrimination of unequal employment opportunities likely incidents of child labour or forced labor
- Risks of labour influx and potential occurrence of gender-based violence and sexual exploitation and abuse/sexual harassment (SEA/SH) incidents
- Risks of exposure to COVID-19 contagion
- General understanding and implementation of occupation health and safety requirements
- Inadequate Grievance Mechanism (GM) to handle complaints and concerns for all the Subproject Workers.

8.13 Traffic Management Plan (TMP)

When working on roadside construction, it is important to have a traffic management plan in place to ensure the safety of both the workers and drivers in the area. A traffic management plan template can help us create a safe work zone and manage traffic flow around our construction site.

According to Safety, Health, and Welfare at Work (Construction) Regulation, to carry out any construction/maintenance work on any public roads, a contractor shall develop a traffic management plan to ensure the safety and health of the road workers and road users. A traffic management plan/temporary traffic management plan (often shortened to a “TMP” or “TTMP”) is essentially a suite of documents that give details on the proposed measures which are to be implemented to ensure the safety and integrity of the road workers and road users whilst the construction work is being carried out. These documents shall be prepared by an experienced Temporary Traffic Management Designer with a valid certificate and knowledge of the current legislation.

To ensure compliance, the Traffic Management Designer must carefully consider the characteristics of the site and develop a traffic management plan which best addresses the site constraints in a safe manner in so far as is reasonably practicable by the application of the following:

- The Traffic Signs Manual.
- Temporary Traffic Management Design Guidance.
- Temporary Traffic Management Operations.

A traffic management plan aims to promote safety and efficiency during construction activities. Having a plan can avoid potential hazards and disruptions to traffic flow. The traffic management plan should be submitted to the relevant Local Authority for approval prior to carrying out any roadworks on public roads.

8.13.1 Elements of the traffic management plan

A traffic management plan is a document that outlines the steps that a construction site needs to follow to manage the flow of traffic around a construction site safely. The plan should consider the type and location of the construction, as well as the expected traffic volume.

The traffic management plan needs to cover the design, implementation, maintenance, and removal of the temporary traffic management (often shortened to “TTM”) measures to minimize the risk of accidents while the roadworks activity is carried out. At a minimum, the traffic management plan shall address the following:

- Duration of Works
- Hours of Work
- Subproject Details
- Traffic Management System
- Traffic Management Layout/Drawing
- Phasing of Works
- Traffic Management Signage
- Speed Limits
- Road Level
- Design Parameters
- Site Access & Egress
- Communication and Emergency Procedure

The key elements of a traffic management plan template:

- **The type of construction work that will take place:** This is important information for drivers as it will help them know what to expect when traveling through the work zone.
- **The construction site’s location:** This will help drivers plan their route and avoid the construction area if possible.
- **The expected traffic volume:** This will help us determine the necessary traffic control measures.
- **A diagram of the construction site and proposed traffic flow:** This will help drivers understand the traffic control measures that are in place.
- **The contact information for the project manager:** This is important in case there are any questions or concerns about the traffic management plan.
- **The traffic control measures that will be in place:** This includes things like road closures, detours, and lane closures.
- **Proposed measures to control traffic around the construction site:**
 - *Road closures:* We may need to close a section of the road to construction traffic. This will help ensure the safety of both drivers and workers.

- Detours: We may need to set up a detour around the construction site. This will help reduce traffic congestion and allow drivers to avoid construction.
- Lane closures: We may need to close a traffic lane to construction vehicles. This will help reduce the risk of accidents and ensure the safety of both drivers and workers.
- Traffic signs: We will need to place traffic signs around the construction site. These signs will help drivers understand the traffic control measures that are in place.
- Traffic cones: We will need to place traffic cones around the construction site. These cones will help drivers understand the traffic control measures that are in place.
- Barricades: We will need to place barricades around the construction site. These barricades will help drivers understand the traffic control measures that are in place.
- **The appropriate signatures that indicate approval of the plan:** This shows that the traffic management plan has been reviewed and approved by the relevant authorities.

The traffic management plan shall be prepared according to the latest legislation and shall be included in the Safety and Health Plan of the project.

8.13.2 The Traffic Management System

A traffic management system (traffic control method) is essentially the type of traffic control measure which is to be implemented to direct vehicles and pedestrians around the works whilst ensuring the safety of road workers. Some methods of traffic control are:

- Priority
- Stop & Go
- Two-Way Traffic
- Give & Take
- Temporary Traffic Signals
- All Stop & Convoy
- Road Closure
- Lane Closures
- Semi-Static Operations
- Mobile Lane Closures

8.13.3 Layout of a temporary traffic management layout

A temporary traffic management layout (TTML) is a drawing that outlines the traffic control measures which are to be implemented and gives details on the type of control which should be implemented, safe movement of pedestrians, type of delineation device, safety barriers, etc. Contractor should produce the highest quality traffic management layouts/drawings which come with the traffic management plans and would have a guaranteed success rate of approval from the Local Authority. All temporary traffic management layouts/drawings will be easy to read by the construction workers and can be completed at any scale required by the subproject (e.g., 1:500), and with a fast turnaround time.

8.13.4 Purpose of a Traffic Management Plan

A traffic management plan aims to promote safety and efficiency during construction activities. Having a plan can avoid potential hazards and disruptions to traffic flow. A traffic management plan should consider the construction type, location, and expected traffic volume. The plan should also outline the steps to safely manage traffic flow around the construction site.

8.13.5 Benefits of Having a Traffic Management Plan Template

The construction contractors won't realize the importance of having a traffic management plan template until they need it. A traffic management plan can promote many benefits and convenience for the construction subproject.

8.13.6 Staying Organized and on Track

A traffic management plan template ensures that the construction subproject stays organized and on track. A traffic management plan can help keep track of the different elements of the construction subproject, including the construction site's location, the expected traffic volume, and the traffic control measures in place. All this information will be readily available in one place, making it easier for contractor to ensure that the construction subproject is proceeding as planned without much traffic hindrance.

8.13.7 Avoidance of Delays

Without a clear traffic management plan, the construction project will likely experience delays. This is because it will need to take the time to develop a traffic management plan on the fly, which can take away from other aspects of the construction subproject. With a traffic management plan template, contractor can develop a traffic management plan ahead of time, which will help contractor avoid any potential delays down the road.

8.13.8 Ensuring the Safety of Drivers and Workers

One of the most important benefits of having a traffic management plan is that it can help ensure the safety of the both drivers and workers. With a traffic management plan in place, we can be sure that the appropriate traffic control measures will be in place to protect both drivers and workers from accidents. This is especially important if the construction project located on a busy road. A traffic management plan can also help workers know the traffic control measures in place, which will help them stay safe while working on the construction site.

8.13.9 Reduction of Traffic Congestion

Another benefit of having a traffic management plan is that it can help reduce traffic congestion. This is because we will be able to develop a plan that includes detours and lane closures, which can help reduce the amount of traffic going through the construction site. This will help minimize the construction project's impact on the surrounding area and make it easier for drivers to get around. As we can see, a number of benefits come with having a traffic management plan template. If we are planning a construction subproject, be sure to develop a traffic management plan to help ensure the safety of both drivers and workers and to keep our project on track.

8.13.10 Construction Traffic Control Measures

A construction traffic control measures might look like the following:

- Construction work will be taking place on main street between the hours of -
- Traffic will be diverted to side streets during construction hours.
- Drivers will be advised to use caution when driving in the area and to obey all traffic laws.
- Pedestrians will be advised to use caution when walking in the area and to obey all traffic laws.
- The construction site will be marked with signs and cones.
- Traffic control measures will be in place to ensure the safety of both drivers and workers.
- These measures will be in place until the construction subproject is completed.

These are some construction traffic control measures. Site specific traffic control measures will be based on the needs of our construction subproject.

9 GRIEVANCE REDRESS MECHANISM

9.1 General

To receive and facilitate the resolution of affected peoples' concerns, complaints, and grievances about the project's environmental and social safeguards performance a Grievance Redress Mechanism (GRM) has been proposed. When and where the need arises, this mechanism will be used for addressing any complaints that may arise during the pre-construction, construction and operation of the project. The grievance mechanism is scaled to the risks and adverse impacts of the project. It will address affected people's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no costs and without retribution. It will be accessible to members of the community but also workers upon approval of the project by AIIB. The mechanism is not impeding access to the Bangladesh judicial or administrative remedies. LGED with the support of ULBs will appropriately inform the affected people about the mechanism on approval of the project.

Grievance Redress Committees (GRC) will be an instrument where the communities will exercise their basic rights of participation in the project cycle through suggestions and complaints. GRCs also be a para legal court of the sub-project at the ULB level to address local problems and complains related to social and environmental impacts as well as procurement and construction quality issues. Based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly without resorting to any expensive, time-consuming legal actions.

Project-affected-people (including workers) for the AIIB funded construction activities in the ISWMIIP project and any other stakeholder may submit comments or complaints at any time by using the project's Grievance Redress Mechanism (GRM). The overall objectives of the GRM are to:

- Provide a transparent process for timely identification and resolution of issues affecting the project and people, including issues related to the environmental impact, resettlement and compensation program.
- Strengthen accountability to beneficiaries, including project affected people.
- Compensation payment,
- Failure to fulfill commitments,
- Poor management of construction activities,
- Accidents due to inappropriate planning of sub- project implementation
- Cultural conflicts between migrant workers and local communities,
- Disturbance due to excessive noise or other nuisance during construction or operation to unfair treatment of workers or unsafe working conditions.
- GBV and gender issues
- Complain on labor influx
- Complain or comment from different public, private and international stakeholders
- Complain, comments or suggestions from various stakeholders, labors, and contractor.

The GRM will be accessible to all Internal, external, regional and international stakeholders, including affected people, workers, community members, civil society, media, vulnerable people and other interested parties. External stakeholders can use the GRM to submit complaints, feedback, queries, suggestions, or even compliments related to the overall management and implementation of the

ISWMI-AIIB project. The GRM is intended to address issues and complaints in an efficient, timely, and cost-effective manner.

9.2 Grievance Redress Mechanism Process

9.2.1 Formation of GRM

A 4 level GRM will be established to receive, evaluate and facilitate the resolution of affected people's concerns, complaints, and grievances. Level-I GRM is the most significant and AIIB's perspective effective functioning of the field level GRC is most significant. The GRM aims to provide a time bound and transparent mechanism to voice out and resolve social and environmental concerns linked to the project.

In view of this, LGED will establish a procedure to deal with and resolve any queries as well as address complaints and grievances about any irregularities in the application of the guidelines adopted in this RAP for assessment and mitigation of social and environmental impacts through grievance redress mechanism (GRM). LGED is also planning to hire a consultant to set up a cloud based multi-channeled ways to accept feedback on the draft E&S instruments. The system will be also linked with the GRM.

The GRM will deal with complaints and grievances related to both social/resettlement and environmental issues in this Project. Grievance redress committees (GRC) will be formed to receive and resolve complaints as well as grievances from aggrieved persons from the local stakeholders including the project-affected persons. LGED will provide sufficient on boarding and training for the members of the GRCs to ensure their ability to resolve grievances in an effective and efficient manner. Based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly, saving the aggrieved persons from having to resort to expensive, time-consuming legal actions. The procedure will, however, not pre-empt a person's right to go to the courts of law. There will be four-tier grievance redress mechanism; 1st at field level (Ward), 2nd ULB level, 3rd Project management level and final one is for ministry level.

The fundamental objectives of the GRM, implemented through the GRC serving as a para-legal body, are to resolve any resettlement-related grievances locally in consultation with the aggrieved party to facilitate smooth implementation of the social and environmental action plans. Another important objective is to democratize the development process at the local level and to establish accountability to the affected people. The procedures will however not a person's right to go to the courts of law anticipate. There will be four-tier grievance redress mechanism; 1st at local level (Ward level), 2nd District level, 3rd PMO (Project Management Office) level and final one is for ministry level. Level I GRM is the most significant and AIIB's perspective effective functioning of the field level GRC is most significant.

The membership of the GRCs will ensure proper presentation of complaints and grievances as well as impartial hearings and investigations, and transparent resolutions. Where grievances are among the affected persons, the membership composition of the GRCs will consider any traditional conflict resolution arrangements that communities may practice. If the aggrieved person is a female, LGED will ask the concerned female UP member (if the Sub project is located outside the ULB area) or City Corporation Ward Councilor to participate in the hearings. Members of the GRCs will be nominated by the mayor. First level GRC will be formed in the local level where community people will be able to complain /raise grievances directly to the field level project office. According to AIIB's perspective effective functioning, the field level GRM is most significant. NGO /Consulting firm together with Project Implementation Committee (PIC) will inform all affected people and local community about the project grievance Redress Mechanism in local language. This local GRC will ensure easy

accessibility by the PAPs, local communities and interested stakeholders, so that any grievances can be solved directly or within a very short period of time.

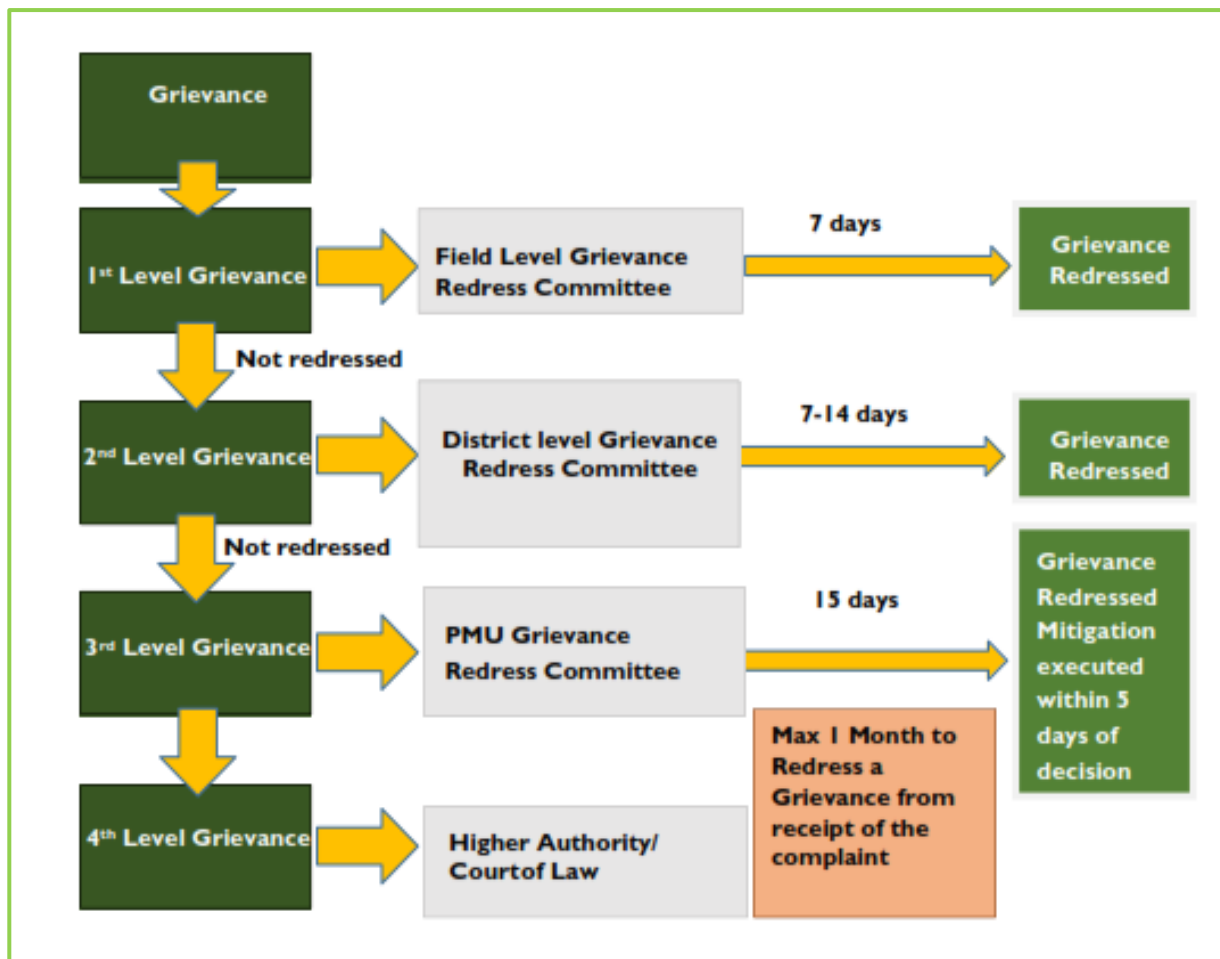


Figure 9.1 Grievance Redress Process Flow Chart

9.2.2.1 Composition of Field level GRC

Table 9.1 GRC membership at local level

SL.	Responsible persons	Position
1	Representative of the Mayor	Chairman
2	SAE of the Engineering Section of the ULB	Member Secretary
3	Social Specialist from NGO / consulting firm	Member
4	Related word Commissioner	Member
5	Teacher from Local Educational Institution	Member
6	Related female ward Councilor	Member
7	Representative from the PAP Group	Member

All complaints will be received at the Office of the XEN of the ULB. All cases at the local level will be heard within four weeks of their receipt. Grievances received through any channel will be registered and a notification of receipt with assurance of necessary review and resolution given in writing to the aggrieved persons.

9.2.2.2 Composition of District GRC

If the resolution attempt at the local level fails, the 1st level GRC will refer the complaint with the minutes of the hearings of the local GRC to district level for further review. With active assistance from the Area RP (NGO) implementing agency, the committee will decide and communicate it to the concerned GRC. Responsible staffs of ULB with the support of NGO/Consulting firm will make periodic visit to the -sub project sites, interact with the communities and affected persons, and pick up issues of concerns, complaints and suggestions to register with the GRM books. The decisions on unresolved cases will be communicated to the GRC within one week of the complaint receipt.

Table 9.2 GRC Membership at City Corporation Level

People of City Corporation	Position in GRC
1. Mayor	Chairman
2. Chief of the Engineering Section of the ULB	Member-Secretary
3. Resettlement Officer, Management Consultant/NGO)	Member
4. Concerned Ward Commissioner	Member
5. Concerned Woman Ward Commissioner	Member
6. One representative of APs	Member
7. One representative from the civil Society	Member

9.2.2.3 Composition at PMO (Project Management Office, LGED) level GRC

If a decision at district level is again found unacceptable by the aggrieved person(s), LGED can refer the case to the PIU with the minutes of the hearings at local and district levels. PD will be the convener and senior social specialist will be the member secretary at PMO level. All the unsolved cases At the PMO level,

Decisions on unresolved cases, if any, at the PMO level will be made in no more than four weeks by an official designated by the Secretary, LGRD. A decision agreed with the aggrieved person(s) at any level of hearing will be binding upon LGED. There will be budgetary allocation for local and district committee members for participating meetings and refreshments during meeting.

To ensure that grievance redress decisions are made in formal hearings and in a transparent manner, the Convener will apply the following guidelines:

- Reject a grievance redress application with any recommendations written on it by a GRC member or others such as politicians and other influential persons.
- Remove a recommendation by any person that may separately accompany the grievance redress application.
- Disqualify a GRC member who has made a recommendation on the application or separately before the formal hearing: Where a GRC member is removed, appoint another person in consultation with the Project Director.
- The Convener will also ensure strict adherence to the impact mitigation policies and guidelines adopted in this RPF and the mitigation standards, such as compensation rates established through market price surveys.

The affected persons and their communities will be informed of the project's grievance redress mechanism in open meetings at important locations and in PAP group meetings. Bangla translations of the RPF in the form of information brochures will be distributed among the affected persons. The

PAPs will also be briefed on the scope of the GRC, the procedure for lodging grievances cases and the procedure of grievance resolution at the project level.

Table 9.3 Grievance Redress Procedures for this Subproject

Step of the Procedures	Functions for Determining the Resolve of Grievance
Step-1	An AP has a grievance about any part of the Land Acquisition and Resettlement Process (LARP) and assumes/finds that it cannot be resolved.
Step-2	The AP can approach the assigned Resettlement Officer/NGO will provide clarification to the AP as per RP within one day.
Step-3	If not resolved or not satisfied with the clarification given by NGO/Resettlement Officer within two days, thus, the AP can approach to the issue before GRC in writing. Resettlement Officer/ NGO staff assist the AP in producing the complains and organize hearing within 21 (twenty-one) days/ three weeks of receiving the complaints.
Step-4	GRC will scrutinize applications to resolve the complaints and cases are referred to DC through EA (Executing Agency) if beyond their mandate.
Step-5	If within its mandate, GRC sessions will be held with the aggrieved AP, minutes are recorded. If resolved, the Project Director will approve it in writing.
Step-6	If resolved, the AP may accept GRC decision, if not, he/she may file a case to the court of law for settlement.
Step-7	The GRC minutes, approved by the Project Director, are received at the Convener's Office. The approved verdict is communicated to the complaint AP in writing.

Any grievance filed with the GRC, must be reported in the Annual report to the CSC who will then submit a consolidated report to AIIB via LGED.

First level GRC will be formed in the local level where community people will be able to complaint / raise grievances directly to the field level project office. According to AIIB's perspective effective functioning of the field level GRM is most significant. NGO /Consulting firm together with Project Implementation Committee (PIC) will inform all affected people and local community about the project Grievance Redress Mechanism in local language. This local GRC will ensure easy accessibility by the PAPs, local communities and interested stakeholders, so that any grievances can be solved directly or within a very short period of time.

The membership of the GRCs will ensure proper presentation of complaints and grievances as well as impartial hearings and investigations, and transparent resolutions. Where grievances are among the affected persons, the membership composition of the GRCs will consider any traditional conflict resolution arrangements that communities may practice. If the aggrieved person is a female, ULB will ask the concerned female City Corporation Ward Councilor to participate in the hearings. Members of the GRCs will be nominated by the mayor.

9.3 Grievance Redress Mechanism Intake Channels

If grievances are raised, there will be various options to submit grievances through mediums such as websites, emails, phones and other appropriate communication methods, which will be recorded and dealt with accordingly.

Multichannel cloud GRM system will be established taking the best examples and practices to diminish the need for Project-affected people to physically interact with Project staff. A training program will be arranged with different stakeholders on how to raise grievances during this pandemic. It will ensure:

- a. Accept, manage and respond to feedback/grievances through calls, text, social media and emails. Feedback is automatically logged and can be accessed remotely.
- b. Ready-made, off-the-shelf solution which requires minimum set-up and training to deploy and operate.
- c. It will be easier to access off/on-line with/out smart phone.
- d. It can be easily integrated with the spot.

9.4 Grievance Registry, Referral, Resolution and Appeals Process

To ensure impartiality and transparency, hearings on complaints at the GRC level will remain open to the public. The GRCs will record the details of the complaints and their resolution in a register, including intake details, resolution process and the closing procedures. LGED will maintain the three GRM books.

Registration Book: (1) Serial No., (2) Date of receipt, (3) Name of Complaint, (4) Gender, story and expectation, (5) Father or husband, (6) Complete address, (7) Main objection (loss of land /property or entitlements, (8) Decision of GRC, (9) Previous records of similar grievances

Resolution Book: (1) Serial No., (2) Case no., (3) Name of Complaint, (4) Complaint's story and expectation, (5) Date of hearing, (6) Date of field investigation (if any), (7) results of hearing and field investigation, (8) Decision of GRC, (9) Progress (Pending, solved), and (10) Agreement of commitments.

Closing Book: (1) Serial No., (2) Case no., (3) Name of Complaint, (4) Decisions and response to complaints, (5) Mode and Medium of Communication, (6) Date of closing, (7) confirmation of complaint's satisfaction, and (8) Management actions to recurrence.

9.5 GRM Monitoring and Reporting

Grievance Regulation will be a continuous process during subproject implementation. The ULBs will keep records of all resolved and unresolved complaints and grievances (one file for each case record) and make them available for review as and when asked for by IDA (International Development Association) and any other interested person/entities. The ULB will also prepare periodic reports on the grievance resolution process and publish these on their websites. LGED will consolidate reports from the ULBs on GRM and post in their website.

9.6 GRM Contact Information

Information on the project and future stakeholder engagement programs will be available on the project's website and will be posted on information boards in the project office in the site office, at the ULB office of contact regarding the stakeholder engagement program at LGED is given in the following Table 9.4:

Table 9.4 Contact regarding the stakeholder engagement program

Description	Contact details
Client:	Local Government Engineering Department (LGED)
To:	Project Director, ISWMI Project
Address:	LGED HQs, Sher-e-Bangla Nagar, Agargaon, Dhaka-1207
E-mail:	pd.iswmip@lged.gov.bd
Website:	www.lged.gov.bd
Telephone:	

9.7 Monitoring and Reporting

LGED will set up its own monitoring and evaluation (M&E) system to report quarterly involving the XENs at the District level. The RP implementing agency will primarily be responsible for collection of monitoring data on land acquisition and implementation of resettlement plans, tribal peoples plans (if any) and gender actions in the process. LGED will engage a monitoring and evaluation (M&E) consultant to assist PMO in day-to-day monitoring and management support for implementation. The DS Consultant includes a senior, experienced Resettlement Specialist who will prepare six monthly reports on monitoring of land acquisition and implementation of resettlement plans, tribal peoples plan (if any) and gender action plans in the process. The PMO will be responsible for monitoring, reporting and evaluation, including the design of the M&E system.

The LGED program intends to strengthen the GRM through information and communication technology to ensure that all complaints including those of sexual exploitation and abuse are immediately reported to the Government. LGED will integrate the GRM on a web-based dashboard, to adequately and promptly address any potential grievance related to Gender Based Violence and SEA. The complaints registered in this system will be managed by a dedicated administrator that will liaise immediately any GBV and SEA complaints with the contractors, consultant and LGED/ PIU (project Implementation Unit, ULB) for immediate measures. If the GRM receives a case on sexual exploitation and abuse related to the project, it will be recorded, and the complainant will be referred to the relevant assistance, if needed, for referral to any other service providers. The supervision consultant will keep the information confidential to protect privacy of GBV and SEA complainants. In cases, where the perpetrator(s) is linked to project activities then the contractor will take appropriate actions as per the Code of Conduct signed by the particular person and under the effective law in Bangladesh. LGED will report activities and outcomes of GBV and SEA surveillance and management to the AIIB on a regular basis.

To ensure that grievance redress decisions are made in formal hearings and in a transparent manner the Convener will apply the following guidelines:

- i. A standard application format will be used for receiving grievances which will be available at the office of INGO /Consulting firm. This application format would be concurred by the PD.
- ii. Reject a grievance redress application with any recommendations written on it by a GRC member or others such as politicians and other influential persons.
- iii. Remove a recommendation by any person that may separately accompany the grievance redress application.
- iv. Disqualify a GRC member who has made a recommendation on the application separately before the formal hearing.
- v. Where a GRC member is removed, appoint another person in consultation with the Project Director.
- vi. The Convener will also ensure strict adherence to the impact mitigation policies and guidelines adopted in this SIA and the mitigation standards, such as compensation rates

established through market price surveys.

9.8 Information Disclosure, Consultation and Participation

Prior to the start of the construction, LGED or its representative will publicize the establishments of the grievance redress steps and the process, and advertise all via contact information and the grievance redress steps posted at every UP office if any, involved, as well as at busy public places in the Project corridor. The poster(s) will be in the local language(s) and posted within 30 days of the start of construction. The LGED representative will check at least monthly to ensure that the posters are prominently displayed and provide clear contact instructions and numbers. This procedure and monitoring will be reported in the semi-annual monitoring report submitted to the AIIB.

9.9 Training

(A) Land acquisition and resettlement experience in former and ongoing projects of LGED formed the basis for RPF. LGED has prior experience of dealing with land acquisition and resettlement in compliance with on Involuntary Resettlement and on Indigenous Peoples. However, the PMU/PIU staff will be oriented on preparation of resettlement plans and implementation of them at the field level. An experienced implementing agency (or NGO) will be employed for social survey and implementation of RPs.

(B) In monitoring land acquisition and RP (and TPP, if needed) implementation activities, the LGED Land Acquisition and Resettlement Specialist (LARS) at the PMU will identify any issues that may be impeding progress and coordinate them with the PD and SMOs (Social Management Officer) for actions by the XENs at the HQ, LGED level. Jointly with the DS Design Supervision Consultant's, Resettlement Specialist, the LARS will design and conduct training of LGED field staff, especially those who will implement the project. on social safeguards compliance issues relating to involuntary resettlement and tribal peoples, as well as implementation of the various impact mitigation policies and measures adopted in this ISWMIP. Gender mainstreaming in project activities will be given special attention in all training and capacity building activities.

10 CONCLUSION AND RECOMMENDATIONS

10.1 Conclusion

The process described in this document has assessed the environmental and social impacts of all elements of the infrastructure proposed under the Rajshahi City Corporation solid waste management sub-project. Potential negative impacts were identified in relation to construction and operation of the improved infrastructure, but no impacts were identified as being due to either the sub-project design or location. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result some measures have already been included in the outline designs for the infrastructure. This means that the number of impacts and their significance has already been reduced by amending the design.

This ESIA report is prepared following the guidelines of DOE and the AIIB approved ESMPF. Regardless of these and various other actions taken during the ESIA process and in developing the subproject, there will still be impacts on the environment when the infrastructure is built and when it is operating. This is mainly because of the invasive nature of excavation work; because the secondary storage facilities (waste bins) are located in the town, some parts of which are densely populated; and because Rajshahi is an area with a rich history, in which there is a high risk that ground disturbance may uncover important remains. Because of these factors the most significant impacts are on the physical environment, the human environment, and the cultural heritage.

During the construction phase, impacts mainly will arise from the need to dispose of large quantities of waste soil produced by excavation at the landfill site. These are common impacts of construction in and around urban areas, and there are well developed methods for their mitigation. One field in which impacts are much less is archaeology, and here the land fill site being vacant city corporation land with no historical use or habitation, there will be no case of chance finds. There were limited opportunities to provide environmental enhancements, but certain measures were included. For example, it is proposed that the project will employ among the workforce people who live in the vicinity of construction sites to provide them with a short-term economic gain; and plant trees on and around completed parts of the landfill site once it is operating, to improve the appearance and provide a small ecological gain.

Once the system is operating, it will be important that Rajshahi City Corporation maintains the facilities and the waste management system as a whole in proper working order, because the city environment will deteriorate rapidly from waste accumulation if the system begins to fail. The subproject will provide capacity building, public education and financial support to ensure continuation of the operating system. If waste is collected regularly from houses and city storage bins, transferred to the landfill and treated as intended, then there should be no significant negative impacts. Even the accumulation of waste to a design height of 6 m at the landfill should not be significant as waste will be compacted and covered with soil daily and when each waste cell is completed, thus limiting pests, odour and visual impacts. There are also no residential areas nearby where people could be affected by such impacts.

The main impacts of the operating waste management system will be beneficial as the general environment of the city will improve considerably as mounds of garbage are no longer evident and the appearance, smell and public health of the area improves as a result. Some people will also gain socio-economically from being employed in companies engaged to operate the system, or in the expanded City Corporation manpower.

Mitigation will be assured by a program of environmental monitoring conducted during construction and operation to ensure that all measures are implemented, and to determine whether the

environment is protected as intended. This will include observations on- and off-site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the PMU. There will also be a longer-term survey to monitor the expected improvements in the city environment from the improved solid waste management.

Finally, stakeholders were involved in developing the ESIA through face-to-face discussions on site and a large public meeting held in the city corporation area, after which views expressed were incorporated into the ESIA and the planning and development of the subproject. The ESIA will be made available at public locations in the city and will be disclosed to a wider audience via the AIB website. The consultation process will be continued and expanded during subproject implementation, when a nationally-recognized NGO will be appointed to handle this key element to ensure that stakeholders are fully engaged in the subproject and have the opportunity to participate in its development and implementation.

10.2 Recommendations

The Project Management Unit (PMU) and Management, Design and Supervision Consultant (MDSC) will be responsible for monitoring. The MDSC will submit monthly monitoring reports to PMU and the PMU will send quarterly monitoring reports to AIB. AIB will post the environmental monitoring reports on their website. Therefore, the proposed sub-project is unlikely to cause significant adverse impacts and net environmental benefits to citizens of Rajshahi City Corporation will be positive. The potential impacts that are associated with design, construction and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures.

The ESMP of this ESIA should be site specific ESMP (SESMP) including monitoring plan. During construction, the contractor will prepare Contractor's Environmental Management Plan, which will include contractor's responsibility in implementing ESMP. The plan should be reviewed and approved by the employer at least 10 days before commencement of construction.

A copy of the ESMP shall be kept on-site during the construction period at all times. The ESMP shall be made binding on the contractor operating on the site, and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set out in this document shall constitute a failure in compliance.

LGED has fully endorsed the ESMP and is committed to implement all the mitigation measures. Rajshahi City Corporation will also ensure that the work is carried out in an environmentally acceptable manner and the monitoring and reporting are completed in a compliant and timely fashion, acceptable to DOE.

As per Government of Bangladesh ECA, 1995 and ECR, 2023, the sub-project is categorized as "red"; and ECC must be obtained from DoE.

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Appendix I: Field Environmental and Social Assessment Checklist of Rajshahi City

A. Project Siting

SCREENING QUESTIONS	Yes	No	REMARKS
Disposal site adjacent to			
1. Environmentally sensitive areas		✓	
2. Cultural heritage site		✓	
3. Protected Area		✓	
4. Wetland	✓		3 ponds used for fish farming located close to the disposal site
5. Mangrove		✓	
6. Estuarine		✓	
7. Buffer zone of protected area		✓	
8. Special area for protecting biodiversity		✓	
9. Bay		✓	
10. Ecological Critical Area (ECA)		✓	

B. Baseline Scenario

SCREENING QUESTIONS	Yes	No	REMARKS
B1. Primary collection			
• Practice of door-to-door collection system	✓		Around 80% waste collected
• Collection of waste daily	✓		Collection starts from 3:30 pm
• Service users willful to pay for waste collection		✓	No payment is taken for waste collection
• Collection of medical waste	✓		Collected by Prism Bangladesh Foundation
• People informed of difference among organic, inorganic, and hazardous waste		✓	
• Haphazard discharge of waste to roadside, drain, water bodies	✓		Portion is low
• Practice of curbside collection		✓	
• Service users currently satisfied with their existing solid waste collection points	✓		
• Service users aware of the need to manage solid waste better		✓	

SCREENING QUESTIONS	Yes	No	REMARKS
<ul style="list-style-type: none"> Health hazards to waste collectors 	✓		Waste collectors frequently affected by tuberculosis
B2. Secondary collection and transport			
<ul style="list-style-type: none"> Existence of secondary transfer stations 	✓		Total 21 STSs operating
<ul style="list-style-type: none"> Sufficient number of secondary transfer stations 		✓	
<ul style="list-style-type: none"> Traffic accident due to frequent movement of vehicle 	✓		
<ul style="list-style-type: none"> Impacts associated with transport of wastes to the disposal site 	✓		Wastes are collected in open van which emit noxious odor to surroundings
B3. Processing (resource recovery)			
<ul style="list-style-type: none"> Provision of segregation 	✓		Only medical waste
<ul style="list-style-type: none"> Use of PPE for workers 	✓		Workers are being provided hand gloves, musk, gumboot.
<ul style="list-style-type: none"> Employment of child labor 		✓	
<ul style="list-style-type: none"> Any social groups or poor neighborhoods consistently excluded from the formal solid waste service 		✓	
B4. Disposal			
<ul style="list-style-type: none"> Impairment of historical/cultural monuments/areas and loss/damage to these site 		✓	
<ul style="list-style-type: none"> Degradation of aesthetic and property value loss 		✓	
<ul style="list-style-type: none"> Nuisance to neighboring areas due to foul odor and influx of insects, rodents, etc. 		✓	
<ul style="list-style-type: none"> Public health hazards from odor, smoke from fire, and diseases transmitted by flies, insects, birds and rats 	✓		Waste pickers reside nearby the disposal site
<ul style="list-style-type: none"> Contamination of ground and/or surface water by leachate from land disposal system 	✓		
<ul style="list-style-type: none"> Soil contamination by heavy metals 	✓		As hazardous wastes are not segregated, possibility of heavy metal contamination
<ul style="list-style-type: none"> Adequate buffer zone around landfill site to alleviate nuisances 	✓		
<ul style="list-style-type: none"> Institutional and financial capabilities of the municipalities for the management of the landfill operation 	✓		The ULB has separate conservancy department
<ul style="list-style-type: none"> Explosion of toxic response from accumulated landfill gas in buildings 		✓	
<ul style="list-style-type: none"> Disturbance or reduction of agricultural production due to uncontrolled waste disposal 		✓	
<ul style="list-style-type: none"> Complain from neighborhood residents 		✓	There is no household around the site; few temporary sheds of

SCREENING QUESTIONS	Yes	No	REMARKS
			waste picker community
• Political or ethnic issues associated with sharing waste disposal site		✓	
• Practice of coping mechanisms (community support, safety nets, insurance mechanisms) used by workers		✓	
• Contamination of air quality from incineration	✓		
• Health and safety hazards to workers from toxic gases and hazardous materials in the site	✓		As hazardous materials are not separated, workers are vulnerable to health and safety risks

C. Construction

SCREENING QUESTIONS	Yes	No	REMARKS
• Land use conflicts		✓	The site is already been used as disposal site
• Issues of land acquisition		✓	
• Dislocation or involuntary resettlement of people		✓	
• Risk to occupational health & safety	✓		There is potential threat to the workers if proper safety measures are not taken
• Disruption of natural land contours and vegetation due to material extraction		✓	There is no vegetation cover
• Soil disturbance due to construction activities	✓		Possibility of soil erosion and contamination if there is provision of soil management
• Noise pollution due to vehicular movement and heavy construction works		✓	There is no settlement exist around the dumping site
• Dust pollution/ air quality deterioration	✓		
• Pollution of surface and/or groundwater due to leachate from construction materials	✓		Pollution to nearby ponds
• Vegetation clearance/tree felling		✓	No trees or vegetation cover
• Threat or disturbance to local biodiversity		✓	
• Discharge or dispose of hazardous materials		✓	
• Community diseases from labor camp		✓	
• Violation of COVID-19 protocol because of labor camp		✓	
• Gender violence in labor management		✓	

SCREENING QUESTIONS	Yes	No	REMARKS
• Requirement for construction new road or repair existing road		✓	
• Traffic congestion/road accidents due to transporting construction materials to the site			

D. Operation

SCREENING QUESTIONS	Yes	No	REMARKS
D1. Primary collection			
• Provision of door-to-door collection system	✓		
• Provision of curbside collection	✓		
• Provision of source segregation	✓		Different colors of waste bin would be provided to the households for different types of wastes
• Collection of medical waste	✓		
• Affect waste pickers to their income	✓		Livelihood of waste picker community might be hampered
• Impacts associated with waste collection system	✓		
D2. Secondary collection and transport			
• Provision of secondary transfer stations	✓		Number of STSs can be increased if necessary
• Impacts associated with transport of wastes to the disposal site		✓	
D3. Processing (Resource recovery)			
• Provision of segregation	✓		After source separation there will be a provision of further segregation, it different types of wastes are mixed
• Use of PPE for workers	✓		Proper PPE should have to be ensured for the waste workers
• Employment of child labor		✓	Bangladesh Labor Act 2006 should have to be followed strictly
• Nuisance to neighboring areas due to foul odor and influx of insects, rodents, etc.		✓	As there are no significant numbers of settlements, with sufficient buffer zone and proper mitigation

SCREENING QUESTIONS	Yes	No	REMARKS
			action the nuisance can be avoided
• Recycling and reuse of plastic and other inorganic wastes	✓		
• Treatment and management of medical waste	✓		
• Reuse and disposal of compost	✓		
D4. Disposal			
• Impairment of historical/cultural monuments/areas and loss/damage to these site		✓	There is no such infrastructure exist around the site
• Degradation of aesthetic and property value loss		✓	
• Nuisance to neighboring areas due to foul odor and influx of insects, rodents, etc.		✓	As there is no significant numbers of settlements, with sufficient buffer zone and proper mitigation action the nuisance can be avoided
• Public health hazards from odor, smoke from fire, and diseases transmitted by flies, insects, birds and rats		✓	with sufficient buffer zone and proper mitigation action the hazard can be avoided
• Contamination of ground and/or surface water by leachate from land disposal system		✓	
• Soil contamination by heavy metals		✓	
• Adequate buffer zone around landfill site to alleviate nuisances		✓	
• Development of intuitional efficiency of the municipality to operate the waste management facilities		✓	
• Contamination of air quality from incineration		✓	
• Health and safety hazards to workers from toxic gases and hazardous materials in the site		✓	
• Increase of vehicular movement and traffic congestion	✓		There is a possibility that traffic volume may increase due to transporting waste

Appendix II: Gender Equity Strategy of LGED

a. Summary

The LGED's Gender Equity Strategy (GES) identified nine (9) strategic issues to be addressed in the respective sector wise gender action plans. The strategic issues are discussed hereunder.

(1) Policy adoption

All sectors, units and projects of the LGED shall prepare their own gender action plan and implementation guidelines in accordance with the Gender Equity Strategy of the LGED. The gender action plans and implementation guidelines will be reviewed by the gender and development forum (GDF) of the LGED, and revised where necessary

(2) Institutional arrangement

A gender and development forum (GDF) is established in the LGED as the main executive body for the implementation of the Gender Equity Strategy. For the sake of good governance, the GDF shall have a written or specific constitution and operation manual/bylaws. Every units and projects of the LGED shall prepare their own action plans where the GDF shall provide required advice and guidance. The GDF shall review all gender-related documents including each action plan, and coordinate with all sections and units of the LGED, and establish required communication for all gender related activities.

(3) Data/information collection, monitoring and evaluation

Irrespective of sources of spheres and activities, collected data and information at all level and all projects shall be gender disaggregated (gender sensitive). In this case, format prepared by the GDF containing key indicators shall be used. The respective project can use any other format with different indicators to meet the project requirement. Collected data/information shall be sent to GDF bi-annually. Based on this information/data, the GDF shall prepare database, through which all gender-related matters shall be monitored and evaluated. At the same time, GDF shall prepare and publish annual and any other reports using this information and shall prepare plans relevant to this. Special attention shall be given to ensure use of information technology in all respects.

(4) Infrastructure development

The infrastructure to be constructed by the LGED shall be gender-friendly. For this purpose, it is to be ensured that the separate essential facilities in all infrastructures have been incorporated in design and drawing and implemented strictly in accordance with the provision of the plan. Planning and design unit shall take necessary measures.

(5) Employment and working-environment

(a) Employment

An action plan shall have to be prepared for future employment in LGED with a view to reduce the existing difference of men and women ratio at work. In this case, the works which are more suitable for the women and the posts for those works can be kept reserved for them at higher ratio. Similar approaches may be adopted in case of employment opportunities created for development works. At the same time, needs-based training and other allied facilities may be increased so that women can acquire skills within a short time in their work fields, including self-employment. Necessary measures have to be taken for increased employment of women in development works and in establishment of equity in wages.

(b) Working-environment

Measures have to be taken to improve working environments for women in the LGED in possible areas where there is scope for such improvement.

There shall be an “internal review and resolving/mitigation committee (IRRC)” under the supervision of the GDF, which will review physical, mental and sexual harassment of personnel and beneficiary women at work places. If there is such occurrence, the IRRC will analyze the complaints of the aggrieved person as per prevailing national laws. The committee will cooperate so that the aggrieved person can receive help from the proper legal assistance as per prevailing national laws.

(1) Training

After identifying expandable working fields for women, the provision of necessary training to them shall be ensured. Gender sensitive training needs shall be identified in conformity with LGED’s activities, and potential human resources will be developed by imparting training on management including training on gender and capacity building by expert trainers.

(2) Participation

The active participation by women shall be ensured in all fields. GDF shall play the lead role in ensuring women’s active participation by establishing appropriate environments and providing strategic directives.

(3) Empowerment

Areas for women’s empowerment at all levels of LGED (e.g. training, information and technology, income, heredity, loan, right of full control on achieved assets) shall be identified and their ratio of inclusion will be decided through proper analysis of appropriateness. At the same time, priority shall be given to the selection/placement of women at a considerable rate for ensuring active and effective representation in the decision-making process at all levels particularly for any organization/committee/group. Where applicable, it can be clearly mentioned in project documents or additions made during implementation at a considerable rate for selection/placement of women. In all cases, matters related to allied facilities, creation of scope, provision of equal wages, security etc. shall be given special attention; and to ensure those issues, necessary criteria shall be incorporated in any project agreement or tender documents fixed.

(4) Financing

LGED’s planning and administration unit shall adopt necessary measures to ensure regular fundflow from the government and development partners for the preparation of gender sensitive budgets and their implementation after identifying fund allocation/areas demanding finance for implementation of the gender equity strategy and its institutionalization agenda.

In order to develop gender-sensitive human resources at all sectors and in all activities of LGED, allocated budgets for training in the Annual Development Programme (ADP) shall be distributed proportionately for gender-related training through the LGED training unit.

While formulating a project, necessary budget provisions shall be made for undertaking gender-related activities. Projects shall have to be prepared in cooperation with the government and development partners keeping budget provision in favor of GDF, and also while conducting study/evaluations.

Appendix III: Urban Sector Gender Equity Action Plan of LGED

Summary (Sample)

ISWMIP is related to the urban sector, the Urban Sector Gender Equity Action Plan (USGEAP), the latest set of activities of urban gender equity which was finalized on 17 July 2013 by the LGED, are highlighted below as a reference.

(1) Policy adoption

- Preparation of gender equity action plan of urban sector based on the gender equity action plan of LGED, which was prepared following the national women development policy- time frame: by June 2013.
- Preparation of implementation guideline for gender equity action plan of urban sector and implement accordingly- time frame: by December 2013.
- Contribute in review of LGED gender equity strategies subject to any amendments of national women development policy 2011- time frame: as applicable.
- Review and evaluate the gender equity action plan of urban sector and implementation guideline- time frame: as applicable.
- Update the gender equity action plan of urban sector and implementation guideline - time frame: as applicable.

(2) Institutional arrangement

- Create a permanent post of gender development officer in urban governance unit.
- Specify the respective local government institution and project based focal point-time frame: by June 2013
- Contribute in preparation of the constitution and bylaws of LGED gender development forum- time frame: as applicable.

(3) Data/information collection, monitoring and evaluation

(a) Data/information collection

- Collection of male-female segregated data/information through the format as developed by gender development forum- time frame: twice in a year.
- Assembling of collected data/information- time frame: twice in a year.
- Send the assembled data/information to forum- time frame: twice in a year.
- Assist in preparation of format containing significant indicators by gender forum-timeframe: as applicable.

(b) Monitoring and evaluation

- Contribute in monitoring and evaluation of gender issues of urban development sector to be done by gender development forum- time frame: as applicable.
- Assist gender development forum in preparation and publication of annual or other reports and plan in this regard- time frame: as applicable.

(4) Infrastructure development

- Include necessary facilities required for women in preparation of plan & design in order to ensure women friendly infrastructure and facilities most essential for women to be implemented under the projects- time frame: shall continue.
- Ensure preparation of design and implementation, operation & maintenance considering necessary facilities (toilet, waiting room, ticket counter etc.) for women in bus terminal

and markets- time frame: shall continue.

- Keep the places reserved for shops for women in the kitchen and other markets-~~time~~ shall continue.

(5) Employment and working-environment

(a) Employment

- Assist in preparation of future recruitment plan of LGED- time frame: as applicable.
- Reduce the existing discrimination of male-female ratio in all works under the projects- time frame: shall continue.
- Engage women in construction of LGED and ULB infrastructure- time frame: shall continue.
- Create opportunities to implement 'equal-wage' for equal work in case of male and female laborers time frame: shall continue.
- In order to increase women employment, identify income generating activities suitable for them to engage them- time frame: shall continue.

(b) Working-environment

- Keep provision of women friendly facilities (separate shades, toilets, day-care) for the female laborers engaged in infrastructure construction- time frame: shall continue.
- Ensure women friendly facilities (e.g. waiting room, toilets, day-care centre etc.) in other work places- time frame: shall continue.
- Implement LGED guidelines on maintaining discipline/social safety/sexual harassment prevention- time frame: shall continue.

(6) Training

- Organize orientation programme on gender issues for urban sector Project Directors, Deputy Project Directors and other officers- time frame: shall continue.
- Assess training needs consisting with urban development sector activities- time frame: shall continue.
- Preparation of gender related appropriate training programme & manual and arrange training coordinating with LGED's training programme- time frame: shall continue.
- Organize trainers group having special knowledge on "gender equity"- time frame: shall continue.
- Include gender related issues in relevant training of urban sector- time frame: by December 2013.
- Undertake income generating training for women working under the project- time frame: shall continue.

(7) Participation

- Ensure participation of female councilors and female officers/staff in preparation of plans for ULB development activities- time frame: shall continue.
- Ensure effective participation at all levels of preparation of project/sub-projects-~~time~~ shall continue.
- Keep opportunities for more participation of women in project/sub-projects implementation- time frame: shall continue.
- Ensure participation of women in income generating activities- time frame: shall continue.

(8) Empowerment

- Identify the areas of women empowerment at all levels of project/sub-projects implementation.
- Provide project assistance to include one third women in formation of CSCC and 40% in formation of WLCC- time frame: shall continue.
- Involve women at equally ratio in social development plan preparation, implementation and monitoring- time frame: shall continue.
- Add supportive facilities for women laborers in tender documents- time frame: shall continue.
- Monitor the issue of reservation at least one post in ULB Mayor Panel for female councilor- time frame: shall continue.
- Give directions by the project regarding inclusion of women in various committees of UB time frame: shall continue.
- Allocate particular places to women traders in kitchen markets and other markets– time frame shall continue.

(9) Financing

- Formulate projects with support from government and development partners considering gender related activities and provision of necessary funds on this area- time frame: shall continue.
- Ensure allocation of required budget considering gender related activities in all components of project- time frame: shall continue.

Appendix IV: Sample format of the Gender Action Plan

Activities under the gender strategies	Indicators	Time-frame	Responsibility	Assumptions/ Comments
1. Policy Adoption	-----	-----	CEO/ PCO, PIU,	
2. Institutional Arrangement	-----	-----	Mayor/PCO/	
3. Data/ Information collection, Monitoring & Evaluation	-----	-----	The Gender Committee(Social Welfare and the Community Center Standing Committee), /PCO	
3.a Data / Information collection				
3.b Monitoring and Evaluation	-----	-----	The Gender Committee (Social Welfare and Community Center Standing Committee)	
4. Infrastructure Development	-----	-----	SE, PCO, Design Unit	
5 Employment and Working Environment	-----	-----		
5 (a) Employment	-----	-----	CEO, PIU, Social Development Consultant	
5(b) Working Environment	-----	-----	GFP, PCO, Social Development Consultant	

Activities under the gender strategies	Indicators	Time-frame	Responsibility	Assumptions/ Comments
6. Training	-----	-----	The Gender Committee(Social Welfare and	
			Community Center Standing Committee), Social Development Consultant	
7.Participation	-----	-----	The Gender Committee(Social Welfare and the Community Center Standing Committee)	
8. Empowerment	-----	-----	The Gender Committee(Social Welfare and the Community Center Standing Committee)	
9.Financing	-----	-----	PCO, PIU, GFP	

Checked by Project Director:

Approved by Mayor:

Appendix V: Sample Implementation Schedule (Gantt chart)

SL	Actions	Person in charge	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	<<Example>>													
	Selection of GFP													
	Progress sharing/quarterly meeting													
	Monitoring and Assessment report													
	Annual Report submission													
	Training on Gender Equality for staffs													
	International women Day observation													
	Observe International Day for the Elimination of Violence Against women and Human rights day													
	Produce IEC materials													

Appendix VI: Gender Action Plan of ISWMIP (Sample)

Activities under the gender strategies	Indicators	Time - frame	Responsibility	Assumption s/ Comments
1. Policy Adoption				
1.1 Preparation of ISWMIP's Gender Equity Action Plan on the basis of Urban Sector's Gender Equity Action Plan and LGED's Gender Equity Strategy, which is prepared based on National Women Development Policy 2011	ISWMIP's Gender Equity Action Plan is prepared	February	PCO/PIU/Social Development consultant	
1.2 Preparation of implementation guideline for ISWMIP's Gender Equity Action Plan and implementation.	Implementation guideline is prepared	February	PCO/PIU/Social Development consultant	
1.3 Review and evaluate ISWMIP's Gender Equity Action Plan and implementation guideline	Review and evaluation is done	June	PCO/PIU/Social Development consultant	
1.4 Updating of ISWMIP's Gender Equity Action Plan and implementation guideline	Action Plan and implementation guideline is updated	June	PCO/PIU/Social Development consultant	
2. Institutional Arrangement				
2.1 Select PCO and PIU based Gender Focal Point	Number of Focal Point	June	PCO/PIU/social Development consultant	
2.2 Select CSCC and WLCC based Gender Focal Point	Number of Focal Point	June	PIU/Social Development consultant	
2.3 Formation of Gender Committees headed by the Female Ward Councilor in all participating ULB	<ul style="list-style-type: none"> • Gender Committees established • Date of gender committee formed 	June	PIU/Social Development consultant	

Activities under the gender strategies	Indicators	Time - frame	Responsibility	Assumption s/ Comments
2.4 Hold quarterly meeting of Gender Focal Point and Gender Committee	Number and date of meeting held	Continue	PCO/PIU/Social Development consultant	
2.5 Prepare and update Gender Action Plan (GAP) and include in ULB Development Plan (PDP)	Prepared and updated GAP and included in PDP	June	PCO/PIU/Social Development consultant	
2.6 Maintain horizontal and vertical linkage on gender related issues through participating/inviting workshop/meetings/training/ campaign etc.	<ul style="list-style-type: none"> • Number of events held • Number of invitees • Number of participants from ULB 	Continue	PIU/Social Development consultant	
2.7 Ensure equal services to women extended by women	<ul style="list-style-type: none"> • Number of women received services 	Continue	PIU/social Development consultant	
2.8 Undertake programmes (rally, distribution of leaflets, workshop/seminar/discussion meetings, publications through electronic and print media etc.) for raising awareness on gender equity strategies	<ul style="list-style-type: none"> • Number of rally held • Number of leaflets • Number of other events 	Continue	PIU/Social Development consultant	
Data/Information Collection, Monitoring & Evaluation				
2.9 Data/Information Collection				
2.9.1 Collection of gender segregated data/Information through the format as prepared by the project as well as by Gender and Development Forum (GDF)	Data/Information collected	Twice in a year	PCO/PIU/Social development consultant	
2.9.2 Analysing of collected data/Information	Data/Information analysed	Twice in a year	PCO/PIU/Social Development consultant	
2.9.3 Prepare report on the analysed data/Information to PCO and GDF respectively	Report prepared	Twice in a year	PCO/PIU/Social Development consultant	

Activities under the gender strategies	Indicators	Time - frame	Responsibility	Assumption s/ Comments
2.9.4 Send the report on the analysed data/Information to PCO and GDF respectively and to other concerned authority.	Report sent	Twice in a year	PCO/PIU/Social Development consultant	
2.10 Monitoring & Evaluation				
2.10.1 Contribute in monitoring & evaluation (M&E) of gender related issues of the project and assist in M & E while conducted by GDF, PCO & PIU	Contributed in monitoring & evaluation	As applicable	PCO/PIU/Social Development consultant	
2.10.2 Assist in preparation, publish of annual or other reports with specific recommendation and preparation of relevant plans accordingly	Assisted in preparation, publish of annual or other reports and preparation of plans	As applicable	PCO/PIU/Social Development consultant	
3. Infrastructure Development				
3.1 Inclusion of facilities (toilet, waiting room, prayer room, ticket counter, drinking water, day care centre etc.) required for women in preparation of planning and design the infrastructure to be built under the project, where applicable to make such infrastructure women friendly and ensure most essential facilities for women	Number of facilities for women in planning & design of infrastructure development	Continue	PCO/design unit	
3.2 Preparations of design considering facilities (toilet, waiting room, prayer room, ticket counter, drinking water etc.) required for women in bus terminal and market and ensure implementation, operation & maintenance.	Number of infrastructures included required facilities; Ensured operation & maintenance	Continue	PCO/PIU/Social Development consultant	
3.3 Keep space/shops earmarked for women traders in kitchen market and other markets	Number of shops earmarked for women traders	Continue	PCO/PIU/Social Development consultant	
3.4 Ensure implementation of the facilities	Number of facilities implemented	Continue	PCO/PIU/Social Development	

Activities under the gender strategies	Indicators	Time - frame	Responsibility	Assumption s/ Comments
			consultant	
3.5 Ensure proper operation and maintenance to keep the facilities usable around the year	Number of facilities that ensured O&M	Continue	PCO/PIU/Social Development consultant	
4. Employment and Working Environment				
4.1 Employment				
4.1.1 Assist in preparation of future recruitment plan of ULB in order to minimise the gap of male-female ratio of the employed ULB staff	Assisted in preparation of recruitment plan	If applicable	PIU	
4.1.2 Identify existing discriminations of male-female ratio in all works under the project and assist to reduce such discriminations	male-female ratio	Continue	PCO/PIU/Social Development consultant	
4.1.3 Inclusion of women in infrastructure construction by the project at least by 20%	<ul style="list-style-type: none"> Number of women engaged male-female ratio 	Continue	PCO/PIU/Social Development consultant	Impose condition in tender document
4.1.4 Create opportunities to implement 'equal-wage' for equal work in case of male and female labour.	<ul style="list-style-type: none"> male-female wage ratio 	Continue	PCO/PIU/Social Development consultant	Impose condition in tender document
4.1.5 Include the gender sensitive clause on women employment in the tender document for contractor to ensure effective implementation and discuss the issue in pre-bid meeting	Gender sensitive clause included	Continue	PCO/PIU/Social Development consultant	Impose condition in tender document
4.1.6 In order to increase women employment, identify suitable income generating activities to engage them	Number of women engaged in identified activities	Continue	PCO/PIU/Social Development consultant	
4.2 Working Environment				

Activities under the gender strategies	Indicators	Time - frame	Responsibility	Assumption s/ Comments
4.2.1 Keep provision of women friendly facilities (separate shades, toilets, day-care) for the female labourers engaged in infrastructure construction	Number of workshaving women supportive facilities	Continue	PCO/PIU/Social Development consultant	Impose condition in tender document
4.2.2 Ensure women friendly facilities (e.g. waiting room, toilets, day-care centre etc.) in other work places	Number of work places ensured women supportive facilities	Continue	PCO/PIU/Social Development consultant	Necessary action to be taken based on the evaluation of facilities
4.2.3 Take necessary measures for maintaining discipline/social safety/ sexual harassment prevention	Implemented necessary measures	Continue	PCO/PIU/Social Development consultant	
4.2.4 Include the gender sensitive clause for maintaining working environment in the tender document for contractor to ensure effective implementation and discuss the issue in pre-bid meeting	Gender sensitive clause included	Continue	PCO/PIU/Social Development consultant	
5. Training				
5.1 Assess training needs corresponding with ISWMIP provision	Training need assessed	Continue	PCO/PIU/Social Development consultant	Need to emphasis on balanced opportunities
5.2 Preparation of gender related appropriate training programme & manual and arrange training coordinating with LGED's training programme	Training programme is prepared, Number of manuals, Number of completed training	Continue	PCO/PIU/Social Development consultant/ Training Unit	Subject based training manual to be prepared
5.3 Organize trainers group having special knowledge on "gender equity" and gender action plan	Trainers group is organized and number of trainer	Continue	PCO/PIU/Social Development consultant/ Training Unit	

Activities under the gender strategies	Indicators	Time - frame	Responsibility	Assumption s/ Comments
5.4 Include gender related issues in each relevant training of ISWMIP as stipulated in DPP	Number of training courses included gender related issues	February	PCO/PIU/Social Development consultant/ Training Unit	
5.5 Consider the gender issue in selection of trainees for the training of ISWMIP	% of women trainees	February	PCO/PIU/Social Development consultant/ Training Unit	
5.6 Undertake income generating training (tailoring, vegetable gardening, poultry & livestock rearing & vaccination etc.) for women working under the project	Number of women participated in income generating training	Continue	PCO/PIU/Social Development consultant/ Training Unit	Income generating training manual to be prepared
6. Participation				
6.1 Identify the area and scope of women participation (various committee, training & exposure visit, sub-project identification, planning, implementation and O & M)	Number of participated women	Continue	PCO/PIU/Social Development consultant	
6.2 Ensure participation of female councilors and female officers/staff in preparation of plans for ULB development activities.	Number of participated women	Continue	PCO/PIU/Social Development consultant	
6.3 Ensure effective participation at all levels of preparation of project/sub-projects	Number of women participated in preparation of project/sub-projects	Continue	PCO/PIU/Social Development consultant	
6.4 Keep opportunities for more participation of women in project/sub-projects implementation	Ratio of male-female in project implementation	Continue	PCO/PIU/Social Development consultant	
6.5 Ensure adequate representatives of women in CSCCs and WLCCs in all participating ULB	Ratio of male-female in CSCC and WLCC	Continue	PIU/Social Development consultant	

Activities under the gender strategies	Indicators	Time - frame	Responsibility	Assumption s/ Comments
6.6 Ensure adequate representatives of women in standing committees	Ratio of male-female in standing committee	Continue	PIU/Social Development consultant	
6.7 Ensure participation of women in income generating activities	Number of women engaged in income generating activities	Continue	PCO/PIU/Social Development consultant	Gender supportive guideline for income generating programme to be prepared and implemented
7. Empowerment				
7.1 Identify the areas of women empowerment at all levels of project/sub-projects implementation	Number of women empowerment areas identified in project/sub-projects		PCO/PIU/Social Development consultant	Organize training to identify women empowerment areas
7.2 Ensure inclusion of one third women in formation of CSCCs and 40% in formation of WLCCs	Number of women included in CSCC Number of women included in WLCC	Continue	PCO/PIU/Social Development consultant	
7.3 Involve women at equally ratio in social development plan preparation, implementation and monitoring	Male-female ratio	Continue	PCO/PIU/Social Development consultant	
7.4 Add supportive facilities for women labour in tender documents	Number of sub-projects included facilities for women labour in tender documents	Continue	PCO/PIU/Social Development consultant	
7.5 Monitor the issue of reservation at least one post in ULB Mayor panel for female councilor	Number of women reserved in Mayor panel	Continue	PCO/PIU/Social Development consultant	
7.6 Give directions by the project regarding inclusion of women in various committees of ULB	Number of women in various committees	Continue	PCO/PIU/Social Development	

Activities under the gender strategies	Indicators	Time - frame	Responsibility	Assumption s/ Comments
			consultant	
7.7 Allocate particular places to women traders in kitchen markets and other markets	Number of women allotted place/shops	Continue	PCO/PIU/Social Development consultant	
8. Financing				
8.1 Identify the area of financing for implementation/ institutionalization of gender equity action plan of ISWMIP	Number of areas identified	Continue	PCO/PIU	
8.2 Prepare gender sensitive budgets for implementation of ISVMIP	Number of sub-projects prepared in ISWMIP considering gender & development activities	Continue	PCO/PIU	
8.3 Ensure allocation of required budget considering gender related activities in all components of project	Amount of money budgeted for gender & development activities	Continue	PCO/PIU	

Appendix VII: Budget Format for GAP (Sample)

S L.	Name of Activity	Activity Details	Unit/Batch/Days	Unit Cost (TK)	Total Amount	Responsible Person	Time Frame				Remarks
							1st Qrt.	2nd Qrt.	3rd Qrt.	4th Qrt.	
1 Quarterly Progress Sharing Meeting											
	Daylong event for 4 times	10 members of Gender Committee (Social Welfare and Community Center standing Committee)	4 Meetings			Gender Committee					
	Food for One day for 4 Meeting	One-time snacks for 10 Person for 4 Days	40	30	1200						
		Lunch-300/Person*40	40	300	12000						
	Logistics	Note pad, Pen, Printing Materials, VIPP Card, Poster Paper, Marker Etc. ;40/ Person	40	100	4000						
Sub Total=					17200						
2 International Day Observance (8 March)											
	Rally					Gender Committee					
	Snacks for 500 Packs	500 packs; 30 TK/Packs	500	30	15000						

S L.	Name of Activity	Activity Details	Unit/Batch/Days	Unit Cost (TK)	Total Amount	Responsible Person	Time Frame				Remarks
							1st Qrt.	2nd Qrt.	3rd Qrt.	4th Qrt.	
	IEC Materials		1	5000	5000						
	Logistics	Banner/ Festoon/ Leaflet etc.			5,000						
	Documentation and Reporting	Printings, Bindings, Photocopy etc.			500						
Subtotal=					25500						
3	International Day for Eliminating Violence Against Women and Human Rights Day observation										
	Rally										
	Snacks for 500 Packs	500 packs; 30 TK/Packs	500	30	15000						
	IEC Materials		1	10000	10000						
	Logistics	Banner/ Festoon/ Leaflet etc.			5,000						
	In house discussion/ Talkshow	Snacks for 30 persons	30	50	1,500						

S L.	Name of Activity	Activity Details	Unit/Batch/Days	Unit Cost (TK)	Total Amount	Responsible Person	Time Frame				Remarks
							1st Qrt.	2nd Qrt.	3rd Qrt.	4th Qrt.	
	Documentation and Reporting	Printings, Bindings, Photocopy			500						
Subtotal=					32000						
Total=					74700						

Appendix VIII: Sample Report Format for GAP

- Title of the Report Format for GAP
- Introduction
- Purpose of the Report
- Brief report of the events

S L	Name of the Events :	Objective s	No of the Participant s	Discussio n point of the events	Decision s of the events	Specific comments by Discussant s	Remark s

Necessary Action:

Output/Result:

Challenges:

Lesson Learned:

Conclusion:

Closing Remarks:

Appendix IX: Sample Labor Court of Conduct covering the GBV/SEA/SHA related risks

Introduction:

The Company is committed to ensuring a work environment which minimizes any negative impacts on the local environment, communities, and its workers. The company also strongly commits to creating and maintaining an environment in which Sexual Exploitation and Abuse (SEA) and Sexual Harassment (SH) have no place, and where they will not be tolerated by any employee, sub-contractor, supplier, associate, or representative of the company. The purpose of this Code of Conduct is to:

- 1) Create a common understanding of what constitutes Sexual exploitation and abuse, and sexual harassment;
- 2) Create a shared commitment to standard behaviors and guidelines for company employees to prevent, report, and respond to SEA and SH; and
- 3) Create understanding that breach of this code of conduct will result in disciplinary action.

Definitions

Sexual Exploitation and Abuse (SEA):

Is defined as any actual or attempted abuse of a position of vulnerability, differential power, or trust, for sexual purposes, including, but not limited to, profiting monetarily, socially or politically from the sexual exploitation of another.

Sexual Abuse:

“The actual or threatened physical intrusion of a sexual nature, whether by force or under unequal or coercive conditions.

” Sexual Harassment:

Unwelcome sexual advances, request for sexual favors, and other verbal or physical conduct of sexual nature.

Sexual Harassment versus SEA:

SEA occurs against a beneficiary or member of the community. Sexual harassment occurs between personnel/staff of an organization or company and involves any unwelcome sexual advance or unwanted verbal or physical conduct of a sexual nature. The distinction between the two is important so that agency policies and staff trainings can include specific instruction on the procedures to report each.

Consent is the choice behind a person’s voluntary decision to do something. Consent for any sexual activity must be freely given, ok to withdraw, made with as much knowledge as possible, and specific to the situation. If agreement is obtained using threats, lies, coercion, or exploitation of power imbalance, it is not consent. Under this Code of Conduct consent cannot be given by anyone under the age of 18, regardless of the age of majority or age of consent locally. Mistaken belief regarding the age of the child is not a defense.

There is no consent when agreement is obtained through:

- The use of threats, force or other forms of coercion, abduction, fraud, manipulation, deception, or misrepresentation
- The use of a threat to withhold a benefit to which the person is already entitled, or
- A promise is made to the person to provide a benefit. While all forms of violence against a community resident or a co-worker are forbidden, this code of conduct is particularly concerned with the prevention and reporting of sexual exploitation and abuse (SEA) and sexual harassment which constitute gross misconduct, are grounds for termination or other consequences related to employment and employment status:

(1) Examples of sexual exploitation and abuse include, but are not limited to:

- A project worker tells women in the community that he can get them jobs related to the work site (cooking and cleaning) in exchange for sex;
- A worker that is connecting electricity input to households says that he can connect women headed households to the grid in exchange for sex;
- A project worker gets drunk after being paid and rapes a local woman;
- A project worker denies passage of a woman through the site that he is working on unless she performs a sexual favor;
- A manager tells a woman applying for a job that he will only hire her if she has sex with him; and
- A worker begins a friendship with a 17-year-old girl who walks to and from school on the road where project related work is taking place. He gives her rides to school. He tells her that he loves her. They have sex.

(2) Examples of sexual harassment in a work context include, but are not limited to:

- Male staff comment on female staffs' appearances (both positive and negative) and sexual desirability;
- When a female staff member complains about comments male staff are making about her appearance, they say she is "asking for it" because of how she dresses; and
- A male manager touches a female staff members' buttocks when he passes her at work. A male staff member tells a female staff member he will get her a raise if she sends him naked photographs of herself.

Individual signed commitment (to be translated in a language understood by the person signing):

I, _____, acknowledge that sexual exploitation and abuse (SEA) and sexual harassment, are prohibited. As an (employee/contractor) of (contracted agency / sub-contracted agency) in (country), I acknowledge that SEA and SH activities on the work site, the work site surroundings, at workers' camps, or the surrounding community constitute a violation of this Code of Conduct. I understand SEA and SH activities are grounds for sanctions, penalties or potential termination of employment. Prosecution of those who commit SEA and SH may be pursued if appropriate.

I agree that while working on the subproject I will:

- Treat all persons, including children (persons under the age of 18), with respect regardless of sex, race, color, language, religion, political or other opinion, national, ethnic or social origin, gender identity, sexual orientation, property, disability, birth or other status.;
- Commit to creating an environment which prevents SEA and SH and promotes this code of conduct. In particular, I will seek to support the systems which maintain this environment;
- Not participate in SEA and SH as defined by this Code of Conduct and as defined under (country) law (and other local law, where applicable);
- Not use language or behavior towards women, children or men that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate;
- Not participate in sexual contact or activity with anyone below the age of 18. Mistaken belief regarding the age of a child is not a defense. Consent from the child is also not a defense. I will not participate in actions intended to build a relationship with a minor that will lead to sexual activity;
- Not solicit/engage in sexual favors in exchange for anything as described above;
- Unless there is the full consent by all parties involved, recognizing that a child is unable to give consent and a child is anyone under the age of 18, I will not have sexual interactions with members of the surrounding communities. This includes relationships involving the withholding or promise of actual provision of benefit (monetary or non-monetary) to community members in exchange for sex—such sexual activity is considered "non-consensual" under this Code.

I commit to:

- Adhere to the provisions of this code of conduct both on and off the project site. Attend and actively partake in training courses related to preventing SEA and SH as requested by my employer. If I am aware of or suspect SEA and SH, at the project site or surrounding community, I understand that I am encouraged to report it to the Grievance Reporting Mechanism (GRM) or to my manager. The safety, consent, and consequences for the person who has suffered the abuse will be part of my consideration when reporting. I understand that I will be expected to maintain confidentiality on any matters related to the incident to protect the privacy and security of all those involved.

Sanctions: I understand that if I breach this Individual Code of Conduct, my employer will take disciplinary action which could include:

- Informal warning or formal warning;
- Additional training;
- Loss of salary;
- Suspension of employment (with or without payment of salary);
- Termination of employment; and

Report to the police or other authorities as warranted.

I understand that it is my responsibility to adhere to this code of conduct. That I will avoid actions or behaviors that could be construed as SEA and SH. Any such actions will be a breach this Individual Code of Conduct. I acknowledge that I have read the Individual Code of Conduct, do agree to comply with the standards contained in this document, and understand my roles and responsibilities to prevent and potentially report SEA and SHA issues. I understand that any action inconsistent with this Individual Code of Conduct or failure to act mandated by this Individual Code of Conduct may result in disciplinary action and may affect my ongoing employment.

Signature: _____

Printed Name: _____

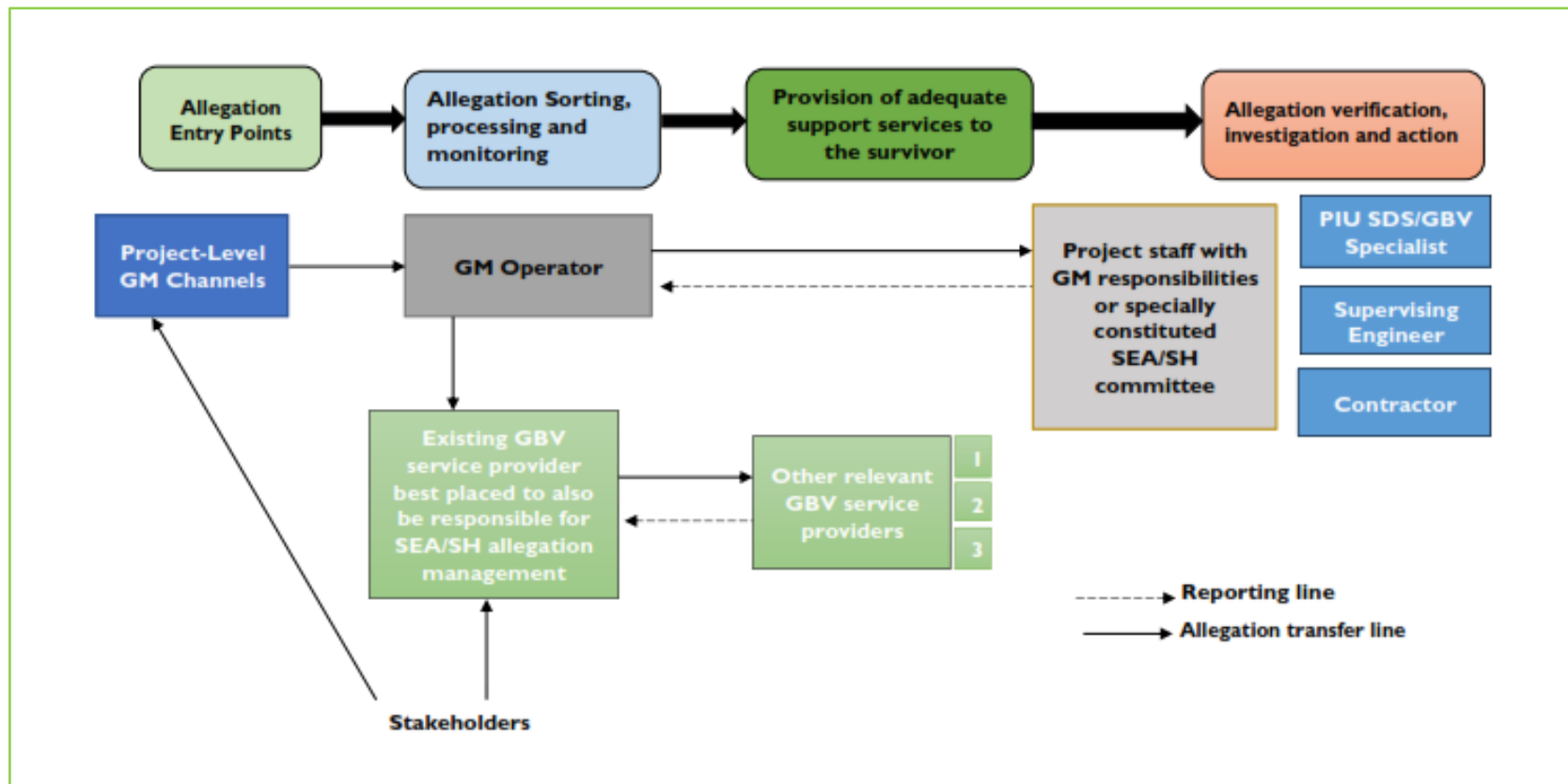
Title: _____

Date: _____

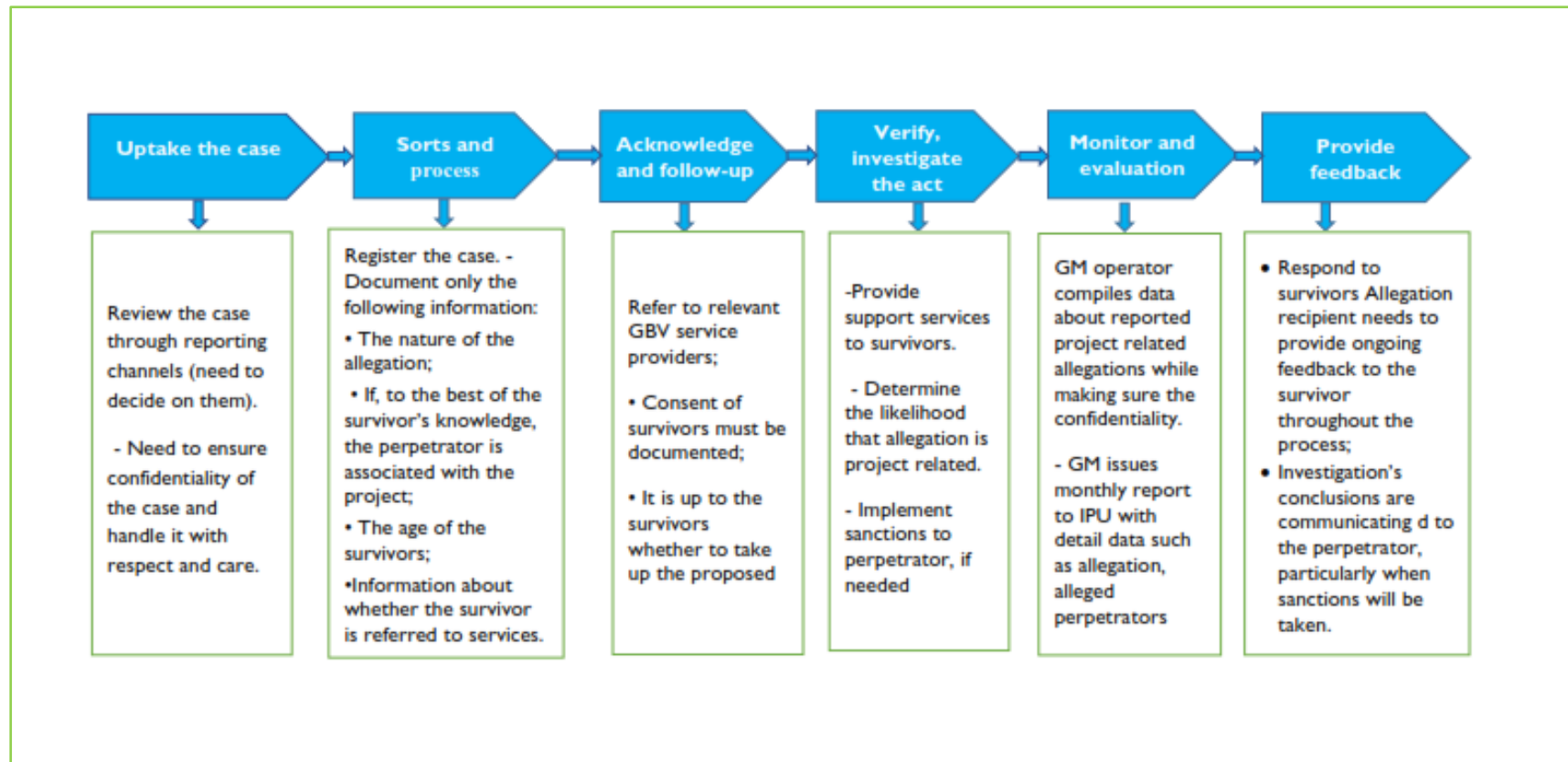
Appendix X: GBV service providers functioning in Bangladesh during COVID-19

Gender Based Violence service providers' particulars	
<p style="text-align: center;"><u>Helplines</u></p> <ul style="list-style-type: none"> • National Helpline Centre for Violence against Women and Children: 10921; • Legal Aid Helpline: 16430; • Marie Stops Bangladesh: 08000222333; • Acid Survivors Foundation (ASF): +8801713010461; • Bangladesh Legal Aid and Services Trust (BLAST); +8801715- 220 220; • Ain o Salish Kendra (ASK): +8801724415677; <ul style="list-style-type: none"> • Rights Jessore: +8801977182023; 	<p style="text-align: center;"><u>Immediate Rescue Information</u></p> <ul style="list-style-type: none"> ➤ OCC (Medical): 109 ➤ OCC(Judicial) • Faridpur: +8801711248085; • Sylhet: +8801716128370; • Barisal: +8801715635866; • Rajshahi: +8801718620310; • Chittagong: +8801819941106; • Bagerhat: +8801911100177;
<p style="text-align: center;"><u>Psycho-social counseling</u></p> <ul style="list-style-type: none"> • Marie Stops Bangladesh: 02-58152538; • Acid Survivors Foundation (ASF): +8801713010461; • Ministry of Women and Children Affairs (focused on COVID19 Psychosocial Counselling): <ul style="list-style-type: none"> • National: 12.00-3.00:+8801715297944, 3:00-6.00: +8801727209070 6.00-9.00:+880191431785 	<p style="text-align: center;"><u>Regional</u></p> <p>9.00-12.00:</p> <ul style="list-style-type: none"> • Dhaka, Dhaka Medical College Hospital (DMCH): +8801780839944; • Barisal, Sher e Bangla Medical College and Hospital (SBMCH): +8801913566477; • Chattogram, Chattogram Medical College and Hospital (CMCH): +8801676095159; <ul style="list-style-type: none"> • Rangpur, Rangpur Medical College and Hospital (RpMCH): +8801777337089 <p>12.00-3.00:</p> <ul style="list-style-type: none"> • Rangpur, Rangpur Medical College and Hospital (RpMCH): +8801919137331, • Khulna, Khulna Medical College and Hospital (KMCH): +8801723545731 <p>3.00-6.00:</p> <ul style="list-style-type: none"> • Rajshahi, Medical College and Hospital (RMCH): +8801515621317, • Dhaka, Dhaka Medical College and Hospital (DMCH): +8801675620992, • Cox's Bazar Medical College and Hospital (CoxMCH): +8801847461880 <p>6.00-9.00:</p> <ul style="list-style-type: none"> • Sylhet, Sylhet Osmani Medical College and Hospital (SOMCH): +8801766356094, • Chattogram, Chattogram Medical College and Hospital (CMCH):+8801761362020, <ul style="list-style-type: none"> • Faridpur, Faridpur Medical College and Hospital (FMCH): +8801673719894; • Aparajita Jessore: +8801761222222-4
<p style="text-align: center;"><u>Shelters</u></p> <ul style="list-style-type: none"> • Judicial OCC • Faridpur: +8801711248085; Sylhet: +8801716128370; Barishal: +8801715635866; Rajshahi: +8801718620310; Chittagong: +8801819941106; Bagerhat: +8801911100177; • Dhaka Ahsania Mission (shelter with transport) (880-2) 58155869, 9127943, 9123402, 9123420; 	<p style="text-align: center;"><u>Legal Counseling</u></p> <ul style="list-style-type: none"> • Bangladesh Legal Aid and Services Trust (BLAST): +8801715-220 220; • Ain o Salish Kendra (ASK): +8801714-025069; • Organization for Women's Development in Bangladesh (OWDEB) – Chittagong (Providing service to Ward 4,5,6 now): +8801711 – 171060 • Aparajita Jessore: +8801761222222-4

Appendix XI: Subproject Grievance Redress Mechanism to address SEA/SH Allegations



Appendix XII: Operating Procedures and Response Protocol for SEA/SH Allegations



Appendix XIII: FGD and Public Consultation Meeting Attendance Sheet of RCC

**Integrated Solid Waste Management Improvement Project, LGED
CONSULTATION MEETING
ATTENDANCE SHEET**

Location	Date	Time
Hetekha, Sweepers Colony, Ward-11	07-02-2023	5.00 PM

SL No.	Name of Participant	Gender	Age	Occupation	Mobile No.	Signature
1	Sri. Raju Babu	M	31	Sweeper	01751525860	[Signature]
2	[Signature]	M	32		01734-681648	[Signature]
3	শ্রী প্রজ্ঞানন্দ দাস	M	37		01687291617 01687211617	[Signature]
4	শ্রী জিহাদ রায়	M	36		01735637092	[Signature]
5	শ্রী বিহার কুমার	M	37		01863879632	[Signature]
6	শ্রী মহালা	M	39		01776833373	[Signature]
7	শ্রী কুমার দাস	M	55		01731910631	[Signature]
8	শ্রী চাঁদ রায়	M	61		01716388786	[Signature]
9	শ্রী সত্যিনন্দ	M	62		01764003594	[Signature]
10	শ্রী মল্লিক	M	48		01709647792 7592	[Signature]
11	শ্রীমতী রায়	M	65		—	[Signature]
12	শ্রী মাহাবুব	M	48		—	[Signature]
13	শ্রী কুমার	M	45		01753738115	[Signature]
14	শ্রী বীণা	M	63		01935889752	[Signature]
15	শ্রী জাহান্না রায়	M	50		01729340163	[Signature]