

Initial Environmental Examination

March 2014

**BAN: Urban Public and Environmental Health
Sector Development Program: Rajshahi Controlled
Landfill**

Prepared by the Local Government Division, Ministry of Local Government, Rural Development and Cooperatives, Government of the People's Republic of Bangladesh for the Asian Development Bank.

ABBREVIATIONS

ADB	–	Asian Development Bank
BBS	–	Bangladesh Bureau of Statistics
BCC	–	Behavior Change Communication
BOD	–	Biochemical Oxygen Demand
CC	–	City Corporations
CCPIU	-	City Corporations Program Implementation Units
COD	–	Chemical Oxygen Demand
DES	–	Domestic Environmental Specialist
DLS	-	Department of Livestock Services
DO	–	Dissolved Oxygen
DoE	–	Department of Environment
DSC	–	Design, Supervision, and Construction Consultant
DSCC	–	Dhaka South City Corporation
DWASA	–	Dhaka Water Supply and Sewerage Authority
EA	–	executing agency
ECC	–	Environmental Clearance Certificate
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
EU	–	European Unions
HDPE	–	High Density Poly-Ethylene
IEE	–	Initial Environmental Examination
IES	–	International Environmental Specialist
IMA	–	Independent Monitoring Agency
LGD	–	Local Government Division
LGRDC	–	Ministry of Local Government, Rural Development and Cooperatives
NGO	–	nongovernmental organization
OM	–	Operations Manual
O&M	–	operation and maintenance
PPTA	–	Project Preparation Technical Assistance
RCC	–	Rajshahi City Corporation
RF	–	Resettlement Framework
RP	–	Resettlement Plan
SCMO	–	Safeguards and Community Mobilization Officer
SIEE	–	Summary Initial Environmental Examinations
CLF	-	Controlled Landfill
SO	–	Safety Officer
STS	-	Secondary Transfer Station
ToR	–	Terms of Reference
UPEHSDP	–	Urban Public and Environmental Health Sector Development Program
UPEHU	–	Urban Public and Environmental Health Unit
WMD	-	Waste Management Department

WEIGHTS AND MEASURES

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

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I. INTRODUCTION

A. Purpose of the Report

1. With nearly 30% of the country's total population (around 140 million) currently living in urban areas along with a predicted to rise to 50% in the next 25 years and still a higher rate of urbanization than the previous ones, Bangladesh is beset with a situation of continued deterioration in the overall and general state of urban public and environmental health. Such a situation has its root in the existing services overwhelmed by continued influx of ever-increasing number of people in the urban areas and growth of slums and squatter settlements currently accommodating over 35% of the urban population. Disease prevention and health promotion in urban areas encompass a range of issues including water and sanitation, waste management, food safety, healthcare, awareness-raising, etc. These are all the responsibility of the city corporations and municipalities under the authority of the Local Government Division (LGD) of the Ministry of Local Government, Rural Development and Cooperatives (LGRDC). Most of these services are under-provided, particularly to the poor.

2. The Bangladesh Urban Public and Environmental Health Sector Development Program (UPEHSDP) aims to establish a sustainable approach to public and environmental health at national level to guide and support city corporations and municipalities in improving the quality of life and economic status of urban residents, especially the poor. This will be achieved by a range of measures, including: (i) creating an Urban Public and Environmental Health Unit (UPEHU) under LGD with a mandate to improve public health; (ii) improving staff and financial resources to enable city corporations and municipalities fulfill their responsibilities in public and environmental health; (iii) improving management of solid waste and hospital waste through municipality-managed public-private partnerships and other mechanisms; and (iv) improving food safety by providing food testing laboratories, food inspection services and sanitary slaughterhouses.

3. The program is being supported by ADB through: (i) a program loan to implement policy measures in institutional strengthening, financial reform, public/ environmental health strategies, governance and service delivery; and (ii) a sector loan, funding investments in municipal and hospital waste management, food safety, and pro-poor integrated services (water supply, sanitation, nutrition/ food security, and health of the urban poor). LGD of the MOLGRDC has been the Executing Agency (EA), whereas the six city corporations (Dhaka, Chittagong, Sylhet, Barisal, Rajshahi and Rajshahi) have been the implementing agencies. The Program is being implemented over a period of seven years (2010-2016) in the main urban areas of the country.

4. UPEHSDP has been classified by ADB as environmental assessment category B (some negative impacts but less significant than category A). The impacts of activities under the program loan, therefore, need to be reviewed by an Environmental Assessment of the Policy Matrix. The sector loan will be implemented via a series of subprojects, providing infrastructure and other improvements in a particular sector (waste management, food safety, etc). Four sample subprojects were developed by a Project Preparation Technical Assistance (PPTA) study and the environmental impacts of these were assessed by Initial Environmental Examinations (IEE) (or Environmental Reviews for Category C subprojects). Studies were conducted according to ADB Environment Policy (2002) and Environmental Assessment Guidelines (2003). Current IEE had been in line with the Environmental Assessment and Review Framework (EARF) developed for the purpose in 2009 and assessment of environmental impacts previously conducted on the above four sample subprojects developed through the PPTA study.

5. This Initial Environmental Examination (IEE) has been undertaken to (i) assess the extent and magnitude of impacts that the proposed Rajshahi Controlled Landfill subproject in

Rajshahi City Corporation have on the overall environment within and around the subproject site; (ii) propose mitigation measures in respect of adverse impacts, enhancement of beneficial impacts; and (iii) formulate an Environment Management Plan (EMP).

B. Extent of IEE Study

6. Bangladeshi law and ADB policy require that the environmental impacts of development projects are identified and assessed as part of the planning and design process, and that action is taken to reduce those impacts to acceptable levels. This is done through the environmental assessment process, which has become an integral part of lending operations and project development and implementation worldwide.

1. ADB Policy

7. ADB's Environment Policy requires that environmental issues are taken into account in all aspects of the Bank's operations, and the requirements for Environmental Assessment are described in Operations Manual (OM) 20: Environmental Considerations in ADB Operations (2003). This states that ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, financial intermediation loans and private sector investment operations.

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

(i) **Category A.** Projects that could have significant environmental impacts. An Environmental Impact Assessment (EIA) is required.

(ii) **Category B.** Projects that could have some adverse environmental impacts, but of less significance than those for category A. An Initial Environmental Examination (IEE) is required to determine whether significant impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

A Category B project may be classified as B-sensitive if it involves environmentally sensitive activities. Such projects require IEE, but have the same requirements for disclosure and Environmental Management Plans as Category A.

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

9. For Category B projects the Draft IEE reports, Summary IEE (SIEE) and any other reports prepared to comply with ADB procedure (in this case the EA of the Policy Matrix) are reviewed by ADB's Regional Department Sector Division and Social and Environmental Safeguards Division. They are also reviewed in-country by the Executing Agency, and additional comments may be sought from project affected people and other stakeholders. All comments are incorporated in preparing final documents, which are reviewed by the Executing Agency and the national environmental protection agency (in this case the Department of Environment, DoE). The EA then officially submits the reports to ADB for consideration by the Board of Directors.

2. National Law

10. **Environmental Assessment, Protection, and Pollution Control.** The main provisions for environmental protection and pollution control in Bangladesh are contained in the Environmental Conservation Act (ECA) of 1995 and the Environmental Conservation Rules (ECR) of 1997. These legislations also provide the principal mechanism for assessing

and mitigating the environmental impacts of projects, both existing and proposed. Projects are classified as green, orange or red depending on their location and environmental impacts. As per ECR 1997, it is included the Red Category in item 43 and described as 'Land-filling by industrial, household and commercial wastes'.

11. Rule 7 states that the proponent of such projects must obtain a Location Clearance Certificate and an Environmental Clearance Certificate (ECC) from the Department of Environment (DoE). For Red category projects this requires submission to the relevant DoE Divisional Officer of the following:

- (i) Completed Application for Environmental Clearance Certificate, and the appropriate fee, shown in Schedule 13 of the Rules;
- (ii) Report on the feasibility of the project;
- (iii) Report on the IEE for the project, and its Process Flow Diagram, Layout Plan;
- (iv) Report on the Environmental Management Plan;
- (v) No objection certificate from the local authority;
- (vi) Emergency plan relating to adverse environmental impact and plan for mitigation of the effect of pollution; and
- (vii) Outline of the relocation and rehabilitation plan (where applicable).

12. As part of the Environmental Clearance Certificate application, a detailed Environmental Impact Assessment and environmental management plans satisfactory to the Department of Environment must be prepared. During the process of preparing the 2009 Environmental Planning Document, DoE was consulted and it was indicated that ADB IEE, SIEE, Resettlement Framework and other reports prepared during project preparation would be acceptable to DoE as fulfilling many of their national EIA requirements. However, they will review IEEs upon further submission by LGD. All projects are to submit any further materials, if any, as per requirement of DoE toward obtaining the Environmental Clearance Certificate.

13. The Rajshahi Controlled Landfill subproject is considered to have some potential for environmental impacts therefore must conduct an IEE and prepare EMPs acceptable to DoE as part of the ECC application. Under the ECR DoE has 60 days to respond from the receipt of the ECC application for a Red category project. After obtaining location clearance on the basis of Initial Environment Examination (IEE) Report, the Environmental Impact Assessment (EIA) Report in accordance with the approved terms of reference along with design of Effluent Treatment Plant (ETP) and its time schedule shall be submitted within approved time limit.

14. In short, in a simpler language the timeframe for obtaining ECC is as follows. In case of red category projects, the DOE will issue Location Clearance Certificate (LCC) within 60 days after satisfactory submission of IEE report along with other relevant documents. The DOE will mention a specific timeframe for submission of EIA report in the LCC issued by them. Then in the next step the DOE will issue Environmental Clearance Certificate (ECC) within 60 days after satisfactory submission of EIA report. In addition to fulfillment of other relevant conditions of DOE, Effluent Treatment Plant (ETP) must be designed and its implementation schedule finalized before issuance of ECC from the DOE. Five individual applications for each of the components in Package – 4 like MWTF in Dhaka, CLRs in Chittagong, Barisal, Rajshahi and Sylhet will be lodged in five local divisional offices with a view to obtaining ECC from these authorities separately.

15. **Other Policies, Plans, and Strategies.** In addition to ECA and ECR, there are a number of other policies, plans and strategies which are applicable to the subproject. These are National 3R (Reduce, reuse, recycle) Strategy for Waste Management 2010, The Local Government (City Corporation) Act 2009, and Medical Waste Management Rules 2008.

16. The National Building Code 2006 and National Labor Act 2006 have defined certain measures to ensure proper safety and work environment as well as the compensation measures to the laborers. By national law, in order to be compensated, Contractors must follow these safety provisions and compensation arrangements. The implementing agency must ensure that the appropriate occupational health and safety provisions have been included in the bidding documents and are being implemented by Contractor. As per the Safe Drinking Water Supply and Sanitation Policy 1998, provision for arsenic free drinking water and adequate sanitation will have to be ensured. The water quality needs to be monitored to ensure that the supplied water is safe for drinking.

17. The summary of environmental regulations and mandatory requirements for the proposed subproject is shown in **Table 1**.

Table 1: Summary of Environmental Regulations and Mandatory requirements for the Rajshahi CLF Subproject

Acts/ Guidelines	Purpose	Applicability to the Subproject
Environmental Conservation Act, 1995 and Environmental Conservation Rules, 1997	<ul style="list-style-type: none"> - main provisions for environmental protection and pollution control in Bangladesh - provides the principal mechanism for assessing and mitigating the environmental impacts of projects, both existing and proposed - projects are classified as green, orange or red depending on their location and environmental impacts 	<ul style="list-style-type: none"> - As per ECR 1997, it is included the Red Category in item 43 and described as 'Land-filling by industrial, household and commercial wastes'. - Rule 7 states a Location Clearance Certificate and an Environmental Clearance Certificate (ECC) must be obtained from the Department of Environment (DoE). - Recommends standards for disposal of different types of waste.
National 3R (Reduce, reuse, recycle) Strategy for Waste Management, 2010	<ul style="list-style-type: none"> - The national 3R Goal for waste management is to achieve complete elimination of waste disposal on open dumps, rivers, flood plains by 2015 through mandatory segregation of waste at source as well as to create a market for recycled products and provide incentives for recycling of waste. - The main objective of the 3R Strategy is to delineate ways and means of achieving national 3R goals through providing a uniform guideline for all stakeholders. 	<ul style="list-style-type: none"> - Source segregation is mandatory and gave directives to municipalities to pursue organic waste-recycling projects through composting, refuse derived fuel, and biogas via Public Private Partnerships (PPPs). - It makes clear that medium to large-scale organic waste-recycling projects will be implemented and managed by the private sector. Moreover, the strategy makes recommendations concerning issues such as tipping fees and access to municipal land for recycling projects.
Local Government (City Corporation) Act, 2009	<p>This Act was incorporated under Bangladesh Gazette on 15 October 2009. The act contains four sub-clauses regarding waste collection and management, which have been depicted as follows:</p> <ul style="list-style-type: none"> – City Corporation will take all necessary steps to collect and dispose waste from all the roads, toilets, drains, structures and areas under its jurisdiction – The occupiers of all the structures and spaces within the jurisdiction of the City Corporation will be responsible for removing waste from their possession under the control and supervision of the Corporation. 	<p>Construction of CLF is necessary infrastructure to fulfill the responsibility of the City Corporations for collection, transportation and disposal of municipal solid wastes. Municipal solid waste will be collected in the Secondary Transfer Stations for onward transportation to the CLF site of the City Corporation outside the city with a view to arranging a safe and satisfactory disposal.</p>

Acts/ Guidelines	Purpose	Applicability to the Subproject
	<ul style="list-style-type: none"> – Corporation will make arrangement for waste collection containers or other type of bins at different places of the city, and wherever such containers or bins are placed, the Corporation will ask the occupiers of the neighboring houses, structures and spaces to dump their wastes into these containers or bins through issuance of a general notice. – All the wastes removed or collected by or under direction of the staff of the Corporation as well as the wastes stored in the containers or bins established by the Corporation will be treated as the property of the City Corporation. 	
Medical Waste Management Rules 2008	The main objective is to control overall management including collection, treatment and disposal of medical waste in Bangladesh.	CLF will have a specific section to deal with medical wastes; these hazardous wastes will be collected, transported by special arrangement by the City Corporation and treated separately in the Medical Waste Management section of CLF.

C. Scope of the Study

18. This is the IEE for the Rajshahi Controlled Landfill subproject. It discusses the environmental impacts and mitigation measures relating to the location, design, construction and operation of all physical works proposed under this subproject. This IEE report will clarify the situation to the Department of Environment and fulfill the requirement for obtaining Location Clearance Certificate and an Environmental Clearance Certificate (ECC) from DOE. This report will identify the potential environmental impacts due to implementation of the subproject and will suggest appropriate mitigation measures.

II. DESCRIPTION OF THE PROJECT

A. Type, Category and Need

19. This is a subproject in the field of solid waste management, and as explained above it has been classified by ADB as Category B because it is not expected to have major negative environmental impacts. Under ADB procedures such developments require an IEE to identify and mitigate the impacts, and to determine whether further study or a more detailed EIA may be required.

20. Improvements in solid waste management facilities are needed in Rajshahi and in other urban areas in Bangladesh because present services are inadequate. The main problems are that:

- (i) Although house-to-house waste collection by NGOs or CBOs is available in most urban areas, slum dwellers still mainly dispose of garbage on open spaces;
- (ii) Secondary waste collection has not expanded in line with the primary collection service because of inadequate cost recovery and insufficient public or private investment;

- (iii) The interface between private sector primary collection and municipality-run secondary collection systems is also inefficient mainly because of a lack of mechanization.
- (iv) Some improvement in the collection, storage and transportation of solid waste is anticipated after implementation of 6 Secondary Transfer Stations under UPEHSDP in different locations of the Rajshahi City; but the safe disposal of these wastes in the landfill site has not been properly addressed yet.

21. UPEHSDP will address this issue by implementing modern Controlled Landfill (CLF) in Rajshahi, which may then be replicated in other urban centers through further subprojects.

B. Location, Size and Implementation Schedule

22. The Rajshahi CLF subproject will be implemented on the land acquired by the City Corporation and at present being used as solid waste disposal site; photographs of the proposed site are attached as Annex 2.

23. Location of the subproject is shown in the following map (Fig 1). The landfill site is in Titor, Naudapura, around 3 km far to the north from Amchottor. The proposed area lies adjacent to the Rajshahi bypass near a truck terminal. The estimated volume of waste, currently on site is about 42,000 m³. Total area of land proposed for CLF is 24,656 m² (6.09 acres). The shape of the land is nearly rectangular, which is suitable for construction of Controlled landfill. As per requirement of the EARF selection criteria #8 for waste management, it has been ensured that no habitation or sensitive receptors are within 250 meters of the proposed landfill site. Also it has been confirmed that the landfill (i) will not be constructed in areas where the groundwater table is less than 2 meters below the ground level; (ii) will not be constructed within the flood prone areas; (iii) are not within the environmentally sensitive areas; (iv) will not be constructed within or near water supply wells, and at least 500 meters of any downgraded wells; and (v) will ensure a buffer zone around the landfill with the distance agreed upon with the regulatory agencies. If during construction any of the criteria cannot be adhered to, specific design options will be taken into consideration. NOC from the DPHE will be obtained if proposed landfill is within or near water supply wells or within 500 meters of any downgraded well.

24. Preliminary design of Rajshahi CLF subproject has begun in the end of 2012 and has been completed by the end of the year 2013. As this subproject will be implemented on the basis of turnkey contract, the detailed design will be done by the contractor, and the IEE/EMP will be updated at the time of detailed design and will be revised by the Design and Supervision Consultants (DSC) team. Construction of the civil works and procurement of equipment would take around 18 months. So the operation of the CLF should therefore begin in late 2015 or early 2016.

C. Description of the Project

25. In Rajshahi City Corporation, wastes are produced from commercial, institutional, municipal and household sources. Almost 49,248 tons of waste is generated per year usually around the city though the collection of waste is only 25,609 tons¹. The wastes are collected by the city corporation from the roadside dustbins and gathered in the main disposal site. There are also many undefined garbage stations e.g. drains, roadsides, markets etc. around the city. As the wastes mostly contain organic wastes and are not controlled as per legal way, the scattered wastes often jam the flow of water in the drains; create nuisance and bad odor making disturbances to the passersby. Under the present situation, there are no secondary transfer stations but in near future six numbers of STSs will be implemented. The

¹ Data collection by Ecorem-DDC JV

CLF site is being developed on the available size of the landfill at present being used for dumping solid waste.

26. Environmental pathway study was conducted to find out the existing condition of the landfill site and take appropriate interventions to be included in the project activities. Currently, a mixture of medical waste and household waste is dumped on an uncontrolled way. The presence of the waste has a negative impact on the environment, agriculture and human health. In particular, soil and groundwater pollution are to be expected.

27. In the pathway study it is been advised that at least the environmental protection measurement mentioned in the following paragraphs should be taken.

28. Physical separation between the pollution and the environment should be guaranteed (gates and fences, covering, trees, etc.);

- Groundwater protection by draining and treatment of the polluted water and leachate:
 - o The groundwater which is affected by the current waste should be drained and should be treated in a waste water treatment plant;
 - o To prevent further contamination of the groundwater, new landfill cells should be constructed where an impermeable layer will prevent further contamination in the environment.
 - o A drainage system in the new landfill cell will drain all new leachate from the landfill cell into the waste water treatment facility.
- Leachate reducing measurements:
 - o To prevent the production of new leachate, surface waters should be separated as much as possible from the pollution source. To reduce the infiltration in the landfill mass, wastes should be covered by impermeable layers (clay layer of 0.5m; $K < 1 \cdot 10^{-9}$ m/s).
- No uncontrolled landfill of untreated medical waste:
 - o Medical waste should be collected and treated separately and should be disinfected and stored safely. No unauthorised persons and animals may come into contact with medical waste. Disinfected medical waste shall be stored safely in anticipation of future technology (for incineration).
 - o Monitoring of quantity and quality of the waste for improving the environmental assessments.

29. Periodic control and measurements on the quality of the surrounding groundwater. Extra measurements can be proposed if negative impacts remain over a certain period of time. All measurements and laboratory analysis are recommended to be executed by an international credited laboratory for quality reasons.

30. The following are the modules used during the preliminary design of the landfill site:

- Module 1: Landfill for Household Waste
- Module 2: Medical Waste Treatment Facility
- Module 3: Area for Medical and Hazardous Waste (Bunkers)
- Module 4: Wheel Washing
- Module 5: Weighing Bridge
- Module 6: Zone for Wastewater Treatment
- Module 7: Pilot Composting Plant

31. **Landfill for Household Waste:** The landfill area will have protective fence of total height 3.00 meters to keep the area free from any trespassers. Surface water drainage ditch will be constructed just inside the protective fence to keep the area dry and free from accumulation of rain water or any other extra wash water within the landfill area. The surface drain will be one meter deep in the natural soil, having bottom width 1 meter, top width 3.5 meters, outside edge slope of 1:1 and inside slope of 2:3. There will be geo-textile lining for the surface drain. Next to the surface drain, one strip of 3 meters width will be kept reserve for installation or construction of utilities.

32. The entire landfill area will be divided into three cells. The cell – 2 and 3 will be developed at the present stage and the cell – 1 will be used for storage of existing waste in the landfill site. Landfill wall will be constructed surrounding the landfill area as well as to separate the two cells. The top of landfill wall will be at a level of 5.25 meters.

33. The landfill area will be backfilled by sand layer of variable thickness to attain a level surface for placing the liner system. The liner system will consist of serially from bottom to top (1) clay layer, 0.5 meter, $k < 1.10^{-9}$ m/s; (2) geo-textile; (3) drainage layer, 0.4 meter, $k > 1.10^{-4}$ m/s; (4) HDPE liner, 2.5 mm; (5) drainage geo-composite, $k = 10^{-3}$ m²/s; and (6) drainage layer, 0.4 meter, $k > 1.10^{-4}$ m/s.

34. The main leachate drainage pipe will be HDPE PN10, diameter 300 mm; and the side leachate drainage pipe will be HDPE PN10, diameter 110 mm. Both of these leachate drainage pipes will be placed above the HDPE impermeable layer. On the other hand, the groundwater drainage pipe HDPE PN10, diameter 110 mm will be placed below the impermeable layer. Geo-textile and filtering material gravel 16/32 will be placed around these pipes to prevent entrainment of sand and soil.

35. There will be inspection well in the junction point of main and side leachate drainage pipes. At the end point, there will be groundwater pumping well to pump the groundwater to surface drain. And the leachate will be pumped from the leachate well to the wastewater treatment plant. Control devices for groundwater and leachate have been incorporated; however, gas monitoring has not been incorporated due to budget constraints.

36. There will be no recycling facilities, only sorting places will be provided. This decision has been taken due to budget constraint as well as lack of adequate space in the landfill site. Wastes like plastics, glasses and tires will be taken out of the landfill site for probable recycling elsewhere.

37. **Medical Waste Treatment Facility:** This unit will contain autoclave for disinfection of disposable materials that will be taken to the bunkers. Plastic materials will be taken to the recycling plant, disinfected and grinded in the chemical disinfection and shredding unit for re-use. Sharps will be disposed in the closed bunkers for burial. Hazardous wastes will also be taken to the specific compartments in the bunkers.

38. **Area for Medical and Hazardous Waste (Bunkers):** This area is reserved for disposal of medical and hazardous wastes. There will be several compartments to deal with wastes from autoclave, ashes from the incinerator, sharps, etc.

39. **Wheel Washing:** Wheels of dump trucks and other vehicles entering the landfill site will be ensured to clean the wheels before ply in the public roads. Vehicles will pass through a depression where water will be available to wet and clean the wheels. There will also be arrangement for spraying water to the wheels and other parts of the vehicles by using water pumps and spraying nozzles.

40. **Weighing Bridge:** Weighing Bridge will be installed near the entry gate to facilitate weighing of the total solid waste carried by the dump truck and to maintain a record of total waste taken to the landfill site. Computerized system of weighing and recording will be there in the Checkpoint Cabin to ensure proper recording in an well maintained database and reporting properly in user friendly formats.

41. **Wastewater/ Effluent Treatment Plant (ETP):** Leachate will be pumped to the collection chamber from the landfill site as well as from the composting plant. Feed pump will be used to transport the leachate from this chamber to the equalization tank. Then treatment of this wastewater will be done by activated sludge method. Methane reactor will be used for separation of methane gas. Sedimentation tank will be used and chemicals like hydrochloric acid, ammonium hydroxide and ferric chloride will added for effective coagulation. Blowers will be used for aeration. Sludge will be recycled from the final clarifier and extra sludge will be returned to the landfill site for drying. The effluent from the final clarifier will be used for root zone plant system for further polishing. The final effluent from the landfill site will meet the effluent standard as per ECR 1997.

42. **Pilot Composting Plant:** The overall dimension of the composting plant is 110 meters length X 27 meters width X 5 meters height. It has the following facilities like office room, dressing cum washing room, storage, packaging corner, fixed place for containers, and a big hall room (85 meters X 27 meters) having longitudinal drain passing along one side, etc. There are 3 options for construction namely shelter steel girder (F1), shelter double slab (F2) and pre-stressed beams (F3).

43. **Management of Existing Wastes:** For preparatory step the waste from the cell – 1 will be transported to the cells 2 and 3 temporarily for placement of impermeable clay layer in the bottom of Cell – 1. Then the existing wastes of the entire landfill site will be transported to the landfill Cell – 1 located in the North West corner of the site. Wastes will be placed systematically in layers with adequate and proper compaction; suitable covering soil will be added over each of the layers; capping will be done by clay layer to prevent further pollution; and finally covering turf or grasses will be grown on properly shaped surfaces keeping adequate arrangement for drainage of rainwater.

44. No additional chemical or heavy metal testing has been planned as part of the subproject because of the fact that there was no indication of presence of these kinds of wastes in the samples used for characterization of wastes in the pathway studies.

45. Implementation of small transfer stations under the separate package in UPEHSDP is anticipated to lead to a 50% reduction in operating cost of secondary collection services per tonne. This will free up significant resources to expand the coverage and quality of secondary collection services, as well as to pay for the operating and maintenance costs of the integrated waste treatment and disposal facility.

46. Modern electrical, mechanical machineries and equipment are also included in the subproject to operate the CLF to modern sanitary standards.

47. Figures 2 to 12 provide preliminary site layout plans including different drawings for medical waste treatment plant and composting plant and other relevant details.



Fig 1: Controlled Landfill of Rajshahi CC Beside City Bypass (24°24'35"N, 88°35'31"E)

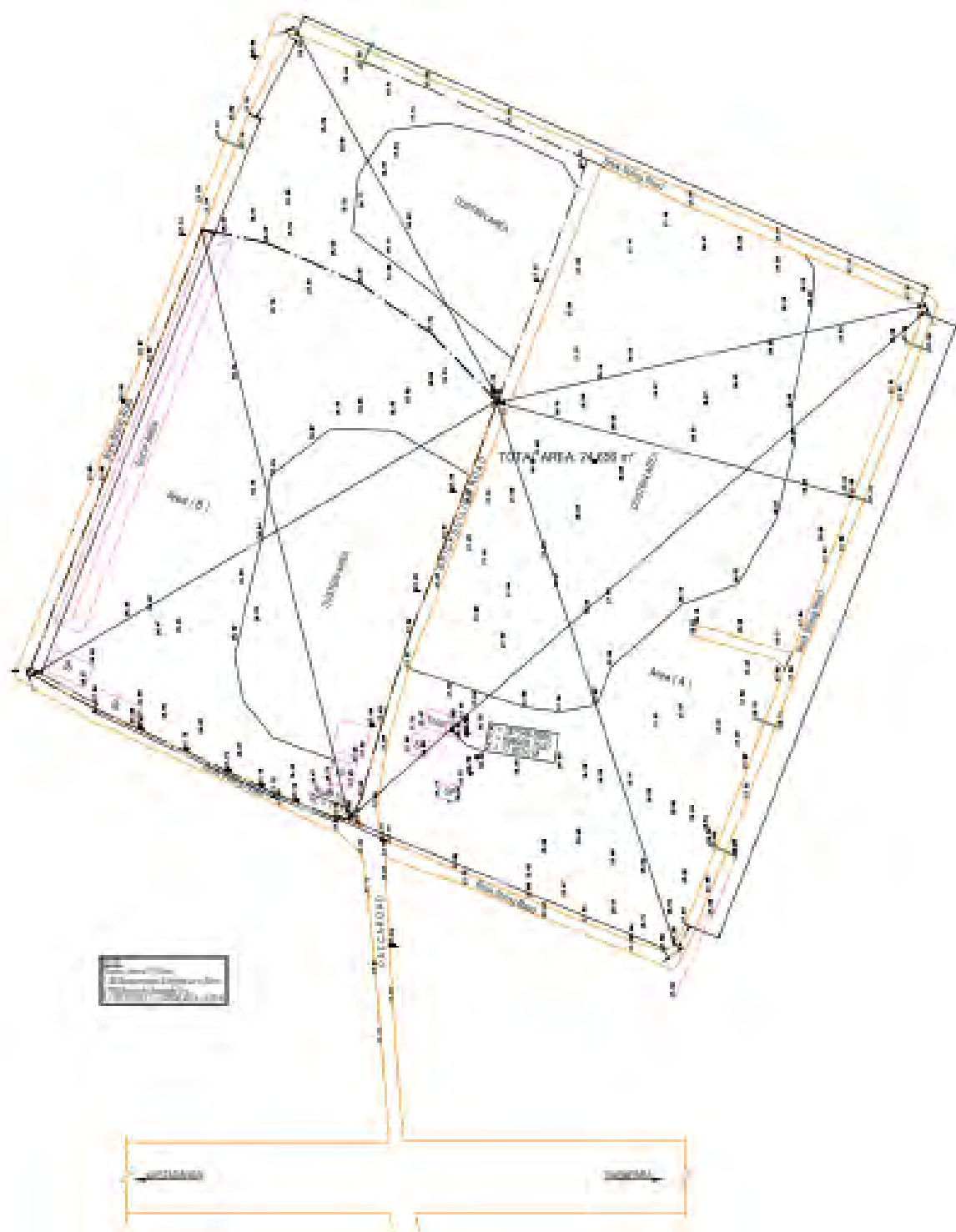


Fig 2: Contour Map of CLF Area

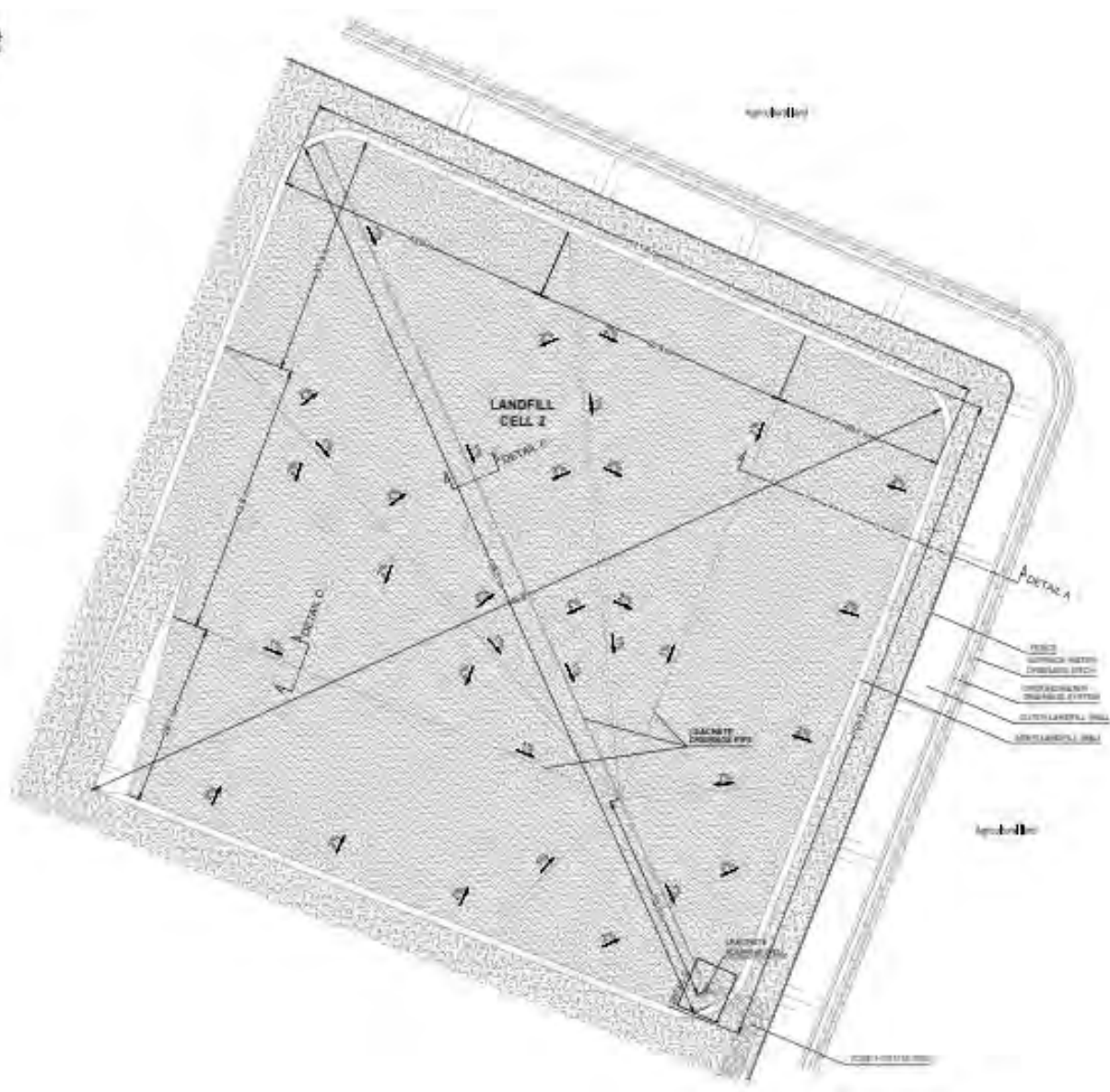


Fig 4: Landfill Cell 2

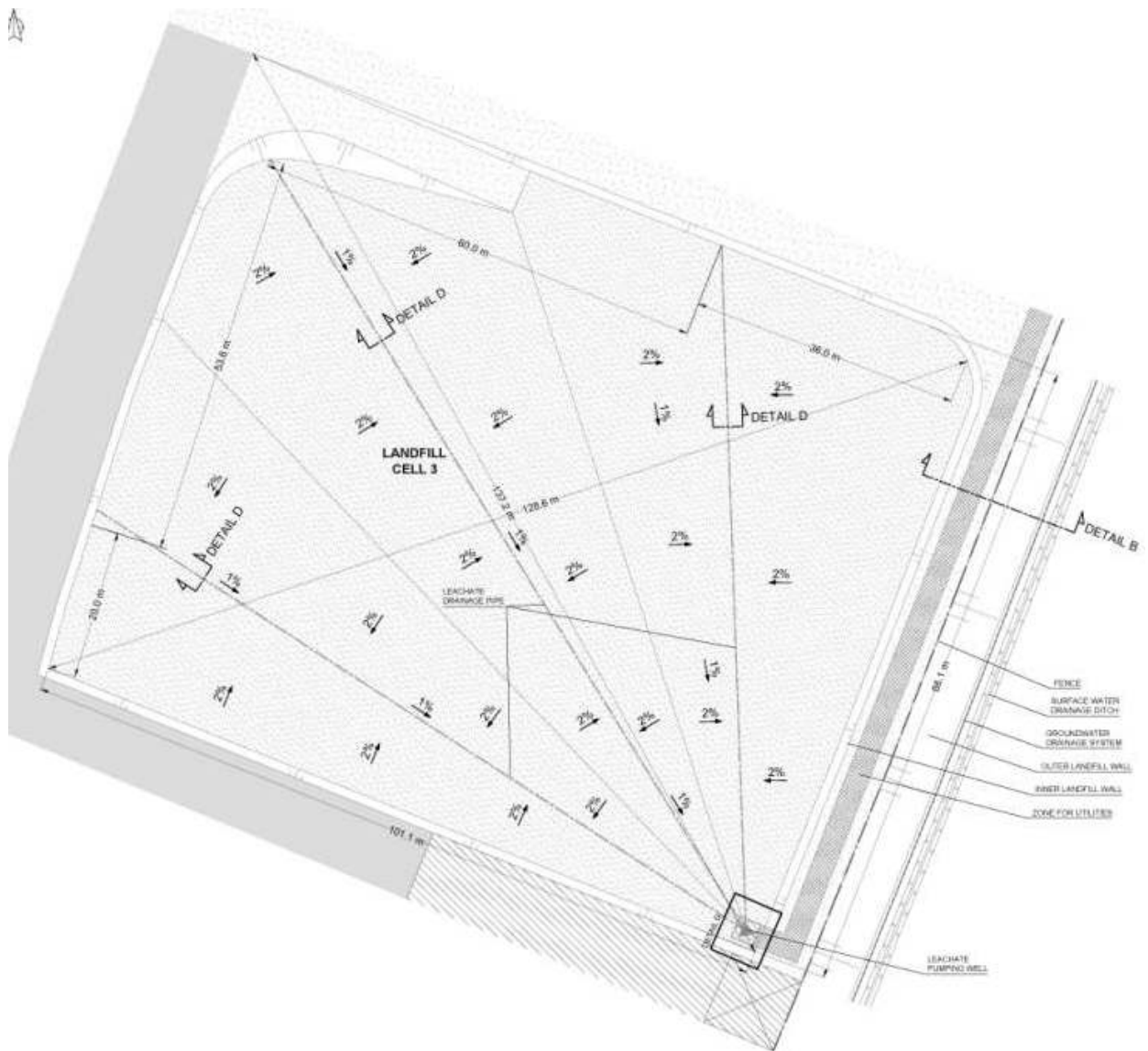
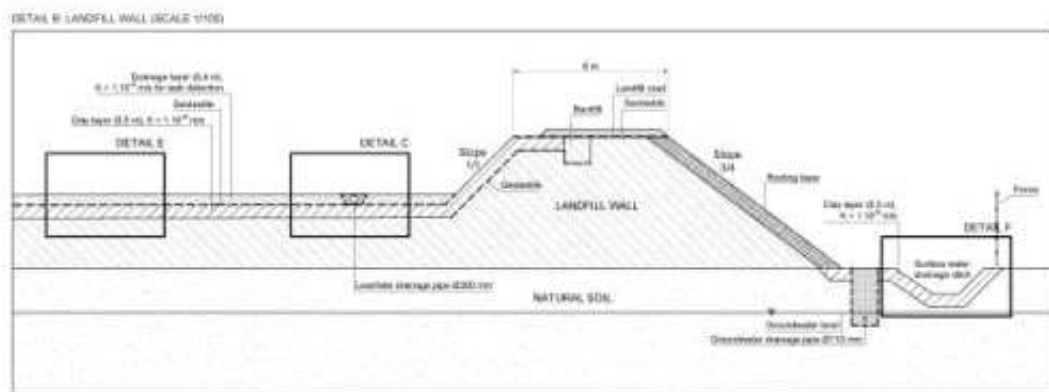
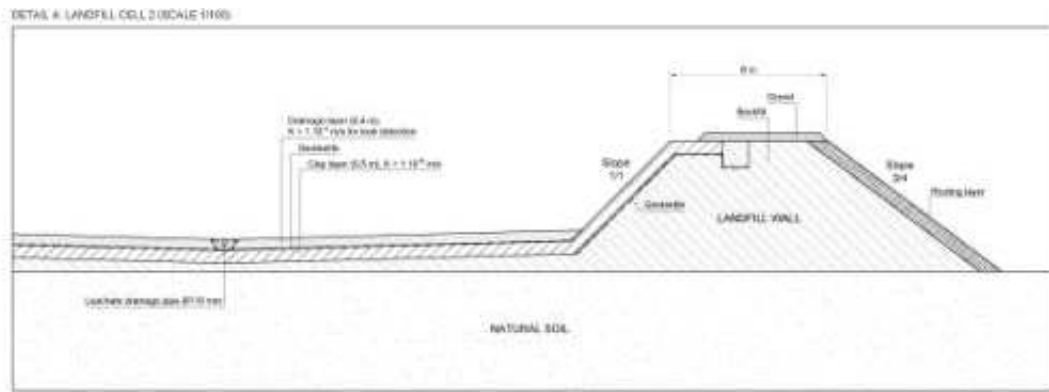


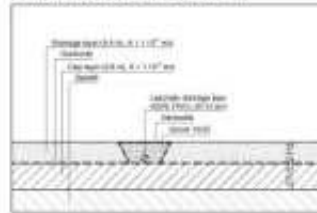
Fig 5: Landfill Cell 3



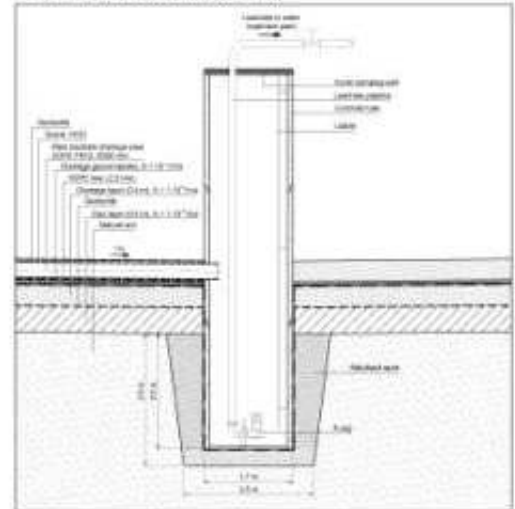
DETAIL C: MAIN DRAINAGE PIPE (SCALE 1/100)



DETAIL D: SIDE DRAINAGE PIPE (SCALE 1/100)



DETAIL E: LEACHATE PUMPING WELL (SCALE 1/100)



DETAIL F: LINDER SYSTEM (SCALE 1/100)



DETAIL G: SURFACE WATER DRAINAGE DITCH (SCALE 1/100)

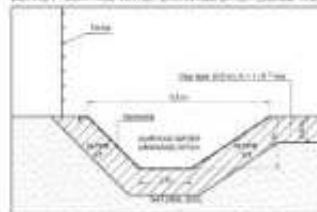


Fig 7: Technical Details of CLF

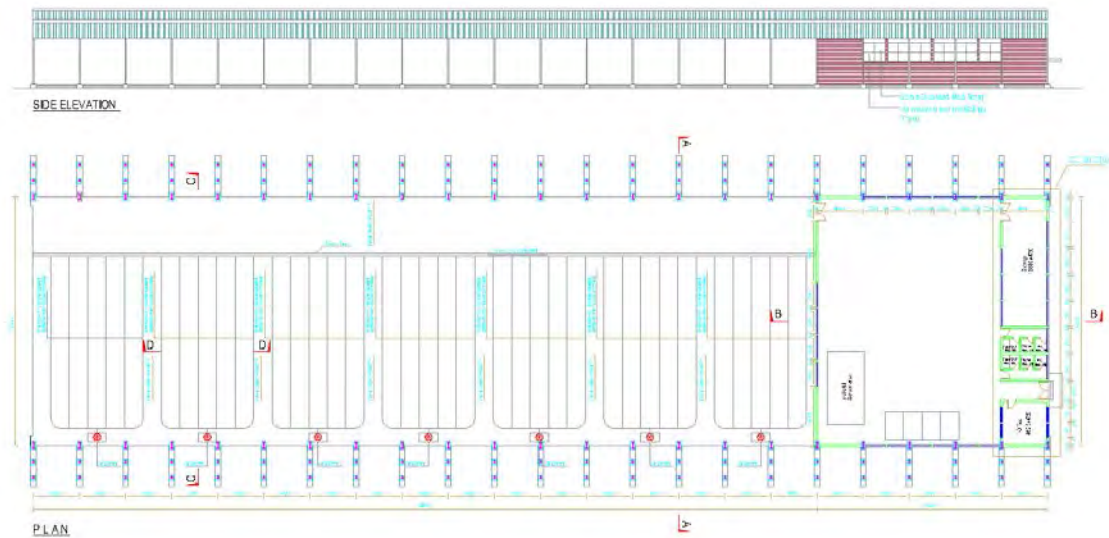
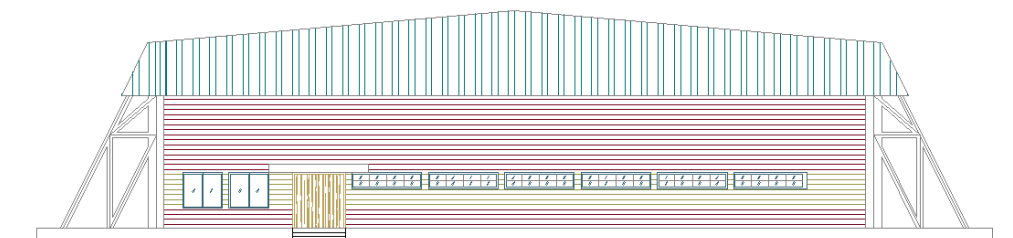


Fig 11: Plan of Composting Plant



FRONT ELEVATION

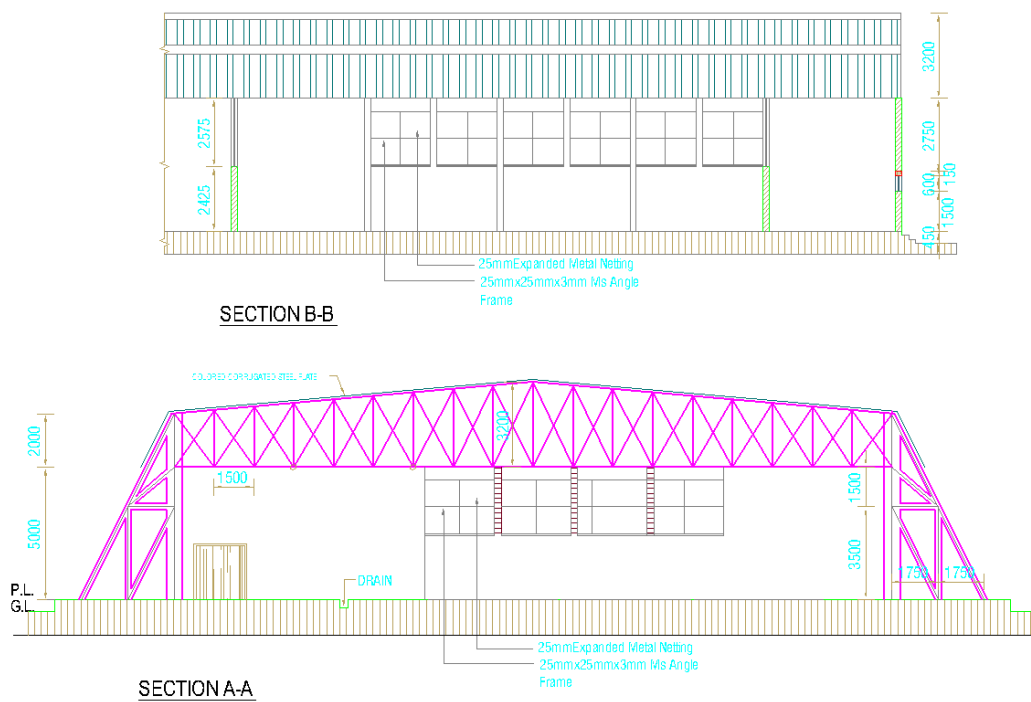


Fig 12: Elevation and Sections of Composting Plant

III. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. Topography and Soils

48. The part of Bangladesh to which the silk city of Rajshahi belongs is dominated by the rivers Padma, Mahananda, Baral and Barnai rivers and their tributaries, which drain large quantities of water from the Himalayan Mountains into the Bay of Bengal, through a complex delta system of tidal tributaries and creeks, formed by sediment deposited by the rivers. This sub-region stretches between the Old Himayalan Piedmont Plain in the west and the right bank of the N – S flowing Brahmaputra in the east. An elongated outlier representing the floodplain of the ancient Teesta extends up to Sherpur (Bogra district) in the south. Most of the land is shallowly flooded during monsoons. The southern portion is located in the Ganges river floodplain. The Ganges channel is constantly shifting within its active floodplain, eroding and depositing large areas of new char land each flood season, but it is less braided than that of the Brahmaputra – Jamuna. Ganges alluvium is calcareous when deposited, but most basin clays and some older ridge soils have been decalcified and acidified in their upper layers; lime is found only in the subsoil or substratum of such soils. Clay soils predominate in basins and on the middle parts of most ridges, with loamy soils (and occasionally sands) occurring mainly on ridge crests.

49. Figure 14 representing the bio-ecological regions of Bangladesh shows the Teesta Floodplain (4a) where the north western region, accommodating the city of Rajshahi, belongs. The Barind area is located just in the north of Rajshahi city.

50. The topography of the proposed CLF site is flat and at grade with the adjacent and approach road. No elevation changes occur within or around the site. The subsurface is characterized by sandy clay with silt and very fine sand particles.

51. The type of soil available around the site of CLF is sandy soil, which is suitable for earth filling during construction activities. This soil will also be very good for covering the waste during the operation phase. Huge quantity of backfilling soil may be collected from dredging of soil from river bed. But additional clay will be required to be brought from outside.

2. Climate

52. The climate in the subproject area is dry and sub-tropical, with a typical three season pattern. During the winter season (November-February), cool winds blow from the north-east. The weather is cool and dry. Rainfall, however, shows variations over the last decade (2002-2011) between 507 mm in June 2004 and 0 mm in December 2002. Average minimum temperatures show, over the same period, variation between 3.4°C in January 2003 and 25.6°C in July 2010. Similarly, the maximum yearly temperature also varies like 38.0°C in March 2011 and 42.8°C in June 2005. Rainfall also increases, and this period is characterized by unstable weather. The monsoon begins in May-June as hot air rises over the Indian subcontinent, creating low pressure areas into which rush the cooler moisture-laden winds from the Indian Ocean and the Bay of Bengal. Around 70-80% of the annual rain falls during this time. The rain is often accompanied by strong winds, sometimes exceeding 100 km/h. Temperature and rainfall both decline post-monsoon, returning rapidly to the winter lows.

53. Wind data from the Bangladesh Meteorological Department Climate Division suggests that wind directions vary month-to-month in Rajshahi, though predominantly in the NW, S,

and NE directions. As the CLF will be far from the city center and in open space, problem of windborne odor will get minimized.

54. Although weather patterns are broadly similar throughout the country, differences in topography, winds and other factors produce some quite marked local variations. This is particularly evident in the annual rainfall of around 1,786 mm in 2004 (last ten years' maximum) and 792 mm in 2010 (last ten years' minimum) in Rajshahi. Relative humidity, average dry bulb temperature, maximum and minimum temperatures and rainfall patterns are represented as under based on the raw data obtained from the Bangladesh Meteorological Department (Fig 15, 16, 17, 18 and 19)².

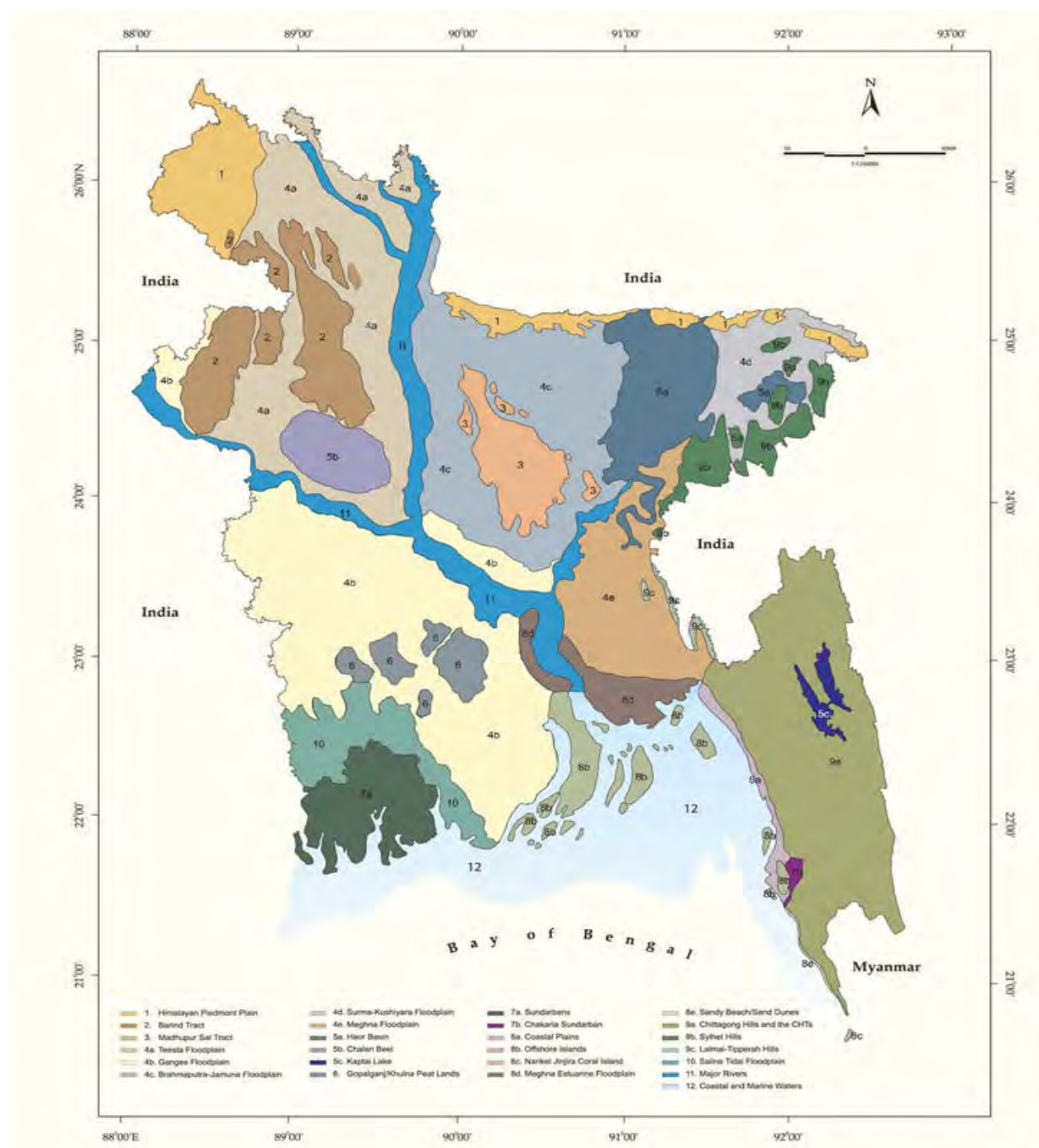


Fig 13: Bio-ecological Map of Bangladesh

² Source of raw data (Fig.15,16,17,18 and 19): Bangladesh Meteorological Department, April, 2012

Source: Internet

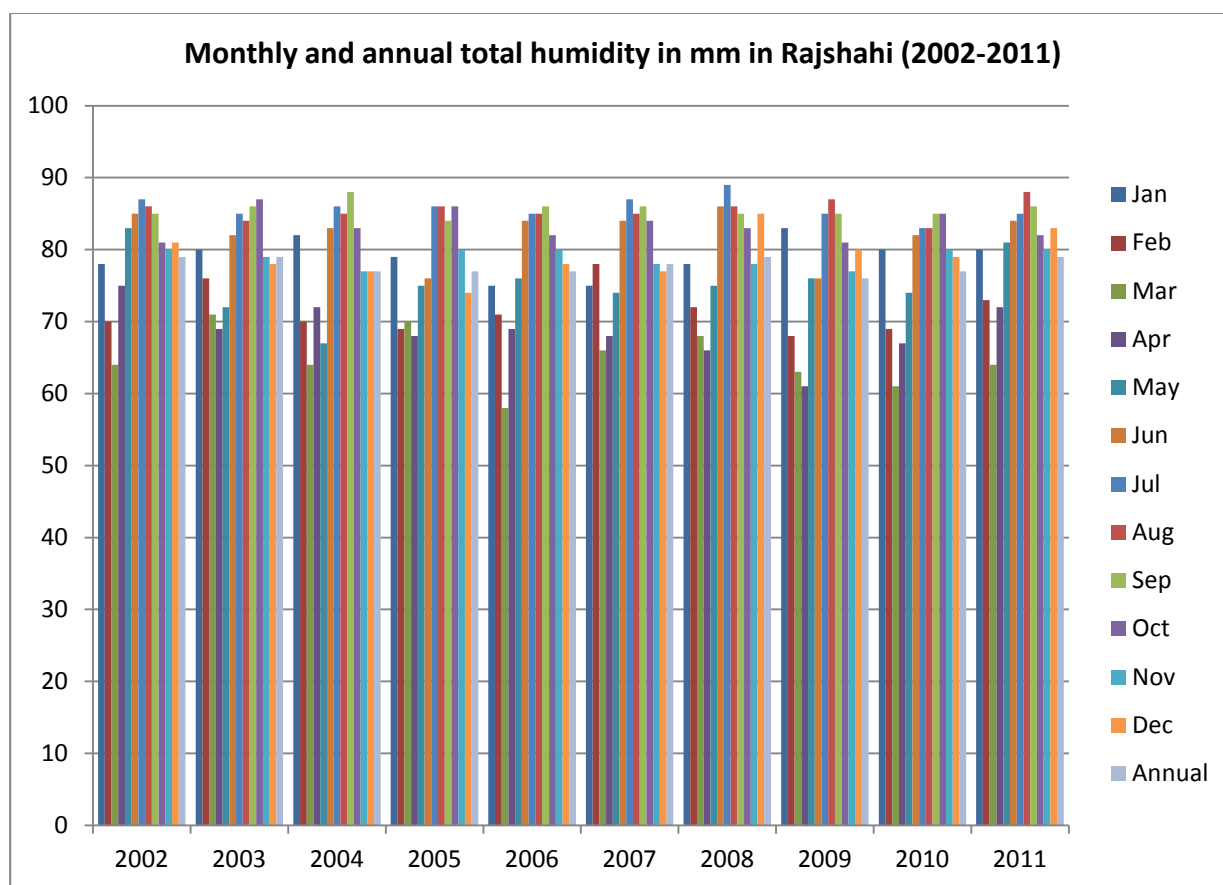


Fig 14: Monthly and annual humidity (%) in Rajshahi (2002-2011)

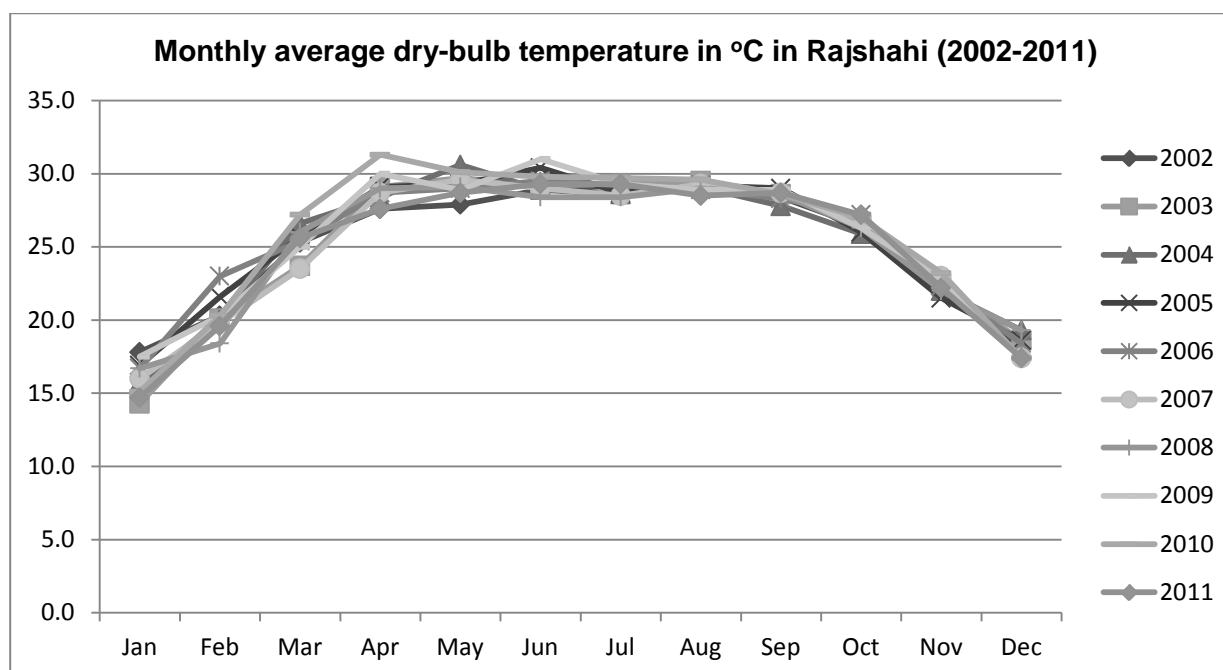


Fig 15: Monthly average dry bulb temperature (°C) in Rajshahi (2002-2011)

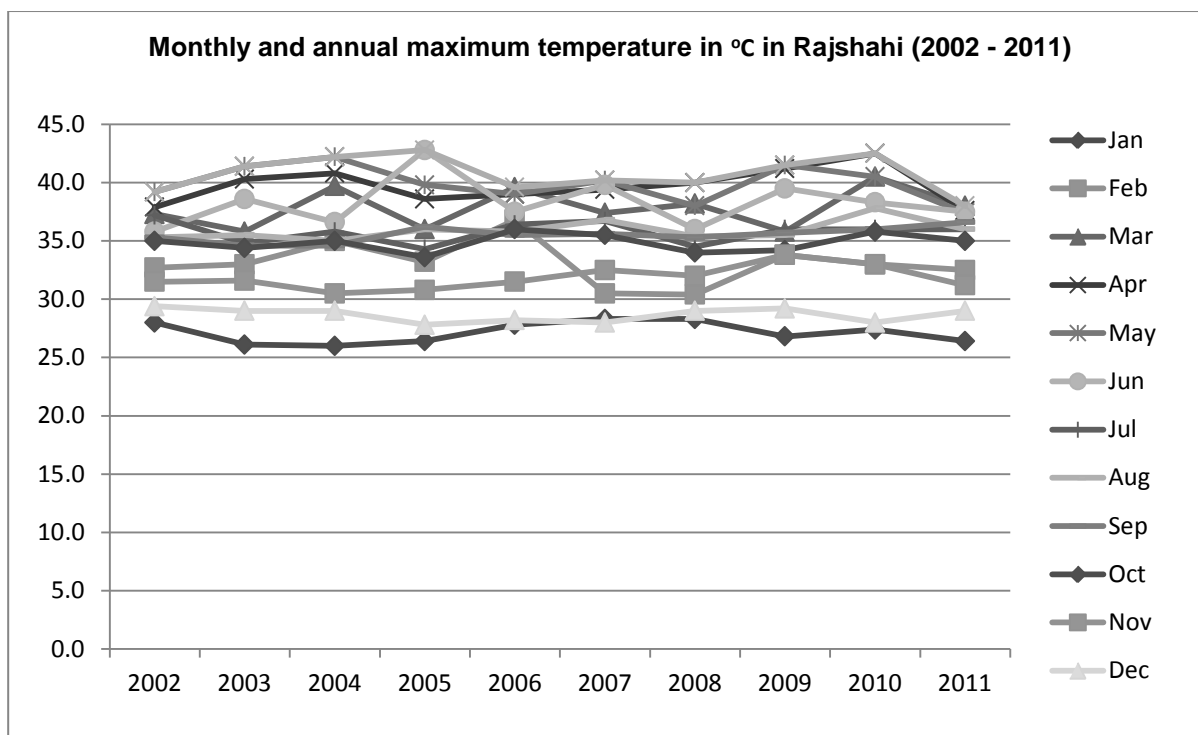


Fig 16: Monthly and annual maximum temperature (°C) in Rajshahi (2002-2011)

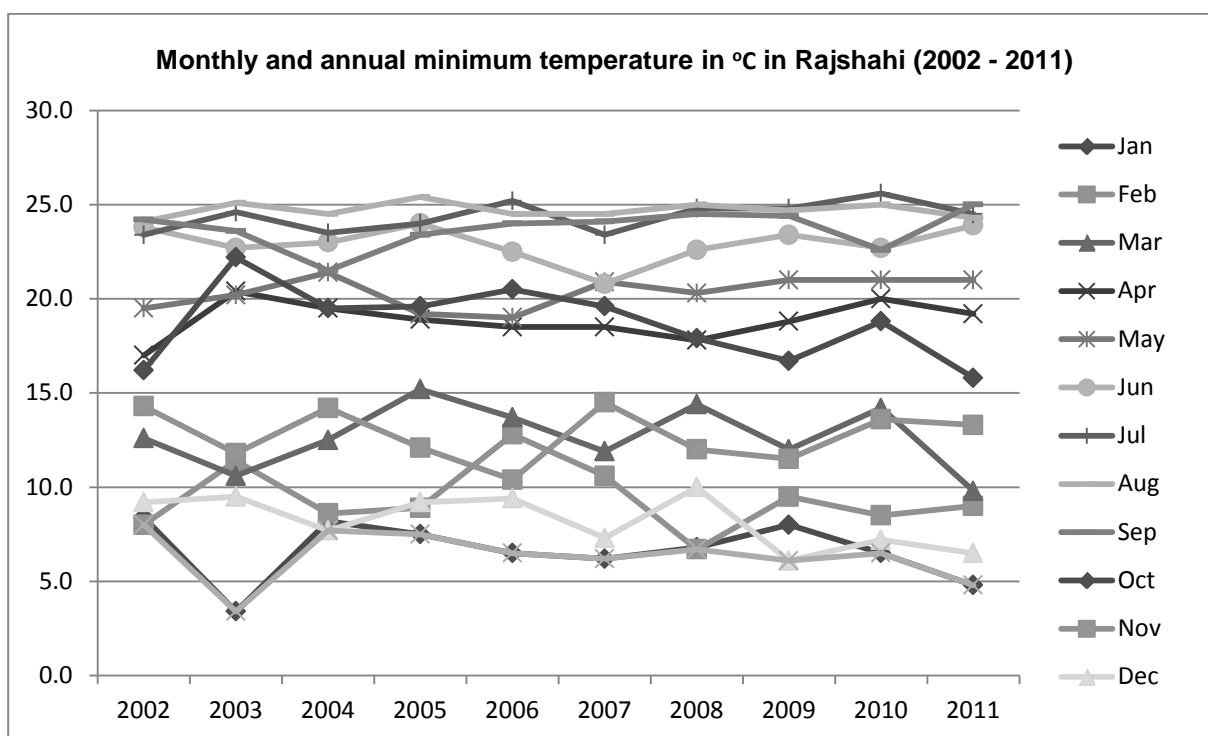


Fig 17: Monthly and annual minimum temperature (°C) in Rajshahi (2002-2011)

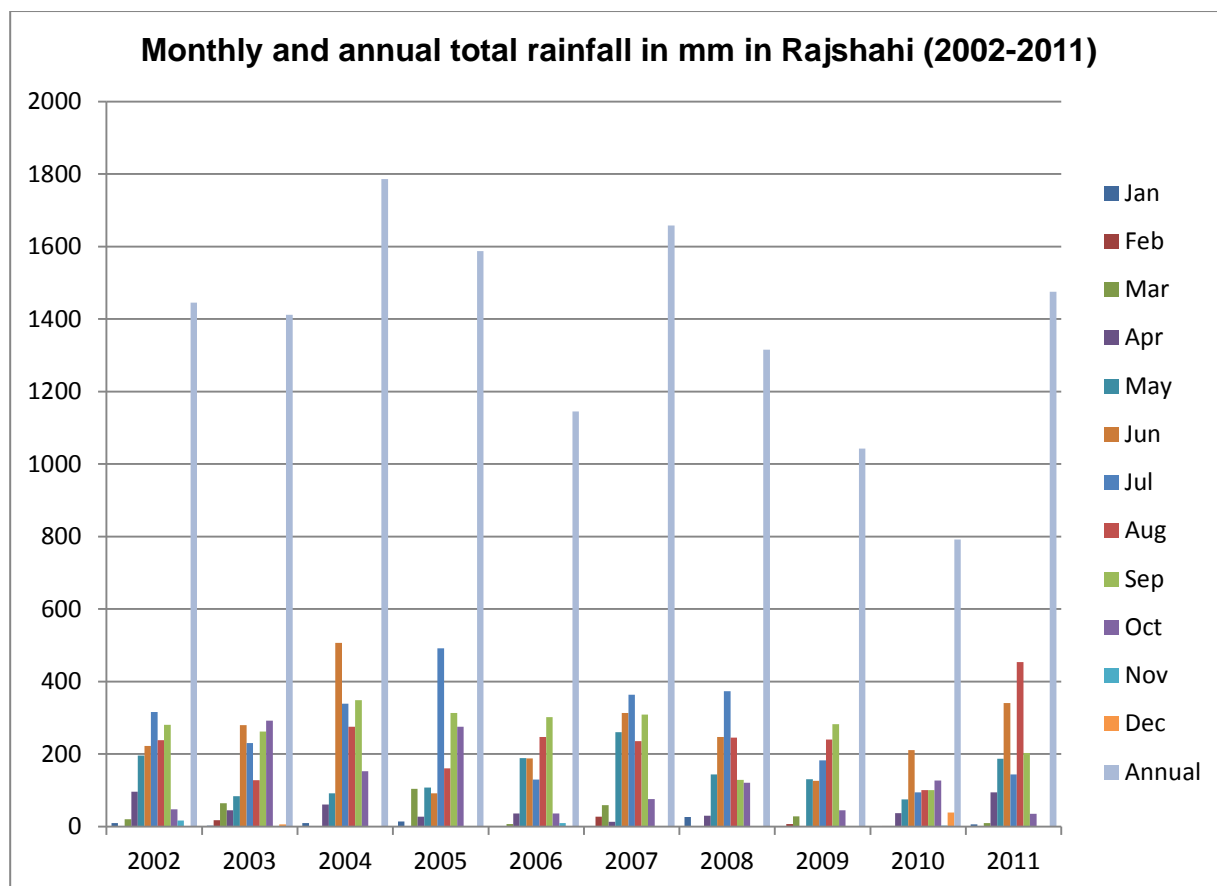


Fig 18: Monthly and annual total rainfall (mm) in Rajshahi (2002-2011)

3. Air Quality

55. Air quality is generally good in rural Bangladesh, where there are few industries and low densities of people and vehicles. The situation is very different in the cities, where urbanization, industrialization and overcrowding create major air quality problems. In 1988 the World Bank estimated that 15,000 deaths per year and a million cases of major illness are caused by air pollution in Dhaka, Chittagong and Rajshahi.

56. The main atmospheric pollutants are those produced by vehicles and industries and in particular by the burning of fuels. These include particulate matter, hydrocarbons, carbon dioxide, carbon monoxide, sulfur dioxide, oxides of nitrogen, lead, ammonia and hydrogen sulfide. Many of these cause respiratory problems in humans, plus other diseases if substances accumulate in the tissues. The main causes of the poor air quality are:

- (i) Poor roads and traffic management leading to severe traffic congestion;
- (ii) Use of high sulfur diesel by buses and trucks, and inadequate control of emissions;
- (iii) Heavy industrialization, and use of cheaper high-sulfur fuels (coal, wood and tyres) by smaller industries like brick kilns; and
- (iv) Poor solid waste management, so burning is the common method of treating garbage.

57. Surveys by the DoE show levels of Suspended Particulate Matter (SPM) and sulfur dioxide (SO₂) in Rajshahi and other cities that exceed Bangladesh Air Quality Standards, and levels of atmospheric lead that are above World Health Organization (WHO) standards. These should fall over the next few years however, as laws are enforced reducing the

number of two-stroke vehicles, and consumers change to vehicles using lower cost unleaded petrol and compressed natural gas. As the proposed Rajshahi landfill site is located in a rural agricultural setting, the air quality is generally good.

4. Surface Water

58. Most of Bangladesh lies within the floodplains of the Ganges, Jamuna and Meghna rivers, which drain a catchment of around 1.72 million km² in India, Nepal, China, Bhutan and Bangladesh. Only 8% of the catchment is within Bangladesh, and because of its topography, flood-risk and population density, the quality and quantity of surface waters are major issues for the country. Rajshahi lies in the North Western Region of Bangladesh, and it is situated on the bank of river Padma. All rivers in the region show large seasonal variations in flow, and discharge in the Jamuna for example fluctuates between <5,000 cumecs in the dry season to a maximum of around 67,000 cumecs in the monsoon.

59. Like other towns and cities of Bangladesh, the Rajshahi city dwellers, too, use both surface and groundwater as a source of domestic water. Principal difference lies in use of supply water based on treatment with some application of chlorine in Rajshahi and other population centers. Pollution of rivers is a major problem, because of the discharge of industrial wastewater and inadequate sewerage.

60. During the preparation of Master Plan, Structure Plan and Detailed Area Plan of Rajshahi Metropolitan City (2004), detailed samples were analyzed to get first hand information about the quality of surface water around Rajshahi. Table 2 below presents that result in detail. According to ECR 1997, standard for inland surface water to be used by various process and cooling industries should have pH (6.5 – 8.5), BOD (10 mg/l or less), DO (5 mg/l or more) and total coliform number/100 ml (5000 or less). In Table 3, Dargapara point of Padma river is located near the proposed site for slaughterhouse and has the following parameter values: pH (8.4 to 8.7), DO (7.0), Fecal Coliform (200 in summer and >250 in rainy season). After careful consideration, it is clear that this water can be used for water source if proper treatment is ensured. Alternatively, the safer source will be the groundwater from well dug inside the proposed site.

Table 2: Surface Water Quality in Rajshahi Area during the Summer, Rainy and Autumn Seasons

Sl. No.	Location	Date & Time	Seasons	PH	Turbidity JTU	DO mg/L	Cl	Total Hardness	Ca.H	Mg.H	Fe	Mn	F.C
1.	Talaimari point Padma river water	11.05.02 9:05AM	Summer	8.7	12		20	53	-	-	0.5	0.05	70
		21.08.02 12:05PM	Rainy	8.5	80	7.0	10	36	30	6	6.5	0.22	>200
2.	Dargapara point Padma river water	11.05.02 9:30AM	Summer	8.7	15		22	64	-	-	0.3	0.04	200
		21.08.02 12:25PM	Rainy	8.4	80	7.0	10	35	29	6	9	0.24	>250
3.	Central park point Padma river water	11.05.02 9:45AM	Summer	8.7	12		20	54	-	-	0.3	0.04	100
		21.08.02 12:45PM	Rainy	8.4	85	8.0	11	41	32	9	8.5	0.26	>200
4.	Naohata Bridge Barannai river	11.05.02 11:45AM	Summer	7.6	50		25	40	-	-	2.7	0.04	200
		21.08.02 10:00AM	Rainy	7.8	75	6.0	13	46	24	22	3	0.02	>200
5.	By pass road beel (Tikri beel)	11.05.02 12:30PM	Summer	8.6	22		85	106	-	-	0.3	0.05	200
		21.08.02 9:45PM	Rainy	7.4	10	5.0	43	99	64	35	0.6	0.77	>200
6.	Naohata Area (Tikri para) pond water	21.08.02 10:30AM	Rainy	7.8	10		32	114	80	34	0.4	0.12	>300
7.	Sopura Industrial Area pond water	21.08.02 11:00AM	Rainy	7.9	10		87	52	35	17	0.3	0.02	>300
8.	Kadirganj Area pond water	21.08.02 11:20PM	Rainy	8.0	12		65	74	38	36	2	0.50	>300
9.	Sonadighi Area	21.08.02	Rainy	8.6	20		102	49	34	15	0.45	0.02	>300

Sl. No.	Location	Date & Time	Seasons	PH	Turbidity JTU	DO mg/L	Cl	Total Hardness	Ca.H	Mg.H	Fe	Mn	F.C
	pond water	11:45AM											
10.	Bhatapara point pond water	21.08.02 1:00PM	Rainy	8.0	20		77	72	58	14	0.8	0.10	>300
11.	Shibpur Beel	08-08-02 10.10 AM	Rainy	7.2	-	5.0	-						
		30-09-02 11.05AM	Autumn	7.9	26.5		20	126	99	27	0.34	0.20	200
12.	Foliar Beel	08-08-02 12.10PM	Rainy	8.1	-	9.0	-						
		30-09-02 12.35PM	Autumn	7.8	34.5		32	126	99	27	0.30	0.17	400
13.	Belpukuria pond	30-09-02 11.15AM	Autumn	7.8	14.5		40	100	77	23	0.67	0.10	200
14.	Katakhali Khal at Harian	30-09-02 11.30AM	Autumn	7.3	24.8		40	127	102	25	0.72	0.30	50
15.	Kazla pond	30-09-02 11.55AM	Autumn	8.0	15.8		120	136	109	27	1.96	0.79	150
16.	Champa pukur pond	30-09-02 12.15PM	Autumn	7.8	13.0		44	133	102	31	1.06	0.43	70
17.	Pora beel near Kayra	30-09-02 1.00PM	Autumn	7.8	31.5		36	133	106	27	0.39	0.15	60
Bangladesh Standard for Drinking Water				6.5-8.5	10	6.0	150-600	200-500			0.3-1.0	0.10	0

61. The distance of the proposed CLF and effluent discharge point to the river Padma is about 7 kilometers. The leachate from the CLF will be treated in the treatment plant and final finishing will achieved by allowing to pass through green zone created within the CLF area.

5. Groundwater

62. There are three main aquifers in the central region of Bangladesh:

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

63. Ground water quality of Rajshahi City Corporation area is poor. For high amount of manganese as well as iron and hardness, the city dwellers face very bad situation during drinking of water. This water is even not suitable for bathing. For high manganese, iron and hardness, the hair gets clumsy and it is necessary to use soap and shampoo regularly. Loosing of hair is also reported. Ground water of 25 pumps of Rajshahi City Corporation was collected and analyzed by Bangladesh Arsenic Mitigation Water Supply Project. From their analysis it was found that 24 pumps out of 25 contained a higher amount of manganese than drinking water permissible limit of Bangladesh. However, iron concentration exceeds the standard only in five pumps. Outside Rajshahi City Corporation, except Charghat area, iron concentration of some ground water sources of Paba and Puthia exceeds the WHO and Bangladesh Standard for drinking water. Manganese is high in all three areas. However, the hardness is above the WHO Standard but below the Bangladesh Standard. The chloride in ground water is low in the context of pollution. Not hardness, manganese and iron only but also the ground water arsenic contamination is a major concern in the project area. WATSAN Partnership Project (2001) identified many arsenic contaminated tube-wells in the western, northern and eastern parts of Rajshahi City Corporation area.³

64. Elsewhere in the country, domestic water in urban areas is mainly abstracted from the surface and middle aquifers, which in many cases (including Rajshahi, Rajshahi and Barisal)

³ Study by DDCL during preparation of Master Plan for RCC

are contaminated by naturally-occurring arsenic, iron and aluminum, plus sewage bacteria, pesticides and industrial chemicals. Groundwater tables often fall by several meters in the dry season, exacerbated by excessive drawdown by tube-wells. Supply of potable water is an increasing problem for the water and sewerage authorities because of the depleting supplies and source contamination.

65. Supply of potable water is an increasing problem for the water and sewerage authorities because of the depleting supplies and source contamination. Water for the CLF will initially be sourced from city corporation supply but provision will be kept for digging well within the site for construction of CLF. The necessary clearance for digging well will be taken from the RCC.

6. Geology and Seismology

66. Most geological features of southern Asia were formed 54-38 million years ago in the Eocene Period, when the Indo-Australian tectonic plate moved northwards and collided with the Eurasian and East Asian Plates, forming the Himalayan Mountains where the plates overlap. Then in the Oligocene (38-26 million years ago) the north-eastern part of the Indian landmass fractured and sank below sea level, forming the Bengal Basin between outcropping older rocks in the west and east. Surrounded by high ground, with the sea in the south, and crossed by the Ganges and Brahmaputra rivers that formed at this time, the Basin gradually filled with sediment transported by the rivers. Subsequently the sediments have been eroded during periods of high sea level, and covered by more recent alluvial deposits when sea level has dropped.

67. With one of the world's major subduction faults in the north and a major transform fault in the Arkan Yomas to the east (where plate boundaries collide), the Bengal Basin is in one of the most active tectonic and seismic areas in the world. The National Seismic Zoning Map (Fig 20) produced by the Geological Survey of Bangladesh (GSB), divides the country into three regions: a high risk zone between Mymensingh and Sylhet in the north and north-east; a medium risk zone stretching diagonally from Rajshahi in the north-west through Dhaka and Comilla to Chittagong and Cox's Bazar in the south-east; and a low-risk zone in the south and south-west, around Rajshahi and Barisal. In the medium risk zone, shocks of moderate intensity are possible, with a probable maximum magnitude of 6-7 on the Richter scale. Seismic events in Bangladesh are relatively infrequent but historically have been severe. The Assam earthquake of 1897 was the largest in the region's history, when a force of 8.7 on the Richter scale caused extensive damage across Assam, Bengal and Bihar.



Fig 19: National Seismic Zoning Map of Bangladesh
Source: Internet

68. The National Seismic Zoning Map (Fig 20) of Bangladesh clarifies the seismological status of the various region of the country. The city of Rajshahi falls within the low-risk zone. The earthquake risk factor for this zone – 1 is 0.075, while the risk factors for zone – 2 and zone – 3 are 0.15 and 0.25 respectively.

B. Ecological Resources

1. Habitats

69. The main physical features of Bangladesh are its mainly flat and low-lying topography, the dominant presence of the major rivers that drain enormous catchments in surrounding countries, a seasonal monsoon that swells river volumes for several months each year, and the resulting floods that inundate large areas of land. It is not surprising therefore that those aquatic habitats are the country's most important ecological resources.

70. There is a wide array of aquatic habitats throughout the country: natural and man-made, permanent and ephemeral, of varying sizes and characteristics. The rivers and floodplains are the most important, as they support species that are exploited by man, are the most productive of the habitats, and attract other important species, such as birds. However, as in other environmental sectors, the rapid urbanization and industrialization of the country and its expanding population (particularly the urban poor who use natural resources to supplement both food and income) have brought large scale damage and degradation to these areas.

71. Both terrestrial and aquatic habitats exist in the Rajshahi City Corporation area. Terrestrial habitat dominates the aquatic habitat for much coverage of land by high land and medium high land. The highlands, homesteads and roads act as a habitat for terrestrial flora and fauna. However, the aquatic habitats include rivers, khals, beels, ponds, and borrow pits.

2. Rivers

72. Most rivers in Bangladesh suffer under the influence of man, from the disposal of solid and liquid waste in urban and industrial areas around Rajshahi and the other cities and towns, and from the diversion of water upstream for irrigation and/ or power generation.

73. Three main rivers around Rajshahi City Corporation area are Padma in south, Barnai in north and Baral in east. Padma, once a mighty river in Bangladesh is now calm, due to Farakka Barrage upstream constructed by the Indian Government to divert the water of Padma river to Hoogli river. The water flow of Padma river is about 30,000 cusec in lean period and 300,000 – 750,000 cusec during flood period. The maximum discharges of Baral and Barnai rivers are 20,500 cusec and 20,000 cusec respectively. Major natural khals in the project area are Duari khal, Barajal river, Hojakhal, and Katakhal khal. Some important beels are Shilinder beel, Tikure beel, Duari beel and Foliar beel.

74. The Rajshahi CLF will be located in the northern part of the Rajshahi city. Leachate from the CLF will be treated to achieve the required effluent standard. There will be no direct discharge of any effluent from the CLF to the river. Based on the environmental assessment conducted during project preparation, main use of the river is fishing and transportation of passengers and goods by different kinds of river vessels, and downstream users of the river include fishermen as well as residents of the Rajshahi city and other villages.

3. Floodplains and Fisheries

75. Floodplains are the natural lowlands alongside rivers, which are inundated each year in the monsoon as the increased volumes of water overflow river banks. These zones are important ecologically as they are the areas into which the adults of many species of fish migrate to breed. Floodplains are rich in nutrients from the inundated soil and decaying vegetation, and are also rich in food in the form of dead insects, soil invertebrates, and aquatic plankton that frequently bloom under such conditions. They are also protected from

the strong currents in the main river, so are ideal areas for young fish to feed and grow, before entering the main river when water levels decrease. These areas also frequently attract large numbers of water birds, to feed on the juvenile fish in the shallow waters.

76. This area falls under the AEZ- 10: Active Ganges Floodplain and AEZ – 11: High Ganges River Floodplain. Major land types and extent in AEZ – 10 are HL (12%), MHL (33%) and MLL (18%); and in case of AEZ – 11, these are HL (43%), MHL (32%) and MLL (12%).⁴ AEZ – 10 occupies unstable alluvial land within and adjoining Ganges river. It has irregular relief of broad and narrow ridges and depressions. The area has complex mixtures of calcareous sandy, silty and clayey alluvium. The General Soil Types predominantly include Calcareous Alluvium and Calcareous Brown Floodplain soils. Soils are low in organic matter and slightly alkaline in reaction. General fertility level is medium with high CEC but deficient in N, P and Zn contents. Boron status is medium.

77. AEZ - 11 includes the western part of the Ganges River Floodplain which is predominantly high land and medium highland. Most areas have a complex relief of broad and narrow ridges and inter-ridge depressions, separated by areas with smooth, broad ridges and basins. There is an overall pattern of olive-brown silt loams and silty clay loams on the upper parts of floodplain ridges and dark grey mottled brown, mainly clay soils on ridge sites and in basins. Most ridge soils are calcareous throughout. General Soil Types predominantly include Calcareous Dark Grey Floodplain soils and Calcareous Brown Floodplain soils. Organic matter content in the brown ridge soils is low but higher in the dark grey soils. Soils are slightly alkaline in reaction. General fertility level is low although CEC is medium and K-bearing minerals are medium to high but the Zn and B status is low to medium.

78. Elsewhere in the country floodplains have been similarly affected by flood protection schemes, land reclamation and urban development, and there is little doubt that such areas are far less productive than they once were. Even in the more rural areas the quality of floodplains is degraded, in this case by agricultural development, which exposes floodwaters to pesticides and fertilizers in the soil and crops.

79. There is city protection embankment in the northern bank of the Padma river, which protects the city from flooding. Padma river bank protection revetment was constructed in the year 2008 to stop bank erosion. However, the Bangladesh Water Development Board (BWDB) authority suggested that the structures built outside the city protection embankment should be designed considering the highest flood level of (+) 19.50 meters PWD (Public Works Department).

4. Other Aquatic Habitats

80. There are a variety of other aquatic habitats throughout the country, and in urban areas these include man-made lakes in residential neighborhoods, permanent and ephemeral pools in natural lowlands (known as *bheels*), and flooded borrow pits excavated for building material. These are generally of little ecological value as the water is frequently polluted, and these areas are often characterized by dense growths of the water hyacinth *Echicornica crassipes*, which out-competes other plants through its rapid growth, although species such as water chestnut, helanca (*Alternanthera philoxeroides*), kalmi (*Ipomoea aquatica*) and lotus can be seen in some places.

81. In the subproject area of influence, there are aquatic species that were ascertained in different studies in the recent past. There are 265 species of fishes under 154 genera and 55

⁴ HL = High Land, MHL = Medium High Land and MLL = Medium Low Land.

families in the inland waters of Bangladesh (Rahman, 2005)⁵. Islam and Hossain (1983)⁶ provided an account of 110 species of fishes of the river Padma near Rajshahi. Bhuiyan *et al.* (1992)⁷ listed 133 species inhabiting the freshwater fishes of Rajshahi district. IUCN (1998)⁸ reported that roughly 56 freshwater fish species out of 265 species are critically endangered and 50 species of fishes have become rare which were found abundant in last decades in their research covered areas in Bangladesh.

5. Terrestrial Ecology

82. The city of Rajshahi is almost denuded of the trees and vegetation that once had beautified and made its environment congenial to terrestrial ecology specific of this area. Only the mango and lichi trees are seen as special plants in this region. Rapid and continuous growth in the city population has encouraged various land-grabbers and mushroom growth of land development firms with a resultant erasure of wetlands, trees, greeneries, vegetation and forest lands in and around the city and replaced by widespread concrete jungles in the name of high-rise buildings.. The urban terrestrial fauna is very limited as a result, and mainly consists of animals able to live close to man, such as lizards and geckoes, scavenging birds like house sparrow and crows, mice, rats and other rodents, plus jackal, mongoose, squirrel and monkeys. There is a wider range of species in the farming areas, but even these are mainly animals that are commonly found close to man, such as cattle egrets.

83. Based on findings during the site visits in the preparatory phase, an estimated 4 numbers of small trees are present in the CLF site. All these trees are owned by the Rajshahi City Corporation. The actual requirement for tree-cutting will be finalized during the detailed design stage. Permit/ clearance for tree-cutting will be obtained from the RCC before any removal of trees in the area.

6. Protected Areas and Endangered Species

84. Important conservation areas are invariably well away from centers of inhabitation for obvious reasons. Nevertheless there are certain areas in the towns and cities that are protected because of their ecological or scientific interest. These are mainly created by man and are intended primarily for entertainment and leisure purposes (such as zoo gardens, civic parks and children's gardens), and are of little interest in terms of nature conservation or species diversity. Rajshahi is well known for its archaeological and protected sites of tourist destination and famous landmarks. Notable places include: (i) Sompur Bihar, a large Buddhist monastery; (ii) Varendra Research Museum, one of the foremost museums specializing in history of ancient Bengal; (iii) Mohasthangar, home to archeological sites of Hindu, Buddhist and Muslim periods; (iv) Puthia Temple Complex and Palaces, the palaces of old *Jamidars*, some Kilometers drive from Rajshahi city; (v) Bagha Mosque, in Bagha thana of Rajshahi District; (vi) Dighapatia Palace, palace of the famous Queen of Dighapatia, located in Natore district; (vii) Kushumba Mosque, Naogaon, (viii) Shona Mosque, Chapai Nawabgonj, and (ix) Chalan Beel, the largest water body in Bangladesh, spreading in Natore and Pabna districts.

⁵ Rahman A K A (2005), Freshwater Fishes of Bangladesh (2nd Edition); Zoological Society of Bangladesh, Dhaka, 394 pp.

⁶ Islam M S and Hossain M A (1983) An account of the fishes of the Padma river near Rajshahi, Raj. Fish Bull. 1(2): 1-31

⁷ Bhuiyan A S, Islam M N and Hossain T (1992) A checklist of the fishes of Rajshahi, The Rajshahi University Studies Part B, XX, pp. 287 - 306

⁸ IUCN (1998) Major conservation issues of the 1990s: Results of the World Conservation Congress workshops. 203pp.

85. There are no protected areas within or adjacent to the CLF site. The nearest protected area of Varendra Research Museum is about 6 kms from the proposed CLF site located in the northern part of the city. There are some endangered species in the Padma river as discussed in the previous paragraph under aquatic habitats. Flora and fauna found in the CLF site are those commonly found in developed and urban areas.

C. Economic Development

1. Industry

86. Rajshahi is not an industrial city. Three major industries are Rajshahi Jute Mills, Rajshahi Textile Mills and Rajshahi Sugar Mills. Two mills are located in the eastern side of Rajshahi City at Katakhal area. Rajshahi Silk Mills is located in the western side of Central Bus Stand at Sheroil. Three cold storages are located in the northern side of Rajshahi City Corporation area near Naohata, along Rajshahi –Naogaon Road.

87. Brickfields are scattered in and around the Rajshahi City Corporation area. There are 66 brickfields in the Rajshahi metropolitan area and 45 in the existing Rajshahi Development Authority boundary. A high number, 30 brickfields are located only in Parilla UP, 12 in Haragram and 8 in Harian UP. Brickfields cause severe air pollution in the Rajshahi City Corporation area, particularly in these three UPs. The people have reported reduction of mango and boro production. Brickfields are also responsible for changing the natural topography of earth surface by soil collection. Valuable topsoil is being lost due to soil collection from fertile agricultural land.

2. Infrastructure

88. Infrastructure is a major problem in all towns and cities in Bangladesh, where many facilities are inadequate to serve the needs of such a large population, after decades of under-funding and neglect. Dhaka is the only area in Bangladesh with a sewer system and this serves only 20% of the population and the sewers are blocked and leaking in many places. Throughout the rest of the country people use a variety of methods including septic tanks, pit latrines, and open defecation. Septic tanks malfunction because of inadequate design, construction or maintenance, or because the high water table impedes the soak-away function. Many buildings, including high-rise developments, have no sanitation system at all, and discharge their effluent into lakes, rivers, drainage ditches or onto open ground, causing unsightly areas, health risks and water pollution.

89. In Rajshahi urban areas, solid waste management is the responsibility of the Rajshahi city corporation; and in most locations NGOs or CBOs operates the primary collection service, removing waste from houses and businesses each day, mainly on cycle-rickshaws. These carry waste to Secondary Transfer Stations (STS) at various locations around the town, from where it is carried for final disposal by vehicles operated by the Rajshahi City Corporation. There is no properly designed and operated controlled landfill area for the Rajshahi City Corporation. The Rajshahi City Corporation at present dumping the waste in the landfill site located in the northern side of Rajshahi bypass road. There has been some limited and minor development of this landfill site under the STIFPP – II of LGED⁹. The process of disposal is by open dumping with little or no management or pest control, and as a result these areas are highly insanitary and hazardous to public and environmental health. There is no effective medical waste treatment facility run by the Rajshahi City Corporation.

⁹ Secondary Town Integrated Flood Protection Project phase II of Local Government Engineering Department; some secondary transfer stations (STS) and development of waste disposal sites by construction of peripheral embankment with brick soling, approach road for the site, etc. were relevant to solid waste management of RCC.

But new initiatives have been taken to construct controlled landfill site including facilities for management of medical waste under the present program of UPEHSDP. After implementation of UPEHSDP, it will be possible to utilize these facilities for safe disposal of domestic wastes, slaughterhouse wastes as well as other hazardous wastes from the RCC.

90. In the existing landfill site in Rajshahi, there is no compost plant although there are some compost plants within the city but with small capacities and poor and unhygienic management. New compost plant will be installed in the controlled landfill site to be developed under the UPEHSDP. At present, there are some modern type transfer stations in RCC area implemented under the STIFPP but the collection and transportation of solid waste will be improved substantially after implementation of the 6 STSs proposed under different package of UPEHSDP.

3. Transportation

91. Rajshahi city has a good network of road, railway and air communication with other parts of Bangladesh. Inter-district buses ply along 20 routes and intra-district buses another 12 routes daily. It has a good bus communication with major towns and cities of Bangladesh such as Chapai Nawabganj, Naogaon, Natore, Bogra, Rangpur, Dinajpur, Pabna, Kustia, Jessore, Rajshahi, Sirajganj, Tangail, Mymensingh, Dhaka and Chittagong. Air-conditioned buses are in operation between Dhaka and Rajshahi daily. Dhaka Rajshahi air transport started in 1984. But at present, it is not in operation because of various reasons. Rajshahi is also linked to other parts of Bangladesh with rail communication. Inter-city trains and many mail and local trains ply between Rajshahi and other towns.

92. Local communication in Rajshahi City area is still outdated. Rickshaw is the main vehicle for local communication. There is no available town service bus in this city. Only one double-decker moves between Court to Baneshwar, but irregularly. A few numbers of baby-taxis and some tempos also ply from Court to Bus Stand, Ghorehanga Moar to Naohata and Shaheb Bazar to Katakhal route. During office period, many people are found to use bicycle to reach the offices and working places.

4. Land Use

93. In most urban areas the expansion has been inadequately planned and controlled, because of ineffective planning and inadequate policing of the planning laws and implementation of the land use policies. As a result, inappropriate mixes of land uses are commonplace (e.g. residential and industrial), and areas have grown without the provision of supporting infrastructure (water, sanitation, schools, hospitals, etc). Planning problems are compounded by natural and anthropogenic factors, which include: seasonal flooding, which limits the use of large areas; population expansion, which puts a high demand on land; and the high proportion of urban poor, who have little alternative but to erect makeshift shelters on vacant land, increasing the slum areas.

94. The urbanization pattern of Rajshahi City is characterized by haphazard growth. Land use follows a similar general pattern in most towns and cities, with mainly urban uses in the centre and residential in the outskirts. The town centre normally houses the main business and commercial districts, and contains shops and offices lining the roads, often in high-rise developments. There are also service industries in these areas, including restaurants, convenience stores, vehicle repair etc, plus residential units, often above the shops and offices. The urban fringe generally contains the better quality residential developments, and there are also shops and retail outlets, but less industry. There is also some agriculture in the outskirts, particularly in the more rural parts of the city.

95. The proposed site for the CLF is on the land owned by the RCC and Government of Bangladesh, and at present being used as disposal site for dumping of solid waste from the entire Rajshahi city. There are no existing structures or sheds used by the waste pickers/scavengers.

5. Power Sources and Transmission

96. The sole Government authority for generation of electricity is the Bangladesh Power Development Board (BPDB). Major agencies in distribution of electricity include the BPDB itself and the Rural Electrification Board (REB). There are a few other specialized power distribution agencies such as the Dhaka Electric Supply Authority (DESA) and Dhaka Electric Supply Company (DESCO) for Dhaka or the Rajshahi Electric Supply Company (RESCO) for Rajshahi. The power division of the Ministry of Energy and Mineral Resources is the umbrella organization that controls power generation, transmission and distribution. An Independent Power Project (IPP) of the ministry is under implementation for improvement in generation and distribution of electricity by Government and private agencies. BPDB operates 22 power stations with a total installed capacity of 3,150 mw. The new 15 stations include 2 barge-mounted plants (one at Rajshahi and the other at Sikalbaha) and 13 conventional ones at Ashuganj, Sylhet, Fenchuganj, Ghorasal, Haripur, Raozan, Baghabari, Bheramara, Saidpur, Barisal, Rangpur, Bhola, and Chittagong.

97. Power is provided to most urban areas through a network of electricity pylons and poles, mainly located beside roadways. This provides connections to individual houses, and revenue collection is by individual household meters. Generation is insufficient to offer a continuous supply, and the providers operate a system of “load-shedding” whereby they turn off the supply for 1-2 hours each day to conserve the resource. Hotels, businesses and the more wealthy residents increasingly use their own generators to augment the supply from the national grid.

98. Power problem in the Rajshahi region has turned acute over a couple of years as there is a gap between the supply and demand. Regular activities in public and private offices and commercial establishments are routinely hampered because of a shortfall of about 20 MW of power each day on average. The region accommodates more than 1 crore population leading to an average daily demand of about 100MW of power, while the supply hovers between 75 MW and 85 MW. As a result the Power Development Board (PDB) has to go for load shedding everyday in a cyclic order in the region and the city. Rural electrification Board provides electricity to the areas other than PDB Circle. Two 50KV power stations have been already built at Katakhalī to meet the growing electricity demand of the city.

99. The proposed site of the CLF is located within the city area. Power supply for this site will be possible by extension of the existing facility to the site by installation of few electric poles as per design requirements. A transformer/ substation might be required to fulfill the design needs.

6. Other Economic Development

100. Apart from the usual agricultural products of Bangladesh, such as rice, wheat, potatoes and lentils, Rajshahi and its neighboring regions are specially suited from various crops such as Watermelons, Sugarcanes, Mangoes and Lichies. Rajshahi Krishi Unnayan Bank, a nationalized bank with its head office at Rajshahi is working in a mission to help the agriculture sector of Rajshahi & Rangpur division.

101. In spite of being an important city and located on a riverbank, industrial development in Rajshahi has not taken place to any great extent. Though locals have claimed that this is

due to lack of attention from the central government in Dhaka, business community of the city is also responsible for lack of initiative to build industries in the private sector. In the 60's an *Industrial Park* had been established in Rajshahi, which is now mainly home to industries producing products of the famous Rajshahi silk. Rajshahi is also home to number of jute mills, textile mills, a sugar mill and mango based industries. No doubt there will be rapid industrial development in Rajshahi if gas is supplied through pipeline which the people of Rajshahi have been demanding for a long time. The Government has taken steps to supply gas to Rajshahi quickly and a project towards this end has already begun.

102. There is a potential for tourism in the bank of river Padma. The RCC authority has already developed some spots and arranged for public facilities, which has been appreciated by the people. It might also be possible to develop agro-based cottage and medium-sized industries in certain farming areas.

D. Social and Cultural Resources

1. Population and Communities

103. The population of the greater Rajshahi area is 615,616. Of them, 339,932 live in the RCC area, about 55% of the total population and the second highest, 31.63% live in Paba area. The population density in RCC is 3,514 per Sq. Km., which is three times higher than Paba, 2.48 times than Puthia and 2.15 times than Charghat thana. The male-female ratio in urban area (RCC) is 102.69:100 and 107.85:100 in rural area. The population growth rate in the greater Rajshahi area is 1.46. Household size in RCC is 5.31 and 4.51 in rural area; those are slightly lower than the country average of 5.5.

104. From sample survey¹⁰ it is found that a major portion of population is within 0-14 years of age. In urban area (RCC), 27.3% population is within this age group whereas in rural area it is 33.6%. Other major age groups are 15-19 and 20-24. These two age groups comprise of 11.60% and 11.70% in urban area, and 10.60% and 9.60% in rural area. However, the percentage of higher age (59+) people is very low, only 5.60% in urban area and 5.20% in rural area. 47.20% people are married in urban area and 48.11% people are married in rural area.

105. In Rajshahi district, the total population is 2,595,197, of which number of Muslims is 2,430,194 (93.64%), Hindus 122,394 (4.72%), Christian 27,830 (1.07%), Buddhist 134 (0.01%) and others 14,645 (0.56%).¹¹

2. Health Facilities

106. Rajshahi city is a very important place for treatment of patients of the entire division, especially people from remote areas who cannot afford their journey to the capital city of Dhaka. Generally, people tend to visit qualified or competent health service providers, but it is also a common tendency to prefer sources, which are cheaper or free of charges. Government health centres can provide low cost health services, but the quality of services is not up to the mark. Low income of the people is a bar to avail of the advantages of improved healthcare facilities available in the private sector. Government hospitals are still important places for treatment particularly for the low income people.

107. Health facilities are available in all four thanas of Paba, Boalia, Charghat and Puthia in Greater Rajshahi Metropolitan area. In Charghat and Puthia, people get health services from Union Health Complex and Thana Health Complex. However, the city dwellers mainly

¹⁰ Field survey by Master Plan Preparation Consultants.

¹¹ Bureau of Statistics data for 2011.

rely on Rajshahi Medical College (RMC) for health services. Complicated patients from the rural area of RDA come to the RMC for better treatment. Even patients from northern other districts come to this hospital.

108. Besides RMC, other hospitals like TB Hospital, Infectious Diseases Hospital, Christian Mission Hospital, City Hospital, etc. provide health services to the people. Health service facility to the government employees is provided by the Police Hospital, BDR Hospital and Combined Military Hospital. Rajshahi University has its own health service system for students, teachers and employees. Family planning and immunization facilities exist more or less in all hospitals.

109. Public health facilities provide good service, but many are under staffed and under resourced, and ratios of beds per numbers of population are inadequate. Facilities are significantly better in the private sector, but care is expensive, and out of reach of any but the wealthier citizens.

3. Educational Facilities

110. Rajshahi is an important educational center in Bangladesh. Major educational institutes include: Rajshahi University, Rajshahi University of Engineering & Technology, Rajshahi Medical College, Rajshahi College, Rajshahi cadet college, New Government Degree College, Rajshahi Government City College, Rajshahi Government Women's College, Teacher's Training College, Rajshahi Collegiate School and College (The oldest of the region), Silk Research and Training Institute, Rajshahi Polytechnic Institute, Rajshahi Mohila Polytechnic Institute, Asian University of Bangladesh - Rajshahi Campus, Islami Bank Medical College, Project Headway English Training Institute Uposhahar, University of Information Technology and Sciences, Rajshahi Campus, Barendra College, Shah Mokhdum College, Institute of Forest, Birkutsha Abinash School and College – Bagmara – Rajshahi, Northern University Bangladesh - Rajshahi Campus, Adarsha College – Katakali, Shardah Government Pilot High School, Shaleha Shah Mohammad high School and Bangladesh Polytechnic Institute.

111. In Rajshahi, total numbers educational institutions are: Kindergartens (41), Primary Schools (911), Junior High Schools ((30), Secondary High Schools (215), Colleges (63), Universities (2) and Madrasahs (489).

4. Socio-economic conditions

112. Rajshahi is the biggest city in northern Bangladesh and it is the heart of divisional administration. Offices of most of the regional headquarters are located here. Government offices and semi-government organizations are the main employment sources, 27.8% in Rajshahi City Corporation area and 12.9% in rural area. Due to location of this city at the western edge of Bangladesh, industries, non-government and commercial offices have not grown well like Dhaka and Chittagong. Industries make up employment only 0.8%, both in rural and urban area. Rajshahi is famous for its high number of educational organizations. Government offices, Rajshahi University, BIT, Rajshahi Medical College (RMC), other technical and general colleges play important roles for employment in the project area.

113. Around the RMC at Laxmipur, many private clinics, diagnostic centers and hospitals have grown up. These organizations have also created job opportunity for many people. Transportation sector is also another employment area in Rajshahi. Rajshahi has good bus communication linkage with Dhaka, Bogra, Pabna, Jessore, Natore, Rangpur, Naogaon, Chapai Nawabganj and to local thanas. Many people are directly or indirectly involved in transportation sector. Major industries in the project area are Rajshahi Jute Mills, Rajshahi Sugar Mills, Rajshahi Cotton Mills, Rajshahi Silk Industry and some cold storages.

Employment opportunity is very limited (0.8%) in these few industrial units. Business is the second main employment sector in Rajshahi city. A large number of people are involved in business, 26.9% in urban area and 23.3% in rural area. Shaheb Bazar is the main commercial hub of Rajshahi city. Poor people are mainly rickshaw/ van pullers (2.7% in urban area and 5.2% in rural area) and day laborers. Many poor women work in students' mess and in the house of rich people. Some poor women are engaged in selling smuggled sugar, clothes, stainless plate, etc. in the project area. However, outside Rajshahi City Corporation, agriculture is the main sector of employment and income.

114. In general, the trend for rural-urban migration is largely a result of a lack of secure employment and sustenance in the rural areas, so people move to the cities where they believe there are better job opportunities. As noted above these rarely materialize and the end result is an increase in the urban poor, and an expansion of the slums. More than 82% of the population of Bangladesh lives on less than \$2 per day, and such people are mainly the urban poor and the rural poor. Slum dwellers in the towns and cities include people who are in regular employment, plus large numbers who are unemployed and who obtain an income from the streets where they can. Employed slum dwellers work mainly in construction or in factories, or as domestic servants, rickshaw operators, street vendors, etc.

115. Waste pickers are observed at the existing dumping site and consist of male, females, and children. This is often their primary source of livelihood made from recycling waste.

5. Physical and Cultural Heritage

116. The main cultural monument in Rajshahi City Corporation area is Mazar-e-Sharif of Hazrat Shah Makdum (R) at Darga Para of Rajshahi City. Everyday many people visit this shrine. There are about 20 historical places and tourists' spots in the city boundary according to the Authority of Varendra Museum, Rajshahi.

117. Some cultural heritage and monuments like Sompur Buddha Bihar, Kushumba masjid, Bagha Shahi Mosque and Choto Shona Masjid are located at the adjacent districts of Naogaon and Chapai Nawabganj. However, both national and foreign tourists use Rajshahi City as terminal point to visit these places.

118. Rajshahi is famous for its characteristic sweetmeats, not to be found anywhere else in the country. These special preparations include Roshkodom, Khaja, Raghobshahi and Kachagolla (Natore is especially famous for this particular sweetmeat). Along with neighbouring Chapai Nababganj, Rajshahi is the home of the region's best mangoes and lichis. Rajshahi is also the home of Barendra Museum which is famous for its collection of local sculpture and other artefacts dating from medieval times, and of Rajshahi silk, the finest silk produced in Bangladesh.

6. Indigenous Peoples

119. The majority of Bangladesh's people are Bengalis, and approximately 2.5 million are indigenous peoples belonging to 45 different ethnic groups. These peoples are concentrated in the north, and in the Chittagong Hill Tracts (CHT) in the south-east of the country. Their historical background, economic activities, social structure, religious beliefs and festivals make them distinctive. There is no specific pocket in the Rajshahi City Corporation where indigenous people can be found; rather they have mixed with other people of the community. Within the Rajshahi City Corporation, they are getting similar facilities as other citizens there; but they are not having enough opportunities within their own community because mainly of the isolated locations in different rural areas.

120. Environmental degradation has made their lives even more difficult. They have become the victims of the negative impacts of modernization, as they lack the education and awareness to be able to harness and enjoy the positive benefits that Bangladesh's economic growth has created.

IV. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

121. The present report assesses the impacts of the proposed activities on various environmental attributes of the project site.

122. **Methodology.** Issues for consideration have been raised by the following means: (i) input from interested and affected parties, if any; (ii) desktop research of information relevant to the proposed project; (iii) site visit and professional assessment by environment specialist engaged by the implementing agency; and (iv) evaluation of proposed design scope and potential impacts based on the environment specialist's past experience. Categorization of the project and formulation of mitigation measures have been guided by ADB's REA Checklist for Urban Development (Annex 1) and ADB Environment Policy.

A. Location and Design Impacts

123. In the case of this subproject there are few impacts that can clearly be said to result from the design or location. This is because:

- (i) The infrastructure involves relatively straightforward construction at a single site, so it is unlikely that there will be major impacts when the facility is built;
- (ii) The proposed location of the CLF is in an area where the RCC authority has already acquired as per Government regulations and there is no running activities, and also there are no sensitive areas or receptors nearby; and
- (iii) If the CLF operates in the manner intended it should be hygienic and well managed facility that functions with few emissions and without major negative impacts.

124. Planning principles and design considerations have been reviewed and incorporated into the site planning process whenever possible. The concepts considered in design of the CLF are:

- (i) The CLF should be adequate in size to accommodate solid waste collected from the target area.
- (ii) All the ancillary facilities for CLF should be provided with safe water.
- (iii) Water points, hoses and cleaning equipment must be provided in appropriate locations in sufficient numbers. Cleaning program must be performed regularly.
- (iv) Industrial three phase electricity should be supplied and a standby generator installed.
- (v) CLF should have its own drain and all drains must be accessible for cleaning for efficient waste water system.
- (vi) The CLF area should be protected by fencing to keep out from trespassing people, animals specially dogs/ cats etc.
- (vii) Strict enforcement of relevant national rules in solid waste management.
- (viii) CLF of RCC could be managed by private organizations/ parties through competitive bidding process following government public-private partnership guideline.
- (ix) Techniques, installation, management and training should be focused on minimization of water consumption, minimization of energy use, minimization of emission to air and minimization of noise.

- (x) Future extensions or possibilities to add some other installation should be kept in mind during the design and during the period of construction.

125. Interested contractors will bid based on the concept and details included in the bid documents. The bidders will be advised to make their own diligence study prior to the bidding. Necessary documents and studies will be made available to them for their evaluation. It will be up to the bidders to maximize the use of resources made available to them.

126. No impact is anticipated due to the location as the proposed sites are owned by the Rajshahi City Corporation. Resettlement Plan by the RCC authority has been already implemented to compensate, restore, or relocate any building/ infrastructure that will be affected by the subproject.

127. Workers' camp and storage area for materials to be established by the contractor will be needed for the entire 18-month construction period. Proper arrangement for health and safety including water supply and sanitation should be ensured in these places as per criteria mentioned in the EMP.

B. Construction Impacts

128. **Construction method.** The work comprises the construction of Controlled Landfill. The following are the scope of work:

- (i) Site preparation works particularly in (a) areas currently used for dumping, (b) areas with medical waste, (c) existing medical waste facility, and (d) areas used by ragpickers/ scavengers.
- (ii) Preparation of the ground by forming to level and grade and excavating locally for foundations or, if necessary, by excavating unsuitable fill material and replacing with imported compacted backfill.
- (iii) Shaping of ground to suit footings and floor slab layout and falls and to allow exterior ground drainage.
- (iv) Laying and backfilling over underground and under floor drains.
- (v) Boxing foundations and placing reinforcing with column starter bars.
- (vi) Pouring of slab and footings and curing.
- (vii) Construction of unreinforced masonry infill panels.
- (viii) Placing reinforcing, boxing, and pouring columns.
- (ix) Placing reinforcing for lintel beams and pouring concrete.
- (x) Casting in bolts and anchor plates as necessary in the columns and lintels.
- (xi) Fabrication and fixing roof trusses and bracing.
- (xii) Placing and fixing purlins.
- (xiii) Fixing roof cladding, gutters and downpipes.
- (xiv) Wall framing with cladding panels and insect mesh as necessary.
- (xv) Fixing of external rails for sliding doors.
- (xvi) Placing and fixing internal beams for rails plus fitting rails and hangers.
- (xvii) Constructing weather covers for sliding door rails.
- (xviii) Hanging of hinged doors.
- (xix) Internal wall and floor plastering as required.
- (xx) Painting as required.
- (xxi) Electrical Services.
- (xxii) Supply and/ or manufacture and installation of mechanical equipment.
- (xxiii) Construction of external effluent disposal system.
- (xxiv) Construction of solid waste disposal systems.

129. As explained above the land on which the CLF is to be constructed is currently being used as landfill site. This is open space beside the City Bypass road and easily accessible by the trucks. So during construction, there will be some very minor impacts like noise and dust due passage of construction materials carrying trucks on the people and there will be no issue of resettlement of affected persons.

130. Most of the site will be excavated to around 1.50 meter to create the cavities for the foundations of the buildings and paved areas. This will be done by backhoe digger and the excavated sand and soil will be loaded into trucks and transported to the municipal landfill for disposal.

131. All of the buildings and other structures will have Reinforced Cement Concrete (RCC) foundations, so metal reinforcing bars will be put into position in the cavities by hand. Concrete (mixed on site) will then be poured into the cavities to form the foundations and floors of the buildings and other structures and the paved surfaces of the roads.

132. The above-ground RCC elements will then be created by enclosing lengths of metal reinforcing in wooden shuttering and pouring in concrete, which sets to form the structure. This is then repeated in the next portion of reinforcing and so on to create the completed structure. The brick walls of the CLF ancillary buildings, toilets and boundary wall will then be created between the RCC supports by masons laying bricks and mortar by hand. Surfaces will be finished by plastering or tiling, and corrugated iron roofing will be applied and connected up by hand. Doors, windows, electrical fittings and pipe-work for water supply and drainage will also be added by craftsmen and laborers.

133. All materials will be brought to site on small trucks and offloaded and positioned by hand, and a small crane will be used for any heavier elements such as the steel supports and reinforcing bars, doors and the metal gates for the entrance to the site. Due to limited size of the landfill, it will not be possible to accommodate the rubbish there and all debris will be cleared at the end of construction by loading into a truck and depositing at an identified disposal site. Disposal sites for excavated soils and contaminated materials will be identified and agreed upon with the DoE before the commencement of any civil works.

134. There is sufficient space for a staging area, construction equipment, and stockpiling of materials. However, the contractor will need to remove all construction and demolition wastes on a daily basis to an identified disposal site as described in the above paragraph.

135. **Screening Out Areas of No Significant Impact.** From the descriptions given it is clear that implementation of this subproject will not have major environmental impacts because the construction work is relatively straightforward, and will all be conducted at only one site within the jurisdiction of RCC. Because of this there are several aspects of the environment that are not expected to be affected by the construction process and these can be screened out of the assessment at this stage as required by ADB procedure. These are shown in **Table 3**, with an explanation of the reasoning in each case. These environmental sectors have thus been screened out and will not be mentioned further in assessing the impacts of the construction process.

Table 3: Fields in which construction is not expected to have significant impacts

Field	Rationale
Climate	Short-term production of dust is the only effect on atmosphere
Geology and seismology	Excavation will not be large enough to affect these features
Forests, wildlife, endangered species, protected areas	There are no forests, protected nature conservation areas or important habitats or species at or near this site
Coastal resources	Rajshahi CLF site is far from the sea and also such structure constructed in one site only will not affect the coastal resources

Field	Rationale
Agriculture, tourism	There is agriculture in the nearby area but will not be affected by the construction activities; there is no site for tourism at or near this site
Population and communities	Construction will not affect population numbers, location or composition
Health and education facilities	There are no schools, clinics, hospitals, etc at or near this site
Physical or cultural heritage	There are no culturally important buildings or locations at or near this site
Indigenous Peoples (IP)	The proposed site is not used by indigenous peoples or minority communities
Archaeology, paleontology	No material of archaeological or paleontological significance has been found by previous construction projects in this area
Ecological value	There are no protected areas in the vicinity of this site and no special ecological interest exists within the boundary of the site under consideration; construction should therefore have no ecological impacts.

136. **Impacts due to excavations.** Excavating the foundations for the buildings, roads, surface drains, walkways and other structures on the site will produce around 3,000 m³ of waste soil and stone. This is a relatively small quantity so it can be taken to the selected and agreed municipal disposal site without special precautions to reduce the amount of dumping. The material could be put to beneficial use if it was utilized at the landfill to cover waste, so arrangements should be made by the Contractors with the landfill operators to deposit the waste in a suitable location where it can be used for this purpose. The reserved cell of the CLF may be an option for this. In any case, disposal sites for excavated soils and contaminated materials will be identified and agreed upon with the DoE before the commencement of the excavation activities.

137. Excavation is likely to be conducted in the dry season to avoid the difficult conditions that can occur when earthworks are carried out during rain. Precautions will therefore be needed to limit dust so that it does not affect surrounding areas or workers on site. Another physical impact associated with large-scale excavation is the effect on drainage and the local water table if groundwater and/ or surface water collect in the cavities as they are dug.

138. **Impacts due to alteration of the site.** The presence of diggers, trucks and other vehicles and machinery and the developing structures as they are created will gradually alter the landscapes of this site. However most of the surrounding areas are generally not “busy” visually and there are no features of any special landscape interest at or around the site, so it should not be necessary to mask the construction site from view by erecting screens.

139. **Impacts on site-specific economy.** All of the construction related to this subproject will be conducted on land that is at present owned by the Rajshahi City Corporation and currently vacant. So there will be no impact on any site-specific economy. The livelihood of waste-pickers/ scavengers, if any will not be affected during construction period and they will not be displaced during operation phase; and everything will be done as per agreed and approved resettlement plan.

140. Construction work can provide short-term socio-economic gains for local communities if contractors employ local people in the workforce. To ensure that these benefits are directed to communities that are most affected by the work, contractors are often encouraged to employ people who live in the immediate vicinity of construction sites. This is possible in this case because of the presence of inhabitation in the locality, so the contractor should offer employment to any persons who are willing to work on the present site (in breaking bricks and in other activities) and who are not already employed by some other company. Such persons are economically disadvantaged and this would be improved by even a relatively short period of temporary employment.

141. **Impacts on utilities.** There are no temporary infrastructures (power lines, water supply pipes, etc.) on the land proposed for CLF construction; so there will be no economic impacts from the disruption of supply of these facilities due to damage during construction.

142. **Impacts on accessibility.** Excavation work can also have economic impacts if heavy vehicles carrying materials to site and transporting excavated waste to the disposal site cause significant disruption of traffic, particularly where work is conducted in a semi-urban environment as this. However any such impacts should not be significant in this case, because dump trucks normally have a capacity of 25-30 m³ and the disposal of 3,000 m³ of soil and stone by about 100 truck movements will be spread over a period of few months.

143. **Impacts on social and cultural resources.** Construction activities inevitably produce noise and dust, and these plus the visual appearance of the site and restrictions in access caused by excavation and the presence of vehicles and machinery, are generally the factors that disturb people who live or work in the vicinity. These should however not be major problems in this case as there are no people living on or near this site and the people who work there are already well adapted to this type of disturbance. The construction work is also small in scale, so it should not be necessary to apply measures to reduce noise, dust or other disturbance, beyond the dust suppression measures.

144. There are no major permanent public buildings at or near the site, and given the current land-use there are unlikely to be any locations that are of any special social or cultural importance to the community (shrines, meeting places, etc).

145. **Impacts on health and safety.** As is usual on construction sites, the health and safety of workers will need to be protected by measures which the contractor will be required to produce and apply. As adjacent areas are heavily used for the storage and processing of building materials, the contractor should also include measures to assure the safety of the public. The workers will also be needed to take special precautions as they will be required to work within area where unsorted solid waste, dumped medical waste, vectors like insects and rodents, wet wastes will be present with all its objectionable characteristics like excess bad smell/ odor, leachate all around, etc. So it will be needed that they should wear complete uniform usually adopted by the people working in the municipal solid waste disposal sites.

C. Operation and Maintenance Impacts

146. For the first 2 years of operations of the CLF, the Contractor will manage the operations and maintain¹² the facility by itself or through a Contractor and if required, modify, repair or otherwise make improvements to the CLF. The Contractor, in consultation with Rajshahi City Corporation, will also develop a manual for the regular and preventive maintenance of the CLF.

147. The Contractor will be required to keep the ancillary sites of the CLF clean, tidy and orderly condition free of litter, waste material (whether solid or liquid) and debris. The Contractor will also be responsible for the maintenance of the approach roads to the CLF.

148. Sufficient, safe, potable and constant supply of fresh water will be made available at adequate pressure throughout the premises of the ancillary structures. Suitable facilities for washing of hands and nail brushes should be there, soap or detergent will be provided for the workers. All sanitary facilities will be equipped with suitable flushing appliance.

¹² Maintenance activities will include replacement of equipment and consumables, and also horticultural maintenance and repairs to equipment, pavements and other civil works which are part of the CLF.

149. **Land contamination.** CLF will not contaminate the land the way other industrial operations can. The main reason for this is that CLF will have special impermeable layers underneath. Most land contamination is an aesthetics issue rather than one relating to pollution.

150. **Generation of Waste Materials and By-Products.** In general, pollutants generated from CLF include: wastewater from toilet and cleaning of premises, and leachate from the solid waste.

151. **Water contamination.** The wastes from CLF can end up in water bodies, polluting water resources. The main pollutants are wastewater from toilets and from cleaning of the premises, and the leachate from the stored solid waste in the CLF. The quantity of leachate becomes more in the rainy season. No chemicals are used in the CLF. Although the contaminants are non-toxic in nature, they can introduce bacterial contamination and increase nitrates, phosphates and sulfates concentration in water, leading to health problems.

152. **Generation of Wastewater.** The liquid wastes of CLF are high in biological oxygen demand. The quantity of leachate may also be huge during especially in the rainy seasons. Special drains will be constructed to allow it to reach up to the leachate pond, where proper treatment will be ensured.

153. **Odor.** The tropical climate of Bangladesh enhances the process of degeneration of any organic material remaining in the solid waste collected from different parts of the city. Therefore, the CLF premises always give a particular stink. Excessive odor is a nuisance to locals and attracts vermin and scavengers.

154. **Noise.** Noise from the establishment can be a nuisance for communities living in the immediate vicinity of the CLF. Major sources of noise are the chaos created by the laborers working in the operation of the site and heavy vehicular movement to transport solid waste from the municipal areas to the CLF site.

155. **Health, hygiene, and safety.** Spread of diseases to workers and their families may occur due to inadequate provision of safety equipment and lack of practice of safety rules and precautions.

156. **Fires and release of hazardous gases.** Release of hazardous gases from the landfill sites may cause fire within the landfill area under operation.

157. **Topographical modification.** The implementation and subsequent operational activity of the landfill site may lead to unfriendly topographical alterations and modifications in the natural environment and overall landscape of the surrounding area.

158. **Gas migration.** Landfill gas migration due to pressure differentials and diffusion can occur. This can create an explosion hazard if the gas reaches sufficiently high concentrations on adjacent buildings.

159. **Vegetation covers alteration.** Nature of vegetation cover of the landfill site as well as the surrounding area will alter and will have an impact on the drainage pattern of the locality.

160. **Decline in land value.** Declination of land value may be an impact if the landfill site operation is not properly controlled and monitored.

161. **Displacement of waste-pickers/ scavengers.** Waste pickers and scavengers, if any will lose their livelihood because of change in the operational strategy of the landfill area.

162. When the CLF begins to function, it is expected to provide a modern sanitary facility for the workers and staff as well as systematic handling, transportation and disposal of solid waste without causing environmental pollution. Providing this occurs there should be few negative environmental impacts and there are several fields that should be unaffected. These are identified in Table 4 below, with an explanation of the reasoning in each case. These factors are thus screened out of the impact assessment and will not be mentioned further.

Table 4: Fields in which operation and maintenance of the completed CLF is not expected to have significant impacts

Field	Rationale
Geology, seismology	Operating a CLF should not affect these factors
Forests, wildlife, endangered species, protected areas	There are no forests, protected nature conservation areas or important habitats or species at or near the site
Coastal resources	Rajshahi CLF site is far from the sea and also such a structure situated in a single location will not affect the coastal resources
Tourism, population and communities, health and education facilities	There are no tourist attractions, inhabited areas or health/ education facilities near the CLF site
Physical or cultural heritage, archaeology, paleontology	There are also no areas of social, cultural or historical interest or importance near the site
Indigenous Peoples	There are no IP or minority communities near the sites

D. Mitigation Measures

163. There are no impacts that are significant or complex in nature, or that need an in-depth study to assess the impact. Thus, the subproject is unlikely to cause significant adverse impacts. The potential adverse impacts that are associated with design, construction, and O&M can be mitigated to acceptable levels with the following mitigation measures (Table 5).

Table 5: Recommended Mitigation Measures

Parameter	Mitigation Measures
Planning phase	
Updating of safeguard documents	- As this subproject will be implemented on the basis of turnkey contract, the detailed design will be done by the contractor, and the IEE/ EMP will be updated at the time of detailed design and will be revised by the DSC team.
Capacity Building	- Develop and submit for approval a capacity building and training program to ensure (i) all CLF workers are trained to the highest standards available in Bangladesh and given refresher training at least annually; and (ii) Rajshahi City Corporation and UPEHU staffs are given a high level of training and other support sufficient to achieve the expected standards.
Work schedule	- Ensure careful planning and scheduling of the activities. - Prepare a traffic management plan and road safety plan.
Barricades and warning signs	- Use easily transportable barricades and warning signs such as those made of high reflector plastic materials. - Also use aluminized rolled warning signs to warn the public.
Workers	- Employ workers with adequate experience, training, and know-how. It is always advantageous for the contractor to employ workers with adequate experience, training, and know-how in the line of work that they are doing. These people are usually reliable and can be counted upon to exercise good judgment in the field.
Community and public awareness	- Establish extensive coordination with Rajshahi City Corporation, Design and Supervision Consultants (DSC), Department of Environment, operators of landfill sites - A massive information campaign must precede any construction activity in order to make the public aware of the extent of the problem that might be present during the period of construction. - Open liaison channels should be established between Rajshahi City Corporation, the contractors, and interested and affected parties such that any queries, complaints, or

Parameter	Mitigation Measures
	suggestions can be dealt with quickly and by the appropriate persons.
Legislation, permits, and agreements	<ul style="list-style-type: none"> - In all instances, Rajshahi City Corporation, contractors and consultants must remain in compliance with relevant local and national legislation. - A copy of the IEE must be kept on-site and disclosed in Rajshahi City Corporation, Local Government Division, Ministry of Local Government, Rural Development and Cooperatives, and ADB websites. - Ensure Environmental Clearance is obtained prior to award of turnkey contract.
Access to site	<ul style="list-style-type: none"> - Access to site will be via existing roads. The contractor will need to ascertain the existing condition of the roads and repair damage due to construction.
Setting up of construction camp ¹³	<ul style="list-style-type: none"> - Choice of site for the contractor's camp requires the DSC environment management specialist's permission and must take into account location of local residents, businesses, and existing land uses. A site plan must be submitted to the environment management specialist for approval. - If the contractor chooses to locate the camp site on private land, he must get prior permission from the environment management specialist and the landowner. - Under no circumstances may open areas or the surrounding bushes be used as a toilet facility. - Recycling and the provision of separate waste receptacles for different types of waste should be encouraged.
Establishing equipment lay-down and storage area ¹⁴	<ul style="list-style-type: none"> - Storage areas should be secure so as to minimize the risk of crime. They should also be safe from access by children, animals, etc. - The contractor should submit a method statement and plans for the storage of hazardous materials (fuels, oils, and chemicals) and emergency procedures.
Materials management – sourcing ¹⁵	<ul style="list-style-type: none"> - The contractor should prepare a source statement indicating the sources of all materials (including topsoil, sands, natural gravels, crushed stone, asphalt, clay liners, etc), and submit these to the environment management specialist for approval prior to commencement of any work.
Education of site staff on general and environmental conduct ¹⁶	<ul style="list-style-type: none"> - Ensure that all site personnel have a basic level of environmental awareness training. - Staff operating equipment (such as excavators, loaders, etc.) should be adequately trained and sensitized to any potential hazards associated with their task. - No operator should be permitted to operate critical items of mechanical equipment without having been trained by the contractor. - All employees must undergo safety training.
Construction phase	
Excavated materials	<ul style="list-style-type: none"> - Hauling vehicles must always be present at the excavation site. - The contractor can process the excavated materials and use these as selected backfill materials. - If excavated materials are not suitable for reuse, the contractor should deposit these in an area designated by Rajshahi City Corporation. - Coordinate with the landfill operators for the disposal of excavated materials. - Identify and obtain clearance from DoE for disposal sites of excavated soils and contaminated materials. - Obtain from the environment management specialist approval for disposal of excavated materials. - Remove waste rapidly by loading material onto trucks as soon as it is excavated; - Cover or damp down working areas and stockpiled soil in dry, windy weather; and - Use tarpaulins to cover loose material during transportation to and from the site. - Maintain record of excavated materials, disposal dates, and methods. - Conduct the work in the dry season will reduce these impacts, and as the excavation in this case is shallow and small in scale there should be no impact on the water table.
Hauling of Construction Materials	<ul style="list-style-type: none"> - The contractor must maintain all the materials necessary in his inventory so that these can be easily hauled to the construction site when needed. - Advance signage for affected parking areas must indicate duration and alternative parking arrangements.
Access	<ul style="list-style-type: none"> - The contractor should make available in his stock steel plates and wooden planks which will be deployed on top of excavations to provide temporary access to buildings, street crossings, and other areas where these will be necessary. - Advance road signage must indicate the road detour and alternative routes. Provide

¹³ Careful planning of the construction camp can ensure that time and costs associated with environmental management and rehabilitation is reduced

¹⁴ Storage areas can be hazardous and unsightly and can cause environmental pollution if not designed and managed carefully.

¹⁵ Materials must be sourced in a legal and sustainable way to prevent offsite environmental degradation.

¹⁶ These points need to be made clear to all staff on site before the project begins.

Parameter	Mitigation Measures
Occupational health and safety	<p>sign boards for pedestrians to inform them of nature and duration of construction works and contact numbers for concerns/ complaints.</p> <ul style="list-style-type: none"> - Employ workers with adequate experience, training, and know-how. - These workers should be led by an experienced supervisor or engineer, who will provide the leadership in daily activities. - A general regard for the social and ecological well-being of the site and adjacent areas is expected of the site staff. Workers need to be made aware of the following general rules: (i) no alcohol/drugs on site; (ii) prevent excessive noise; (iii) construction staff are to make use of the facilities provided for them, as opposed to ad hoc alternatives (e.g. fires for cooking, the use of surrounding bushes as a toilet facility); (iv) no fires permitted on site except if needed for the construction works; (v) trespassing on private/commercial properties adjoining the site is forbidden; (vi) other than pre-approved security staff, no workers should be permitted to live on the construction site; and (vii) no worker may be forced to do work that is potentially dangerous or that he/she is not trained to do. - Because of existence of solid waste all around in the CLF site, the workers will need to wear uniform, which is usually used by the workers in the solid waste disposal site. - The contractor must monitor the performance of construction workers to ensure that the points relayed during their induction have been properly understood and are being followed. If necessary, a translator should be called to the site to further explain aspects of environmental or social behavior that are unclear. - The rules that are explained in the worker conduct section must be followed at all times.
Community health and safety	<ul style="list-style-type: none"> - Contractor's activities and movement of staff will be restricted to designated construction areas. - Should the construction staff be approached by members of the public or other stakeholders, staff should assist them in locating the environment management specialist or contractor, or provide a number through which they may contact the environment management specialist or contractor. - The conduct of the construction staff when dealing with the public or other stakeholders should be in a manner that is polite and courteous at all times. Failure to adhere to this requirement may result in the removal of staff from the site by the environment management specialist. - Disruption of access for local residents, commercial establishments, institutions, etc. must be minimized and must have the environment management specialist's permissions. - Provide walkways and metal sheets where required to maintain access for people and vehicles. - Consult businesses and institutions regarding operating hours, and factor this in work schedules. - The contractor is to inform neighbors in writing of disruptive activities at least 24 hours beforehand. This can take place by way of leaflets placed in the postboxes giving the environment management specialist's and contractor's details or other method approved by the environment management specialist. - Provide sign boards for pedestrians to inform them of nature and duration of construction works and contact numbers for concerns/complaints. - The contractor will ensure that there is provision of alternate access to business establishments during the construction, so that there is no closure of these shops or any loss of clientele. - The contractor will ensure that any damage to properties and utilities will be restored or compensated to pre-work conditions. - Lighting on the construction site should be pointed downwards and away from oncoming traffic and nearby houses. - The site must be kept clean to minimize the visual impact of the site. - If screening is being used, this must be moved and re-erected as the work front progresses. - Machinery and vehicles are to be kept in good working order for the duration of the project to minimize noise nuisance to neighbors. - Notice of particularly noisy activities must be given to residents/businesses adjacent to the construction site. Examples of these include: noise generated by jackhammers, diesel generator sets, excavators, etc. - Noisy activities must be restricted to the times given in the project specification or general conditions of contract. - The environment management specialist and contractor are responsible for ongoing communication with those people who are interested in or affected by the project. - A complaints register (refer to the grievance redressal mechanism) should be housed

Parameter	Mitigation Measures
	<p>at the site office. This should be in carbon copy format, with numbered pages. Any missing pages must be accounted for by the contractor. This register is to be tabled during monthly site meetings.</p> <ul style="list-style-type: none"> - Interested and affected parties 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. - The contractor should immediately take the necessary remedial action on any complaints/ grievances received by him and forward the details of the grievance along with the action taken to the environment management specialist within 48 hours of receipt of such complaint/ grievance.
Community and public awareness	<ul style="list-style-type: none"> - Storage facilities and other temporary structures on-site should be located such that they have as little visual impact on local residents as possible. - Special attention should be given to the screening of highly reflective materials on site. - In areas where the visual environment is particularly important (e.g. along commercial/ tourism routes) or privacy concerns for surrounding buildings exist, the site may require screening. This could be in the form of shade cloth, temporary walls, or other suitable materials prior to the beginning of construction.
Construction camps and storage areas	<ul style="list-style-type: none"> - The contractor is to ensure that open areas or the surrounding bushes are not being used as toilet facility. - The contractor should ensure that all litter is collected from the work and camp areas daily. - Bins and/or skips should be emptied regularly and waste should be disposed of at the pre-approved site. Waybills for all such disposals are to be kept by the contractor for review by the environment management specialist. - The contractor should ensure that his camp and working areas are kept clean and tidy at all times. - After construction work, all structures comprising the construction camp are to be removed from site or handed over to the property owner/community as per mutual agreement (if established on private/community land). - The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint, etc. and these should be cleaned up. - All hardened surfaces within the construction camp area should be ripped, all imported materials removed, and the area should be top soiled and regressed. - The contractor must arrange the cancellation of all temporary services.
Dust and air pollution	<ul style="list-style-type: none"> - Vehicles travelling to and from the construction site must adhere to speed limits so as to avoid producing excessive dust. - Access and other cleared surfaces, including backfilled trenches, must be dampened whenever possible and especially in dry and windy conditions to avoid excessive dust. - Vehicles and machinery are to be kept in good working order and to meet manufacturer's specifications for safety, fuel consumption, etc. - The contractor is to have the equipment seen to as soon as possible should excessive emissions be observed,
Noise levels	<ul style="list-style-type: none"> - Noise-generating equipment must be fitted with silencers. - If a worker is exposed to noise above a noise exposure limit, the contractor must investigate options for engineered noise control such as using low-noise excavators, jackhammers, drills, and power generators. - 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.
Utilities	<ul style="list-style-type: none"> - Prepare a list of affected utilities and operators - Prepare a contingency plan to include actions to be done in case of unintentional interruption of services.
Water quality	<ul style="list-style-type: none"> - Every effort should 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 should not be permitted to use any stream, river, other open water body, or natural water source adjacent to or within the designated site for the purposes of bathing, washing of clothing, or for any construction or related activities. Municipal water (or another source approved by the environment management specialist) should instead be used for all activities such as washing of equipment or disposal of any type of waste, dust suppression, concrete mixing, compacting etc. - All concrete mixing must take place on a designated, impermeable surface.

Parameter	Mitigation Measures
	<ul style="list-style-type: none"> - No vehicles transporting concrete to the site may be washed on-site. - No vehicles transporting, placing, or compacting asphalt or any other bituminous product may be washed on-site. - All substances required for vehicle maintenance and repair must be stored in sealed containers until they can be disposed of or removed from the site. - Hazardous substance/ materials are to be transported in sealed containers or bags.
Waste management	<ul style="list-style-type: none"> - Wastes must be placed in the designated skips/bins which must be regularly emptied. These should remain within demarcated areas and should be designed to prevent wastes from being blown out by wind. - Littering on-site is forbidden and the site should be cleared of litter at the end of each working day/night period. - 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 or as directed by the environment management specialist. Waybills proving disposal at each site should be provided for the environment management specialist's inspection. - Construction rubble should be disposed of in pre-agreed, demarcated spoil dumps that have been approved by the environment management specialist, or at disposal sites.
Conservation of natural environment	<ul style="list-style-type: none"> - As the work front progresses; the contractor is to check that vegetation clearing has the prior permission of the environment management specialist. - Only trees that have been marked beforehand are to be removed, if cutting of trees is required. - Clean the entire area and maintain immediately after completion of the construction activities to make sure that existing tranquility of the surrounding area is not disturbed in any way.
Cultural and historical environment	<ul style="list-style-type: none"> - Consult laborers who work on the site during the detailed design stage and in the unlikely event that there are social and cultural resources in the site; assistance should be given in relocating the site and any associated artifacts. - All the staff and laborers of the contractor are to be informed about the possible items of historical or archaeological value, which include old stone foundations, tools, clayware, jewelry, remains, fossils etc. - If something of this nature is uncovered, Department of Archaeology should be contacted and work should be stopped immediately.
Safeguards supervisors	<ul style="list-style-type: none"> - The contractor should appoint one environment safeguard supervisor who will be responsible for assisting the contractor in implementation of EMP, coordinating with the DSC, consultations with interested/ affected parties, reporting, and grievance redressal on a day-to-day basis. The resettlement issue will be resolved before the site will be handed over to the Contractor for construction activities.
Post-construction and post-commissioning irregularities	<ul style="list-style-type: none"> - Remove all plant/ machineries/ vehicles and any temporary structures including the workforce camps and warehouses for storage of materials after completion of construction. - Restore the original landscape of the surrounding area as much as possible.
Operation and maintenance phase	
General	<ul style="list-style-type: none"> - Develop O&M Manuals to include all aspects of the management and operation of the CLF: - nature of waste that is accepted; - sequence and location of waste placement; - operation and maintenance of the gas collection system; - introduction of moisture or recirculation of leachate, leachate collection; - maintenance and cleaning of the leachate collection system; and - environmental monitoring, and maintenance of the final cover. - Train all CLF workers to the highest standards available in Bangladesh and given refresher training at least annually - Control access for public/personnel; - Lock rooms or cages for waste storage; - Clean toilets daily; - Provide clean hand washing areas adequate soap and towels; - Provide clothing and laundry service for workers; and - Clean facility after the work of each day. The waste storage area and other adjacent areas should be sprinkled or sprayed regularly with disinfectants to avoid any spread of disease. - Insert plates and stops to prevent vermin from gaining access to the building. Where insect screening is required, this should consist of nylon insect mesh securely fixed to 150 x 50 reinforcing mesh with galvanized tie wire. Edges should be finished with a screw fixed beading strip where possible (all galvanized).

Parameter	Mitigation Measures
	- Audit implementation of O&M procedures at regular intervals (by an Independent Monitoring Agency)
Land contamination	- Do not store wastes outside the CLF areas to avoid issues of aesthetic nature
Wastewater	- After treatment, the discharge standards need to be followed similar to the standards mentioned in Schedule 10 of the ECR 1997 for inland water discharge
Odor	- Audit odor to identify and characterize sources and determine any action required. - Store wastes properly inside the premises, preferably in an aerated area to minimize biodegradation and foul odor - Vendors should be asked to pick up waste on a daily basis to minimize degradation and odor - Enclose wastes and by-products during transport, loading/unloading and storage - Carry out frequent cleaning of material storage areas to prevent odor
Vermin and pest	- Apply soil cover materials rigorously - Compact wastes properly - Carefully maintain general "good housekeeping" - Inspect site regularly to detect indication of prevalence of pests and vermin - Employ an experienced pest control specialist to deal with this problem in case significant numbers are identified.
Noise	- Activities and vehicle movements should be avoided after hours. - Vehicles should be fitted with silencers. - Vehicles and machinery are to be kept in good working order.

164. After handing over of the subproject, Rajshahi City Corporation will be responsible for operating the CLF and will be given support by the project in the form of staff training and financial assistance. ADB, LGD, Urban Public and Environment Health Unit (UPEHU) will need to ensure that the budget for such support is sufficient to ensure that the management and operation of the facility is to the expected high standard and that the elements listed above are provided.

165. The successful operation of the CLF in the manner intended should bring significant benefits to the citizens by keeping the environment cleaner than before. Removal of solid waste will be more organized and efficient; the RCC will save some money because of this higher efficiency of waste removal, which can be utilized for staff training and purchase of modern equipments necessary for this kind of operation.

166. Citizens will also gain from improved health as they will lose fewer working days through illness and will spend less on healthcare. In time there will be wider improvements in quality of life at various locations in the city as the general environment and public health will greatly improve as the practices of throwing garbage here and there will decline.

V. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. Project Stakeholders

167. Primary stakeholders are:

- (i) Companies that operate on the proposed CLF site;
- (ii) People who work at the site, either employed by a company or self-employed;
- (iii) Companies and workers operating in areas adjacent to the CLF site;
- (iv) Workers and companies operating at landfill site elsewhere in Rajshahi; and
- (v) Companies and private individuals who are benefitted from the existing landfill site.

168. Secondary stakeholders are:

- (i) LGD as the Executing Agency and UPEHU as implementer;

- (ii) Other government institutions whose remit includes areas or issues affected by the project (City Corporations, Planning Authorities, Department of Public Health Engineering, Local Government Engineering Department, Ministry of Finance, Ministry of Health, Ministry of Environment, Roads and Highways Department, etc);
- (iii) NGOs, CBOs and other representatives of persons who may be affected by the project;
- (iv) The beneficiary community in general; and
- (v) The ADB.

B. Consultation and Disclosure

169. LGD/ UPEHU will extend and expand the consultation and disclosure process significantly during implementation of UPEHSDP. The UPEHU will appoint an experienced NGO to handle this key aspect of the program, who will conduct a wide range of activities in the target urban areas to ensure that the needs and concerns of stakeholders are registered, and are addressed in project design, construction or operation where appropriate. The program of activities will be developed during the detailed design stage, and is likely to include the following:

170. Consultation during detailed design:

- (i) Focus-group discussions with affected persons and other stakeholders (including women's groups, NGOs and CBOs) to hear their views and concerns, so that these can be addressed in project design where necessary; and
- (ii) Structured consultation meetings with the institutional stakeholders (Government bodies and NGOs) to discuss and approve key aspects of the project.

171. Consultation during construction:

- (i) Public meetings with major stakeholders to discuss and plan work programs and allow issues to be raised and addressed once construction has started; and
- (ii) Smaller-scale meetings to discuss and plan construction work with primary stakeholders to reduce disturbance and other impacts, and provide a mechanism through which affected persons can participate in project monitoring and evaluation.

172. Project disclosure:

- (i) Public information campaigns (via newspaper, TV and radio) to explain the project to the urban populations and prepare them for any disruption they may experience once the construction program is underway;
- (ii) Public disclosure meetings at key stages to inform the public of progress and future plans, and to provide copies of summary documents in the Bangla language; and
- (iii) Formal disclosure of completed project reports by making copies available at convenient locations in each target town, informing the public of their availability, and providing a mechanism through which comments can be made.

C. Public Consultations Conducted

173. Different techniques of consultation with stakeholders were used by the PPTA Consultants during the planning stage of project preparation (interviews, public meetings, group discussions, etc). Details of these consultation meetings in the planning stage have

been presented in the ANNEX 5. A questionnaire was designed and environmental information was collected. Apart from this, a series of public consultation meetings were conducted during the project preparation. Various forms of public consultations (consultation through ad hoc discussions on-site) have been used to discuss the project and involve the community in planning the project design and mitigation measures. Issues discussed and feedback received during preparation of IEE report along with details of date, time, location, and list of participants are given in Annex 3.

VI. ENVIRONMENTAL MANAGEMENT PLAN

A. Implementation Arrangement

174. Figure 20 is an organization chart showing how the project will be managed and implemented.

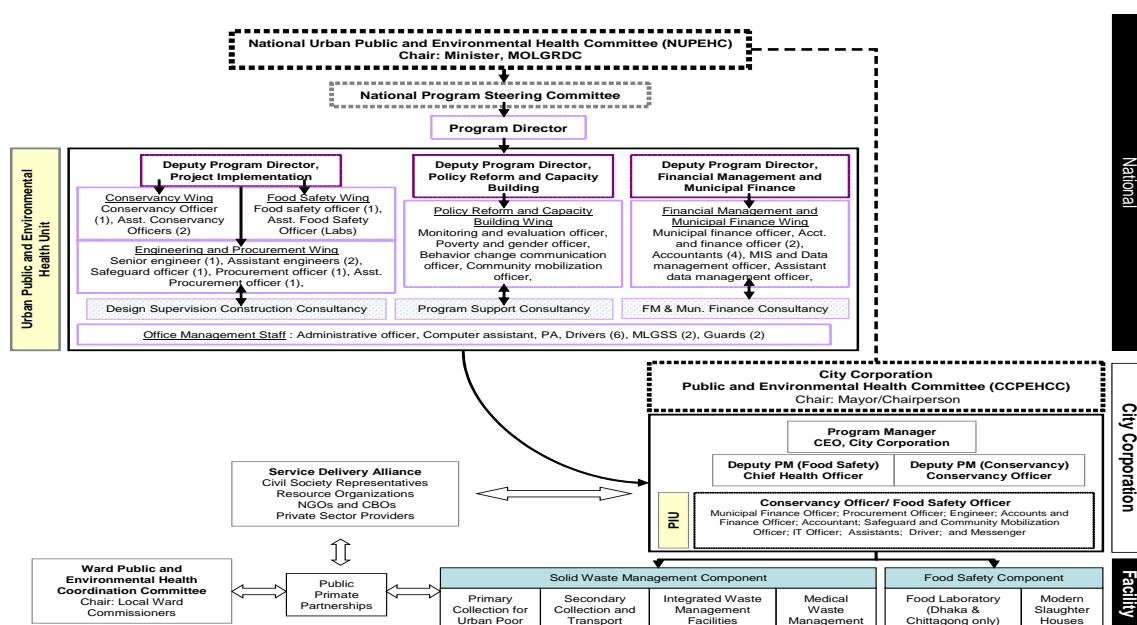


Fig 20: Organization Chart for UPEHSDP

175. **Local Government Division/Urban Public and Environmental Health Unit.** LGD of the Ministry of Local Government, Rural Development and Cooperatives (LGRDC) will be the executing agency (EA) for UPEHSDP providing overall guidance for program implementation. LGD will have the overall responsibility to plan, organize, manage, supervise, coordinate and monitor the progress achieved. LGD will establish a support unit called the Urban Public and Environmental Health Unit (UPEHU) who will be responsible for day-to-day program implementation and will be headed by a full-time program director. UPEHU will function as the Program Management Unit (UPEHU), with responsibility for day-to-day implementation. A Safeguards Officer (SO) to coordinate resettlement and environmental safeguards for UPEHSDP will be part of the Policy and Program Wing of the UPEHU. Through the SO, the UPEHU will ensure environmental compliance with ADB policy and national law across the entire program. This includes: (i) pre-approving final IEEs prior to submission to ADB for review and approval, and (ii) assisting in resolution of complaints and grievances related to IEE implementation not resolved at the CCPIU level.

176. **City Corporations/ Program Implementation Units.** City Corporation Project Implementation Units (CCPIUs) will be established in each City Corporation. The CCPIUs will include a Safeguards and Community Mobilization Officer (SCMO) who will receive training from the International Environmental Specialist (IES) and Domestic Environmental Specialist

(DES) who will be assigned to work with the CCPIU staff to help monitor subprojects and to transfer implementation capability to the CCPIU team. The SCMO will work closely with the IRS and DRS in planning, implementing, and monitoring all project activities. The CCPIUs will: (i) screen and categorize sub-projects; (ii) assist in, public meetings and other consultation with stakeholders; (iii) facilitate activities of the IES/ DES in applying for Location and Environmental Clearances (LCs/ECs).

177. Environmental Specialists. A Design, Supervision, and Construction Consultant Team (DSC) will be contracted to assist the UPEHU and CCPIUs in implementing and managing the investment subprojects including environmental planning. Towards this, International and Domestic Environmental Specialists (IES and DES) within DSC will prepare IEEs in accordance with both ADB and Government of Bangladesh (GoB) policies during the feasibility and detailed design stage, and supervise contractors, with support from CCPIUs, during the construction process. The IES and DES will work in close coordination with UPEHU and CCPIUs. They will coordinate with the SO in the UPEHU to ensure all IEEs comply with ADB and GoB rules and guidelines. The IES and DES will also provide necessary training to CCPIUs to facilitate their monitoring of environmental impacts during construction and operation. It will provide support ensuring that all tasks of the CCPIU with regard to environmental implementation and monitoring are achieved. The IES and DES, in coordination with the contractors, will revise this IEE during detailed design stage and will ensure revised/updated IEE is approved by ADB and disclosed in LGD/ UPEHU and ADB websites.

178. Contractors. The Contractor shall at its own cost and expense:

- (i) Design, construct, supply, manage and maintain the CLF, in accordance with the provisions of the contract, good industry practice and applicable Laws;
- (ii) Observe and fulfill the environmental and other requirements as specified in the IEE/ EMP and under all applicable laws and applicable permits at all time during the service delivery period;
- (iii) Apply for and obtain all necessary clearances and/ or approvals for the construction of the CLF from all the concerned governmental agencies;
- (iv) Coordinate with DSC IES and DES on updating the IEE/EMP based on detailed designs;
- (v) Procure and maintain in full force and effect, as necessary, appropriate proprietary rights, licenses, contracts and permissions for materials, methods, processes and systems used in or incorporated into the subproject;
- (vi) Provide all assistance to the Project Manager as may be reasonably required for the performance of its duties and services under this subproject;
- (vii) Provide to DSC IES and DES reports on a regular basis during the service delivery period in accordance with the provisions of the contract;
- (viii) Appoint, supervise, monitor and control the activities of sub-contractors under their respective project contracts as may be necessary;
- (ix) Make efforts to maintain harmony and good industrial relations amongst the personnel employed by Rajshahi City Corporation in connection with the performance of the contractor's obligations under the contract;
- (x) Develop, implement and administer a surveillance and safety program for the CLF and the users thereof and the contractors' personnel engaged in the provision of any services under any of the project contracts including correction of safety violations and deficiencies, and taking of all other actions necessary to provide a safe and hygienic environment in accordance with applicable laws and good industry practice;
- (xi) Be responsible for safety, soundness and durability of the CLF, including all structures forming part thereof;

- (xii) Ensure that the CLF site remains free from all encroachments and take all steps necessary to remove encroachments, if any;
- (xiii) Remove promptly from the CLF site all surplus construction machinery and materials, waste materials (including, without limitation, hazardous materials and waste water), rubbish and other debris and keep the area in a neat, clean and hygienic condition and in conformity with the applicable Laws and applicable Permits.

B. Capacity Building

179. A training program has been developed to build the capability of EA, city corporations, and CCPIUs. This will be conducted by the DSC and contractors. The contractor will be required to (i) conduct environmental awareness and orientation of workers prior to deployment to work site; (ii) train CLF workers to the highest standards available in Bangladesh and given a refresher training at least annually during the service delivery period; and (iii) provide EA, CCPIUs, UPEHU, etc. a high level of training and other support sufficient to achieve the expected standards.

180. The suggested outline of the training program is presented in Table 6. The capacity building and training program will be updated during the detailed design stage to incorporate the contractors output.

Table 6: Indicative Capacity Building and Training Program for CLF Subproject

Description	Contents	Schedule	Participants
To be conducted by DSC			
Program 1 Orientation workshop	Module 1 – Orientation ADB Safeguards Policy Statement Bangladeshi Environmental Laws and Regulations Module 2 – Environmental Assessment Process ADB environmental process, identification of impacts and mitigation measures, formulation of an environmental management plan (EMP), implementation, and monitoring requirements Review of environmental assessment report to comply with ADB requirements Incorporation of EMP into the project design and contracts	1 day	EA, LGD, UPEHU, and city corporation officials involved in the project implementation CCPIUs
Program 2 Orientation program/workshop for contractors and supervisory staff	Environmental issues during construction Implementation of EMP Monitoring of EMP implementation Reporting requirements	1 day	CCPIUs contractors
To be conducted by contractors			
Program 3 Orientation and safety Issues	CLF implementation activities detailed in drawings; safeguard policy requirements as per ADB and Government of Bangladesh rules; safety instructions and use of PPEs ¹⁷ by the staff and workers	1 day	Staff and workers of the Contractor

¹⁷ **Personal protective equipment (PPE)** refers to protective clothing, helmets, goggles, or other garment or equipment designed to protect the wearer's body from injury. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. Protective equipment may be worn for job-related occupational safety and health purposes, as well as for sports and other recreational activities. "Protective clothing" is applied to traditional categories of clothing, and "protective gear" applies to items such as pads, guards, shields, or masks, and others.

Description	Contents	Schedule	Participants
Program 4 Action plan for implementation of the CLF	Detailed action plan for implementation of the subproject in a timely and qualitative manner	1 day	Staff and workers of the Contractor

C. Environmental Management Action Plan

181. The EMP will guide the environmentally sound construction of the subproject and ensure efficient lines of communication between the CCPIUs, DSC, and contractors. The EMP identifies activities according to the following three phases: (i) site establishment and preliminary activities, including finalizing IEE/EMP; (ii) construction stage; and (iii) post-construction/ operational stage. Table 7 outlines the mitigation measures and persons responsible for implementation and monitoring. The EMP will be updated by DSC during the detailed design stage. Note that the final IEE/EMP should be reviewed and cleared by the EA and ADB at time of detailed design and prior to commencement of construction work.

182. **Environmental monitoring program.** Prior to commencement of any civil work, the contractors will submit a compliance report¹⁸ to the DSC ensuring that all identified pre-construction environmental impact mitigation measures as detailed in the EMP will be undertaken. The DSC will review the report, and thereafter CCPIUs will allow commencement of civil works. CCPIUs and the DSC will be responsible for monitoring.

¹⁸ This compliance report will include information on (i) barricades and warning signs; (ii) area for setting up of construction camps; (iii) methodology for surveys; (iv) area for establishing lay-down and storage; (v) sources of materials; (vi) records of environmental awareness, safety training, and orientation of workers prior to deployment to work sites; (vii) contact information of the environmental and resettlement supervisors; and (viii) construction method statement.

Table 7: Environmental Management Action Plan

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
Planning phase						
Appointment and duties of an ECO	An Independent Environmental Control Officer (ECO) must be appointed, who will monitor the Contractor's compliance with the environmental management plan.	Contractor	CCPIU	Appointment	Once	
	The ECO should be provided with a copy of an adjusted version of the EMP.	Contractor	CCPIU		Once	
	The Priority of the ECO is to maintain the integrity of the development conditions outlined in the EMP and must be enforced and adhered to at all time.	ECO	ECO		Continuous	
	The ECO must form part of the project management team and attend all project meetings.	Contractor	ECO	Attendance sheet meeting	Continuous	
Appointment and duties of EO	The Contractor must appoint an Environmental Officer (EO). This person will be required to monitor the situation with a direct hands-on approach, and ensure compliance and co-operation of all personnel. He should be fluent in the language of the employees.	Contractor	CCPIU	appointment	Once	
Updating of safeguard documents	- As this subproject will be implemented on the basis of turnkey contract, the detailed design will be done by the contractor, and the IEE/ EMP will be updated at the time of detailed design and will be revised by the DSC team.	DSC with input from the contractor	CCPIU	Updated IEE/EMP	---	ADB Environment Policy EARF ECR 1997
Legislation, Permits and Agreements	The Contractor shall ensure that all pertinent permits, certificates and permissions required for the project have been obtained prior to any activities commencing on site and ensure that they are strictly enforced/adhered to. This includes, for example, license for storage of flammable liquids and hazardous materials and other permits and legislative requirements applicable to the project.	Contractor	DSC CCPIU	Permits, certificates and permissions	Prior the start of the project	List of permits which have to be arranged by the Contractor
	The Contractor shall maintain a database of all pertinent permits and permissions required for the contract as a whole and for	Contractor	DSC CCPIU	database	Frequent	

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	critical activities for the duration of the contract. - In all instances, the City Corporations, Contractors and consultants must remain in compliance with relevant local and national legislation. - A copy of the IEE must be kept on-site and disclosed in the City Corporations, Local Government Division (LGD), Ministry of Local Government, Rural Development and Cooperatives, and ADB websites.					
Capacity Building	- Develop and submit for approval a capacity building and training program to ensure (i) all CLF workers are trained to the highest standards available in Bangladesh and given refresher training at least annually; and (ii) Rajshahi City Corporation and UPEHU staffs are given a high level of training and other support sufficient to achieve the expected standards.	Contractors	DSC CCPIU	Capacity building and training program	---	EARF All applicable laws and regulations
Education of site staff on general and environmental conduct ¹⁹	- Ensure that all site personnel have a basic level of environmental awareness training. - Staff operating equipment (such as excavators, loaders, etc.) should be adequately trained and sensitized to any potential hazards associated with their task. - No operator should be permitted to operate critical items of mechanical equipment without having been trained by the Contractor. - All employees must undergo safety training.	Contractor	DSC CCPIU	Records of training	Prior to start of civil works and every new employee	Revised/Updated IEE/EMP (capacity building)
Workers	Employ workers with adequate experience, training, and know-how. It is always advantageous for the Contractor to employ workers with adequate experience, training, and know-how in the line of work	Contractor	DSC CCPIU	Workers list (for internal monitoring)	Prior to approval of detailed design documents	Detailed Design documents

¹⁹ These points need to be made clear to all staff on site before the project begins.

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	that they are doing. These people are usually reliable and can be counted upon to exercise good judgment in the field.					
Work schedule	<ul style="list-style-type: none"> - Ensure careful planning and scheduling of the activities. - Prepare a traffic management plan and road safety plan. 	Contractors	DSC CCPIU	Plan and schedules	Prior to approval of detailed design documents	Detailed Design documents
Community and public awareness	<ul style="list-style-type: none"> - Establish extensive coordination with the City Corporations, Design and Supervision Consultants (DSC), Department of Environment, operators of landfill sites - A massive information campaign must precede any construction activity in order to make the public aware of the extent of the problem that might be present during the period of construction. - Open liaison channels should be established between Khulna City Corporation, the Contractors, and interested and affected parties such that any queries, complaints, or suggestions can be dealt with quickly and by the appropriate persons. 	Contractor	DSC CCPIU	Communication and participation strategy	Prior to approval of detailed design documents	Detailed Design documents
Access to site	Access to site will be via existing roads. The Contractor will need to ascertain the existing condition of the roads and repair damage due to construction.	Contractor	DSC CCPIU	Traffic management plan	Prior to approval of detailed design documents	No complaints received Minimal traffic disturbance
Barricades and warning signs	<ul style="list-style-type: none"> - Use easily transportable barricades and warning signs such as those made of high reflector plastic materials. - Also use aluminized rolled warning signs to warn the public. 	Contractors	DSC CCPIU	Lists and samples of warning signs and barricades	Prior to approval of detailed design documents	Detailed design documents
Method Statements	<p>The Contractor shall submit written Method Statements to the Project Manager for the activities identified by the Project Manager or ECO. Activities that will require method statements include:</p> <ul style="list-style-type: none"> -Concrete pre-cast and batching operation; -Crushing plant operation; -Storage facilities for any hazardous substances; 	Contractor	DSC CCPIU	Method Statements	As necessary	

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	<ul style="list-style-type: none"> -Emergency procedures; -Site establishment; -Removal and clearing of vegetation; -Materials, equipment and staffing requirements (camp establishment); -Transporting the materials and/ or equipment to, from and within the site; -The storage provisions for the materials and/or equipment; -The proposed construction procedure designed to implement the relevant Environmental Specifications; Other information deemed necessary by the RE and/ or ECO.					
	The Contractor shall not commence work on that activity until such time as the Method Statement has been approved in writing by the Project Manager.	Contractor	DSC CCPIU	Approval Method Statement	As necessary	
Setting up of construction camp	<ul style="list-style-type: none"> - Choice of site for the contractor's camp requires the DSC environment management specialist's permission and must take into account location of local residents, businesses, and existing land uses. A site plan must be submitted to the environment management specialist for approval. - If the contractor chooses to locate the camp site on private land, he must get prior permission from the environment management specialist and the landowner. - Under no circumstances may open areas or the surrounding bushes be used as a toilet facility. - Recycling and the provision of separate waste receptacles for different types of waste should be encouraged. 	Contractor	DSC CCPIU	Location plan	Prior to approval of detailed design documents	Approved location plan Construction method No complaints received
Establishing equipment lay-down and storage area	<ul style="list-style-type: none"> - Storage areas should be secure so as to minimize the risk of crime. They should also be safe from access by children, animals, etc. - The contractor should submit a method statement and plans for the storage of 	Contractor	DSC CCPIU	Location plan	Prior to approval of detailed design documents	Approved location plan Construction method

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	hazardous materials (fuels, oils, and chemicals) and emergency procedures.					No complaints received
Materials management – sourcing	- The contractor should prepare a source statement indicating the sources of all materials (including topsoil, sands, natural gravels, crushed stone, asphalt, clay liners, etc), and submit these to the environment management specialist for approval prior to commencement of any work.	Contractor to submit sources of materials to DSC	DSC CCPIU	Lists of sources	Prior to approval of detailed design documents	Section 6 of contract All applicable permits (e.g. from Mining Department for quarries, borrow pits, sands and gravel)
Existing Services and Infrastructure	The Contractor shall ensure that existing services (e.g. roads, pipelines, power lines and telephone services) are not damaged or disrupted unless required by the contract and with the permission of the RE.	Contractor, ECO, Project Manager	DSC CCPIU	Status of existing infrastructure	As necessary	
	The Contractor shall be responsible for the repair and reinstatement of any existing infrastructure that is damaged or services which are interrupted.	Contractor	DSC CCPIU		As necessary	
	Such repair or reinstatement will be to the Contractor's cost and shall receive top priority over all other activities.	Contractor	DSC CCPIU		As necessary	
Management of existing waste	One cell will be selected for storage and management of existing wastes. Wastes will be placed systematically in layers with adequate and proper compaction; suitable covering soil will be added over each of the layers; capping will be done by clay layer to prevent further pollution; and finally covering turf or grasses will be grown on properly shaped surfaces keeping adequate arrangement for drainage of rainwater.	Contractor	DSC CCPIU	Existing condition	As necessary	Detailed design documents
Treatment of leachate	Groundwater protection by draining and treatment of the polluted water and leachate: The groundwater which is affected by the current waste should be drained and should be treated in a waste water treatment plant;	Contractor	DSC CCPIU	Existing condition	As necessary	Detailed design documents

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	<p>To prevent further contamination of the groundwater, new landfill cells should be constructed where an impermeable layer will prevent further contamination in the environment.</p> <p>A drainage system in the new landfill cell will drain all new leachate from the landfill cell into the waste water treatment facility.</p> <p>Leachate reducing measurements:</p> <p>To prevent the production of new leachate, surface waters should be separated as much as possible from the pollution source. To reduce the infiltration in the landfill mass, wastes should be covered by impermeable layers (clay layer of 0.5m; $K < 1.10^{-9}$ m/s).</p>					
Environmental incident	The Contractor must take corrective action to mitigate an incident appropriate to the nature and scale of the incident and must also rehabilitate any residual environmental damage caused by the incident or by the mitigation measures themselves.	EO, ECO, Contractor	DSC CCPIU		Continuous	
Construction phase						
Excavated materials	<ul style="list-style-type: none"> - Hauling vehicles must always be present at the excavation site. - The contractor can process the excavated materials and use these as selected backfill materials. - If excavated materials are not suitable for reuse, the contractor should deposit these in an area designated by Rajshahi City Corporation. - Coordinate with the landfill operators for the disposal of excavated materials. - Obtain from the environment management specialist approval for disposal of excavated materials. - Remove waste rapidly by loading material onto trucks as soon as it is excavated; - Cover or damp down working areas and stockpiled soil in dry, windy weather; and 	Contractor	DSC	Construction method statement	As work progresses	<p>Construction method</p> <p>Detailed design documents</p> <p>Identify and obtain clearance from DoE for disposal sites of excavated soils and contaminated materials</p>

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	<ul style="list-style-type: none"> - Use tarpaulins to cover loose material during transportation to and from the site. - Maintain record of excavated materials, disposal dates, and methods. - Conduct the work in the dry season will reduce these impacts, and as the excavation in this case is shallow and small in scale there should be no impact on the water table. 					
Management of existing waste	<p>For preparatory step the waste from the cell selected for storage of existing waste will be transported to the other cells temporarily for placement of impermeable clay layer in the bottom of selected cell. Then the existing wastes of the entire landfill site will be transported to the selected cell. Wastes will be placed systematically in layers with adequate and proper compaction; suitable covering soil will be added over each of the layers; capping will be done by clay layer to prevent further pollution; and finally covering turf or grasses will be grown on properly shaped surfaces keeping adequate arrangement for drainage of rainwater.</p>	Contractor	DSC CCPIU	Existing condition	As necessary	Detailed design documents
Treatment of leachate	<p>Groundwater protection by draining and treatment of the polluted water and leachate:</p> <p>The groundwater which is affected by the current waste should be drained and should be treated in a waste water treatment plant;</p> <p>To prevent further contamination of the groundwater, new landfill cells should be constructed where an impermeable layer will prevent further contamination in the environment.</p> <p>A drainage system in the new landfill cell will drain all new leachate from the landfill cell into the waste water treatment facility.</p>	Contractor	DSC CCPIU	Existing condition	As necessary	Detailed design documents

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	<p>Leachate reducing measurements:</p> <p>To prevent the production of new leachate, surface waters should be separated as much as possible from the pollution source. To reduce the infiltration in the landfill mass, wastes should be covered by impermeable layers (clay layer of 0.5m; $K < 1.10^{-9}$ m/s).</p>					
Hauling of Construction Materials	<ul style="list-style-type: none"> - The contractor must maintain all the materials necessary in his inventory so that these can be easily hauled to the construction site when needed. - Advance signage for affected parking areas must indicate duration and alternative parking arrangements. 	Contractor	DSC	Construction method statement	As work progresses	<p>Construction method</p> <p>Detailed design documents</p>
Access	<ul style="list-style-type: none"> - The contractor should make available in his stock steel plates and wooden planks which will be deployed on top of excavations to provide temporary access to buildings, street crossings, and other areas where these will be necessary. - Advance road signage must indicate the road detour and alternative routes. Provide sign boards for pedestrians to inform them of nature and duration of construction works and contact numbers for concerns/complaints. 	Contractor	DSC	Construction method statement	As work progresses	<p>Construction method</p> <p>Detailed design documents</p> <p>Zero complaints from community/sensitive receptors</p>
Occupational health and safety	<ul style="list-style-type: none"> - Employ workers with adequate experience, training, and know-how. - These workers should be led by an experienced supervisor or engineer, who will provide the leadership in daily activities. - A general regard for the social and ecological well-being of the site and adjacent areas is expected of the site staff. Workers need to be made aware of the following general rules: (i) no alcohol/drugs on site; (ii) prevent excessive noise; (iii) construction staff are to make use of the facilities provided for them, as opposed to ad hoc alternatives (e.g. fires for cooking, 	Contractor	DSC	<p>Occupational health and safety plan</p> <p>Number of accidents and work-related injuries</p> <p>Complaints from community</p>	As work progresses	<p>Construction method</p> <p>Detailed design documents</p> <p>Zero accident and work-related injuries</p> <p>Zero complaints from community and workers</p>

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	<p>the use of surrounding bushes as a toilet facility); (iv) no fires permitted on site except if needed for the construction works; (v) trespassing on private/commercial properties adjoining the site is forbidden; (vi) other than pre-approved security staff, no workers should be permitted to live on the construction site; and (vii) no worker may be forced to do work that is potentially dangerous or that he/she is not trained to do.</p> <ul style="list-style-type: none"> - Because of existence of solid waste all around in the CLF site, the workers will need to wear uniform, which is usually used by the workers in the solid waste disposal site. - The contractor must monitor the performance of construction workers to ensure that the points relayed during their induction have been properly understood and are being followed. If necessary, a translator should be called to the site to further explain aspects of environmental or social behavior that are unclear. - The rules that are explained in the worker conduct section must be followed at all times. 					
Community health and safety	<ul style="list-style-type: none"> - Contractor's activities and movement of staff will be restricted to designated construction areas. - Should the construction staff be approached by members of the public or other stakeholders, staff should assist them in locating the environment management specialist or contractor, or provide a number through which they may contact the environment management specialist or contractor. - The conduct of the construction staff when dealing with the public or other stakeholders should be in a manner that is polite and courteous at all times. Failure to adhere to this requirement may result in 	Contractor	DSC	<p>Complaints from community</p> <p>Activities based on the communication and participation strategy</p>	As work progresses	Zero complaints from community and workers

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	<p>the removal of staff from the site by the environment management specialist.</p> <ul style="list-style-type: none"> - Disruption of access for local residents, commercial establishments, institutions, etc. must be minimized and must have the environment management specialist's permissions. - Provide walkways and metal sheets where required to maintain access for people and vehicles. - Consult businesses and institutions regarding operating hours, and factor this in work schedules. - The contractor is to inform neighbors in writing of disruptive activities at least 24 hours beforehand. This can take place by way of leaflets placed in the postboxes giving the environment management specialist's and contractor's details or other method approved by the environment management specialist. - Provide sign boards for pedestrians to inform them of nature and duration of construction works and contact numbers for concerns/complaints. - The contractor will ensure that there is provision of alternate access to business establishments during the construction, so that there is no closure of these shops or any loss of clientage. - The contractor will ensure that any damage to properties and utilities will be restored or compensated to pre-work conditions. - Lighting on the construction site should be pointed downwards and away from oncoming traffic and nearby houses. - The site must be kept clean to minimize the visual impact of the site. - If screening is being used, this must be moved and re-erected as the work front progresses. - Machinery and vehicles are to be kept in 					

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	<p>good working order for the duration of the project to minimize noise nuisance to neighbors.</p> <ul style="list-style-type: none"> - Notice of particularly noisy activities must be given to residents/businesses adjacent to the construction site. Examples of these include: noise generated by jackhammers, diesel generator sets, excavators, etc. - Noisy activities must be restricted to the times given in the project specification or general conditions of contract. - The environment management specialist and contractor are responsible for ongoing communication with those people who are interested in or affected by the project. - A complaints register (refer to the grievance redressal mechanism) should be housed at the site office. This should be in carbon copy format, with numbered pages. Any missing pages must be accounted for by the contractor. This register is to be tabled during monthly site meetings. - Interested and affected parties 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. - The contractor should immediately take the necessary remedial action on any complaint/grievance received by him and forward the details of the grievance along with the action taken to the environment management specialist within 48 hours of receipt of such complaint/grievance. 					
Community and	- Storage facilities and other temporary	Contractor	DSC	Complaints	As work	Zero complaints

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
public awareness	<p>structures on-site should be located such that they have as little visual impact on local residents as possible.</p> <ul style="list-style-type: none"> - Special attention should be given to the screening of highly reflective materials on site. - In areas where the visual environment is particularly important (e.g. along commercial/ tourism routes) or privacy concerns for surrounding buildings exist, the site may require screening. This could be in the form of shade cloth, temporary walls, or other suitable materials prior to the beginning of construction. 			<p>from community</p> <p>Activities based on the communication and participation strategy</p>	progresses	from community and workers
Construction camps and storage areas	<ul style="list-style-type: none"> - The contractor is to ensure that open areas or the surrounding bushes are not being used as toilet facility. - The contractor should ensure that all litter is collected from the work and camp areas daily. - Bins and/or skips should be emptied regularly and waste should be disposed of at the pre-approved site. Waybills for all such disposals are to be kept by the contractor for review by the environment management specialist. - The contractor should ensure that his camp and working areas are kept clean and tidy at all times. - After construction work, all structures comprising the construction camp are to be removed from site or handed over to the property owner/community as per mutual agreement (if established on private/community land). - The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint, etc. and these should be cleaned up. - All hardened surfaces within the construction camp area should be ripped, all imported materials removed, and the area should be top soiled and regressed. 	Contractor	DSC	<p>Approved location plan</p> <p>Complaints from community</p>	As work progresses	<p>Approved location plan</p> <p>Zero complaints from community and workers</p>

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	- The contractor must arrange the cancellation of all temporary services.					
Dust and air pollution	<ul style="list-style-type: none"> - Vehicles travelling to and from the construction site must adhere to speed limits so as to avoid producing excessive dust. - Access and other cleared surfaces, including backfilled trenches, must be dampened whenever possible and especially in dry and windy conditions to avoid excessive dust. - Vehicles and machinery are to be kept in good working order and to meet manufacturer's specifications for safety, fuel consumption, etc. - The contractor is to have the equipment seen to as soon as possible should excessive emissions be observed, 	Contractor	DSC	Vehicle emission testing records Complaints from community	As work progresses	No visible increase in dust and particulate matters Zero complaints from community
Noise levels	<ul style="list-style-type: none"> - Noise-generating equipment must be fitted with silencers. - If a worker is exposed to noise above a noise exposure limit, the contractor must investigate options for engineered noise control such as using low-noise excavators, jackhammers, drills, and power generators. - 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. 	Contractor	MASC environment management specialist	Complaints from community Noise level monitoring record	As work progresses	ECR 1997
Utilities	<ul style="list-style-type: none"> - Prepare a list of affected utilities and operators - Prepare a contingency plan to include actions to be done in case of unintentional interruption of services. 	Contractor	DSC	Number of affected utilities Length of time to restore disrupted services	As work progresses	No disrupted service
Water quality	- Every effort should be made to ensure that any chemicals or hazardous substances do not contaminate the soil or	Contractor	DSC	Complaints from community	As work progresses	No visible increase in water pollution due to

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	<p>water on-site.</p> <ul style="list-style-type: none"> - Care must be taken to ensure that runoff from vehicle or plant washing does not enter the surface/ground water. - Site staff should not be permitted to use any stream, river, other open water body, or natural water source adjacent to or within the designated site for the purposes of bathing, washing of clothing, or for any construction or related activities. Municipal water (or another source approved by the environment management specialist) should instead be used for all activities such as washing of equipment or disposal of any type of waste, dust suppression, concrete mixing, compacting etc. - All concrete mixing must take place on a designated, impermeable surface. - No vehicles transporting concrete to the site may be washed on-site. - No vehicles transporting, placing, or compacting asphalt or any other bituminous product may be washed on-site. - All substances required for vehicle maintenance and repair must be stored in sealed containers until they can be disposed of removed from the site. - Hazardous substance/ materials are to be transported in sealed containers or bags. 			Waste disposal manifest/record		<p>the project</p> <p>Zero complaints from community</p>
Waste management	<ul style="list-style-type: none"> - Wastes must be placed in the designated skips/bins which must be regularly emptied. These should remain within demarcated areas and should be designed to prevent wastes from being blown out by wind. - Littering on-site is forbidden and the site should be cleared of litter at the end of each working day/night period. - Recycling is to be encouraged by providing separate receptacles for different types of wastes and making sure that staff is aware of their uses. 	Contractor	DSC	<p>Complaints from community</p> <p>Waste disposal manifest/record</p>	As work progresses	<p>No dumped wastes and litter at work sites at all times</p> <p>Zero complaints from community</p>

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	<ul style="list-style-type: none"> - All waste must be removed from the site and transported to a disposal site or as directed by the environment management specialist. Waybills proving disposal at each site should be provided for the environment management specialist's inspection. - Construction rubble should be disposed of in pre-agreed, demarcated spoil dumps that have been approved by the environment management specialist, or at disposal sites. 					
Conservation of natural environment	<ul style="list-style-type: none"> - As the work front progresses; the contractor is to check that vegetation clearing has the prior permission of the environment management specialist. - Only trees that have been marked beforehand are to be removed, if cutting of trees is required. - Clean the entire area and maintain immediately after completion of the construction activities to make sure that existing tranquility of the surrounding area is not disturbed in any way. 	Contractor	DSC	Vegetation clearing	As required	Only allowed trees/vegetation to be cleared
Cultural and historical environment	<ul style="list-style-type: none"> - Consult laborers who work on the site during the detailed design stage and in the unlikely event that there are social and cultural resources in the site; assistance should be given in relocating the site and any associated artifacts. - All the staff and laborers of the contractor are to be informed about the possible items of historical or archaeological value, which include old stone foundations, tools, clayware, jewelry, remains, fossils etc. - If something of this nature is uncovered, Department of Archaeology should be contacted and work should be stopped immediately. 	Contractor	DSC	Chance finds	As necessary	All chance finds shall be reported and turned over to the Department of Archaeology.
Safeguards supervisors	<ul style="list-style-type: none"> - The contractor should appoint one environment safeguard supervisor who will be responsible for assisting the contractor in implementation of EMP, coordinating 	Contractor	DSC	Hiring and actual work	As work progresses	Continuous work output and reporting records

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	with the DSC, consultations with interested/affected parties, reporting, and grievance redressal on a day-to-day basis.					
Post-construction and post-commissioning irregularities	<ul style="list-style-type: none"> - Remove all plant/ machineries/ vehicles and any temporary structures including the workforce camps and warehouses for storage of materials after completion of construction. - Restore the original landscape of the surrounding area as much as possible. 	Contractor	DSC	Cleanliness of the site and surrounding area	End of construction phase	As specified in the O&M Manual and all applicable laws and regulations
Operation and maintenance phase						
General	<ul style="list-style-type: none"> - Develop O&M Manuals to include all aspects of the management and operation of the CLF: - nature of waste that is accepted; - sequence and location of waste placement; - operation and maintenance of the gas collection system; - introduction of moisture or recirculation of leachate, leachate collection; - maintenance and cleaning of the leachate collection system; and - environmental monitoring, and maintenance of the final cover. - Train all CLF workers to the highest standards available in Bangladesh and given refresher training at least annually - Control access for public/personnel; - Clean toilets daily; - Provide clean hand washing areas adequate soap and towels; - Provide clothing and laundry service for workers; and - Clean facility after the work of each day. <p>The waste storage area and other adjacent areas should be sprinkled or sprayed regularly with disinfectants to avoid any spread of disease.</p>	<p>Contractor (up to service delivery period)</p> <p>Rajshahi City Corporation</p>	<p>Rajshahi City Corporation (up to service delivery period)</p> <p>Independent Monitoring Agency</p>	<p>Specifications in the O&M Manual</p> <p>Public health survey (5 years)²⁰</p>	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations

²⁰ Public health survey will be conducted by the city corporation authority by its own source of fund with a view to evaluating the impact of operation and maintenance of the CLF. Outcome will be utilized to monitor the impacts and to make any changes in the modality of operation of the CLF to make it more public health friendly than before. Target population will be the residents within a distance of one kilometer around the CLF.

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	- Audit implementation of O&M procedures at regular intervals (by an Independent Monitoring Agency)					
Monitoring/ Waste composition, inventory and inspection	Landfill operator must ensure that a register is kept throughout the life of the facility of the quantities and characteristics of the waste deposited.	Contractor	City Corporation (up to service delivery period) Independent Monitoring Agency	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations
	Information on waste register must include the origin of waste, type of waste, date of delivery, identify of the producer or collector.	Contractor	City Corporation (up to service delivery period) Independent Monitoring Agency	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations
	Regular visual inspection of the waste at the point of deposit should be undertaken to ensure that waste is properly sorted/ separated at the site	Contractor	City Corporation (up to service delivery period) Independent Monitoring Agency	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations
Monitoring of gases, wastewater and water	Indicative parameters for environmental pollution like presence of inflammable gases and quality of water and groundwater will be monitored	Contractor (up to service delivery period) Rajshahi City Corporation	Rajshahi City Corporation (up to service delivery period) Independent Monitoring Agency	Specifications in the O&M Manual	As determined in the O&M Manual	ECR 1997 and applicable international guidelines
Land contamination	- Do not store wastes outside the CLF premises to avoid issues of aesthetic nature	Contractor (up to service delivery period) Rajshahi City Corporation	Rajshahi City Corporation (up to service delivery period) Independent Monitoring Agency	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations
Wastewater	- After treatment, the discharge standards need to be followed similar to the standards mentioned in Schedule 10 of the	Contractor (up to service delivery period)	Rajshahi City Corporation (up to service	Specifications in the O&M Manual	As determined in the O&M Manual	ECR 1997 (Rule 13: The standard limits of the

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
	ECR 1997 for inland water discharge	Rajshahi City Corporation	delivery period) Independent Monitoring Agency			discharge of liquid wastes shall be determine in accordance with the standards specified in Schedule 10)
Other wastes	- All other wastes arising in the CLF should be properly graded and disposed of by appropriate methods. - Disposed into a solid waste bin (skip) and immediately transport out of the CLFs in a closed wheel-barrow or similar other device.	Contractor (up to service delivery period) Rajshahi City Corporation	Rajshahi City Corporation (up to service delivery period) Independent Monitoring Agency	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations
Odor	- Audit odor to identify and characterize sources and determine any action required. - Carry out frequent cleaning of material storage areas to prevent odor	Contractor (up to service delivery period) Rajshahi City Corporation	Rajshahi City Corporation (up to service delivery period) Independent Monitoring Agency	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations
Vermin and pest	- Apply soil cover materials rigorously - Compact wastes properly - Carefully maintain general "good housekeeping" - Inspect site regularly to detect indication of prevalence of pests and vermin - Employ an experienced pest control specialist to deal with this problem in case significant numbers are identified.	Contractor (up to service delivery period) Rajshahi City Corporation	Rajshahi City Corporation (up to service delivery period) Independent Monitoring Agency	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations
Noise	- Activities and vehicle movements should be avoided after hours. - Vehicles should be fitted with silencers. - Vehicles and machinery are to be kept in good working order.	Contractor (up to service delivery period) Rajshahi City Corporation	Rajshahi City Corporation (up to service delivery period) Independent Monitoring Agency	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations
Water use	- Minimize water use through dedicated metering of water consumption	Contractor (up to service delivery period)	Rajshahi City Corporation (up to service	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws

Parameter	Mitigation Measures	Responsible for Implementation	Responsible for Monitoring	Parameters to be Monitored	Frequency of Monitoring	Guidelines/ Standards
		Rajshahi City Corporation	delivery period) Independent Monitoring Agency			and regulations
Health, hygiene, and safety	<ul style="list-style-type: none"> - CLF workers should undergo regular medical check-up - CLF workers should be provided with protective gear like head cover, gloves, etc - Provide training on safety to staff to avoid accidents - Regularly monitor the CLF to ensure compliance with occupational health and safety rules 	Contractor (up to service delivery period) Rajshahi City Corporation	Rajshahi City Corporation (up to service delivery period) Independent Monitoring Agency	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations

D. Reporting

183. The DSC will submit monthly monitoring reports to CCPIU, and the CCPIU will send semiannual monitoring reports to ADB. ADB will post the environmental monitoring reports on its website.

E. Environmental Costs

184. The contractor's cost for site establishment, preliminary activities, construction, defect liability activities, and environmental mitigation measures related to EMP implementation during planning, design, construction, and operations will be incorporated into the contractual agreements and engineers costs, which will be binding on him for implementation.

185. The mitigation measures during the operation phase (after the service delivery period) are again of good operating practices, which will be the responsibility of the implementing agency (Rajshahi City Corporation). All monitoring during the operation and maintenance phase will be conducted by Rajshahi City Corporation; therefore, there are no additional costs.

186. The activities identified in the EMP mainly include site inspections and informal discussions with workers and local community, and this will be the responsibility of CCPIU with the assistance of DSC, costs of which are part of project management. The budget required for capacity building and training program mentioned in Table 6 is also included in the project management cost.

187. Table 8 presents the estimated cost to implement the EMP. The EMP and the costs for the EMP implementation will be updated during detailed engineering design. The figures show that the total cost of environmental management and monitoring for all subprojects in Rajshahi is Tk 22.5 million. This includes: the cost of the Independent Monitoring Agency, which will spend one week every month for five years, monitoring the operation of the CLF. It includes the cost of all surveys (long-term bi-annual wastewater monitoring will be done by DOE and test costs borne by operator according to DOE fee rates as per Schedule 14 of the ECR, 1997) and other expenses associated with implementing the EMP for this subproject during project implementation. It also includes the cost of the long-term survey of public health proposed in the EMP for this subproject.

Table 8: Environmental Management and Monitoring Costs for Rajshahi CLF

Item	Quantity	Unit Cost (TK.)	Total Cost (TK.)	Sub-total
1. Monitoring during Construction (1.5 years)				
Domestic Environmental Specialist	1 x 6 month	300,000 ²¹	1,800,000	
Survey Expenses	Lump Sum	2,000,000	2,000,000	3,800,000
2. Monitoring during Operation (5 years)				
Independent Monitoring Expert	5 x 3 month	300,000	4,500,000	
Supporting Staff	5 x 3 month	200,000	3,000,000	
Survey Expenses	Lump Sum	5,000,000	5,000,000	12,500,000
3. IEEs/EIAs required by ADB policy & national law				
Domestic Environmental Specialist	1 x 12 month	300,000	3,600,000	
Expenses (surveys, consultation, disclosure)	Lump Sum	1,000,000	1,000,000	4,600,000

²¹ Unit cost of domestic consultants is based on current rates and includes fee, travel, accommodation and subsistence.

Item	Quantity	Unit Cost (TK.)	Total Cost (TK.)	Sub-total
4. Survey of Public Health (5 years)				
Domestic Consultant	5 x ½ month	300,000	750,000	
Supporting Staff	5 x ½ month	200,000	500,000	
Other Expenses	Lump Sum	500,000	350,000	1,600,000
TOTAL COST (TK.)				22,500,000

VII. FINDINGS AND RECOMMENDATIONS

A. Findings

188. The process described in this document has assessed the environmental impacts of all elements of the infrastructure proposed under the Rajshahi CLF subproject. Potential negative impacts were identified in relation to the design, construction and operation of the infrastructure, and mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects of program development, and as a result some measures have already been included in the outline designs for the infrastructure. These include:

- (i) Ensuring that the site selected for the CLF is owned by the Government and does not contain any residential property, to avoid the need to relocate households; and
- (ii) Selecting a site that is in an uninhabited area where there are no sensitive receptors.

189. This means that the number of impacts and their significance has already been reduced by amending both the design and location of elements of the subproject.

190. Regardless of these and various other actions taken during the IEE 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 a functioning CLF can have major negative impacts on public health and safety, and environmental quality, if it is not operated to the highest professional standards. Because of these factors the most significant impacts are on the physical environment and the human environment.

191. In the construction phase there are not expected to be major negative impacts because the construction work is relatively straightforward and will be conducted at a single site. Other mitigation and enhancement measures are included in the EMP, which also shows the location of the impact, the body responsible for the mitigation, and the program for its implementation.

192. Operation and maintenance of the completed CLF will be the responsibility of the contractor up to the end of the service delivery period and afterwards, the Rajshahi City Corporation. It will be vital that the facility operates to the highest professional standards because if this is not the case it could easily replicate the practices and effects that are common at existing CLF and *ad hoc* solid waste dumping places in the city. These include impacts on:

- (i) **Worker health and safety.** if equipment, procedures and hygiene are inadequate;
- (ii) **Environmental quality.** if solid waste is not properly collected, transported and disposed to proper positions on a daily basis.

193. The IEE includes a number of measures relating to the design to ensure that the facility operates to a high standard and avoids these and other impacts. The main measures are that:

- (i) All aspects of management and operation should be set out in O&M manuals prepared by an international expert in CLF management;
- (ii) Implement of the procedures is checked and audited by an Independent Monitoring Agency every month for the first five years;
- (iii) All workers are trained to the highest available standards and re-trained annually;
- (iv) Ensuring sufficient training and financial support to the Rajshahi City Corporation to achieve expected standards.

194. If these and the other mitigation measures recommended by the IEE are implemented, then the CLF should operate without significant negative impacts. Public health should therefore improve and there will also be economic benefits for the people in general because there will be less possibility of getting sick and subsequent absence of the workers in offices and factories.

195. Mitigation will be assured by a program of environmental monitoring conducted during both construction and operation to ensure that all measures are provided as intended, and to determine whether the environment is protected as envisaged. This will include observations on and off site, document checks, and interviews with workers and beneficiaries during the construction stage, and weekly monitoring of all practices at the CLF for the first five years of operation, by the IMA. Any requirements for remedial action will be reported to LGD/ UPEHU and ADB. There will also be a longer-term survey to monitor the expected improvements in public health.

196. Finally, stakeholders were involved in developing the IEE through face-to-face discussions on site and a large public meeting held in the town, after which views expressed were incorporated into the IEE and the planning and development of the project. The IEE and other documents will be made available at public locations in the town and summaries will be disclosed to a wider audience via the ADB website. The consultation process will be continued and expanded during project implementation, when a nationally-recognized NGO will be appointed to handle this key element to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation.

B. Recommendations

197. There are two straightforward but essential recommendations that need to be followed to ensure that the environmental impacts of the project are successfully mitigated. These are that LGD/ UPEHU should ensure that:

- (i) All mitigation measures proposed in this IEE report (Table 7) are implemented in full, as described in this document; and
- (ii) The EMP of this report is updated during detailed design and also implemented in full during construction and operation period.
- (iii) A copy of the EMP shall be kept on-site during the construction and operation period at all times. Also the SIEE is prepared and provided to contractors upon award of contract.
- (iv) The EMP shall be made binding on all contractors 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.

VIII. CONCLUSIONS

198. The environmental impacts of the proposed CLF subprojects in the Rajshahi City have been assessed according to ADB guidelines and results reported in this IEE. The

potential adverse environmental impacts are related to the (i) construction period, which can be minimized by the mitigating measures and environmentally sound engineering and construction practices; and (ii) operation period, which can be managed by the mitigation measures and environmentally sound O&M practices. Therefore, as per ADB Environment Policy, the project is classified as environmental category B and does not require further environmental impact assessment.

199. In relation to Bangladeshi ECR 1997, the Rajshahi CLF subproject is considered to have significant environmental impacts and can be classified as Red category. The environmental impacts can be mitigated by the measures mentioned in this IEE and EMP. So this IEE document will be sufficient and acceptable to DoE as part of the ECC application although further study to prepare EIA report for impact assessment at a later stage will be necessary.

ANNEX 1: ADB Rapid Environmental Assessment Checklist

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area...			
▪ Densely populated?		X	
▪ Heavy with development activities?		X	The Landfill site is located in city corporation owned land. At present this is not being used for dumping of municipal solid wastes.
▪ Adjacent to or within any environmentally sensitive areas?			
• Cultural heritage site		X	
• Protected Area		X	
• Wetland		X	
• Mangrove		X	
• Estuarine		X	
• Buffer zone of protected area		X	
• Special area for protecting biodiversity		X	
• Bay		X	
B. Potential Environmental Impacts Will the Project cause...			
▪ impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.		X	
▪ deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity, and increased waste generation to the point that both manmade and natural systems are overloaded and the capacities to manage these systems are overwhelmed?		X	
▪ degradation of land and ecosystems (e.g. loss of wetlands and wild lands, coastal zones, watersheds and forests)?		X	
▪ dislocation or involuntary resettlement of people?		X	There will be no dislocation or involuntary resettlement of people.
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable group?		X	
▪ degradation of cultural property, and loss of cultural heritage and tourism revenues?		X	
▪ occupation of low-lying lands, floodplains and steep hillsides by squatters and low-income groups, and their exposure to increased health hazards and risks due to pollutive industries?		X	
▪ water resource problems (e.g. depletion/degradation of available water supply, deterioration for surface and ground water quality , and pollution of receiving waters)?		X	
▪ air pollution due to urban emissions?	X		During construction activities for hauling of materials and operations of excavation equipment; During operations, odor from the

Screening Questions	Yes	No	Remarks
			solid wastes due to agitation and mixing
▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical and biological hazards during project construction and operation?	X		During construction activities – occupational health and safety due to physical hazards; During construction activities – occupational health and safety due to physical and biological hazards
▪ road blocking and temporary flooding due to land excavation during rainy season?		X	
▪ noise and dust from construction activities?	X		During construction phase only
▪ traffic disturbances due to construction material transport and wastes?	X		During construction phase only
▪ temporary silt runoff due to construction?	X		During construction phase only
▪ hazards to public health due to ambient, household and occupational pollution, thermal inversion, and smog formation?		X	
▪ water depletion and/or degradation?		X	
▪ overpaying of ground water, leading to land subsidence, lowered ground water table, and salinization?		X	
▪ contamination of surface and ground waters due to improper waste disposal?	X		During construction phase only
▪ pollution of receiving waters resulting in amenity losses, fisheries and marine resource depletion, and health problems?		X	
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		X	
▪ social conflicts if workers from other regions or countries are hired?		X	
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during operation and construction?		X	
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		X	

ANNEX 2: Photographs of the Proposed CLF Site and the Surrounding Areas



Solid waste spread over the site



Old stocks of dumped solid waste



Some vegetation grown on the dumped waste



Embankment around the site with drainage pipe



Herring bone roads



Portion of slightly low lying area

ANNEX 3: Records of Public Consultations Conducted

The stakeholders' consultation meeting was held at Landfill site beside the City Bypass Road, Rajshahi at 2-00 PM on 1 January 2013 with local people and Rajshahi City Corporation (RCC) officials.

The meeting was held with local people and Conservancy Officer (Mr. Sheikh Mamun Dollar) of RCC. Among the local people, most of them were laborers and engaged in waste picking from landfill site and small businessmen who participated actively in the consultation. Local people and waste pickers were about 80% and the remaining were the employees of the city corporation. Total number of waste pickers in the CLR site is about 30 and discussion was held with the persons available during the visit. First 4 participants in the attendance sheet are the waste pickers and the remaining are the local people.



Meeting at CLF site in Rajshahi

The Environment and Safeguard Specialist of Package-C Consultants welcomed all participants in the meeting and explained goals and objectives of the project. He told that the Government of Bangladesh through the RCC has undertaken a project to construct one modern slaughterhouse, one controlled land fill and 6 secondary transfer stations in RCC area to keep the city free from environmental pollution. This project will benefit the local people by improving the environmental conditions.

It was known from the discussion that the land proposed for construction of the Controlled Landfill (CLF) is owned by the Rajshahi City Corporation. It is a quite big area of about 6.09 acres acquired by the RCC as per GOB rules, and it will be sufficient for construction of a CLF as per design adopted in UPEHSDP. It is at present being used as solid waste disposal site. The participant from the RCC clearly stated that the area proposed for construction of CLF will be kept free from any kind of external hindrance by the own initiative of the RCC during the construction activities by the contractor in the site.

It was disclosed in the meeting that the project would be implemented soon and the local people would get benefit of getting employment as soon as the construction works would start. They also expressed their willingness to get long-term deployment after the implementation of the CLF. It was disclosed to the participants that the local people would get preference during selection of staff and workers for running the CLF in a sustainable manner.

The participants were convinced that the socio-economic and environmental condition of the local people and the locality would be definitely better after implementation of the subproject and they showed their willingness to cooperate whole heartedly during construction and operation and maintenance phase of the CLF.

There were no issues left for discussion and the meeting was closed with a vote of thanks to all participants.

Ministry of Local Government, Rural Development and Cooperatives
Urban Public and Environmental Health Sector Development Project (UPEHSDP)
Attendance Sheet

Time: 1-00 PM

Date: 10/12/2012

Place of meeting: CLF site at Rajshahi **Union:** W-17 **Thana:** Shah Mokhdum

Serial Number	Name of Participant	Father's/ Husband's Name	Address	Mobile Number	Signature
1	Md. Tahasen Ali	Late Mohasen	Koerdara	01721876786	
2	Nazu	Sona	Boro Bonogram	-	
3	Sagori	Nazu	Boro Bonogram	-	
4	Md. Sohel Rana	Md. Alauddin	Khristian Teger	01939794050	
5	Helim	Dawood Ali	Natun Fudkipara	01930445191	
6	Mamun	Sultan	Aam Chottot	01723987381	
7	Salma	Abdus Samad	Kaloor Mour	-	
8	Fadu	Sona	Boro Bonogram	01948735093	
9	Anwar Ali	Hazrat Ali	Boro Bonogram	-	
10	Rokeya	Samir Sheikh	Tikor	-	

Attendance Sheet

Place of meeting: Landfill site Rajahmundry

Union: /W-17

Thana: Shahr Nokhdeh

[illegible]

ANNEX 4: Environmental Pathway Studies – Rajshahi



Joint Venture



FIELD REPORT

ENVIRONMENTAL PATHWAY STUDIES - RAJSHAHI

May - August, 2013

THE URBAN PUBLIC AND ENVIRONMENTAL HEALTH SECTOR DEVELOPMENT PROJECT (UPEHSDP)

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Annexes

Annex 1: Bore logs

Annex 2: Analysis Report

Annex 3: Map

1 PURPOSE OF THE FIELD REPORT

The purpose of the Field Report is to:

- To represent the analyses measured on the soil samples.
- To represent the analyses measured on the samples, ground water samples and surface water samples.
- To represent a short overview of all work done under the TOR

The present Report is the Field Report which contains all results of the Environmental Pathway Study in Rajshahi, performed in May-August 2013. It has been prepared by the two partners and DDC under the JV Ecorem-DDC.

The proposed landfill site of Rajshahi City Corporation is located at Nawdapara near the Truck Terminal and Rajshahi bypass about five kilometers to the north from the city center. It is the existing dump site of the waste the city generates. The area of the site is about ten acres bounded by Herring Bone Bond Brick soling road. The site is accessible from the city center from the south-east, south and south-west. The site is rectangular in shape and has a rough dimension of about 810ft X 562ft.

It is being used as a waste dumping ground since 2002. Medical waste management of the city is done in the campus of Rajshahi medical college.

2 GENERAL DESCRIPTION OF ACTIVITIES PERFORMED UNDER THE ENVIRONMENTAL PATHWAY STUDIES

For the purpose of the study some bore holes were made. Six tube wells were installed in the first available aquifer. Drilling was done manually by slugger method. Since this site is located in the low water table area (water table beyond the suction limit of 24'ft. from the base of a tube well) suction mode manually operated conventional number six hand pumps were used with extended piston rod up to a depth of 32ft to collect ground water samples. These boreholes will serve two purposes namely

- 1) Collection of ground water samples for testing in the laboratory for the determination of the extent of ground water pollution by the leachate of the waste being dumped at the landfill site and;
- 2) Determine the location of the ground water table.

In Rajshahi six observation wells were installed. The location of the observation wells are shown in the site plan. Drilling work started on 18th May 2013 and completed on 21st May 2013. The site plan is attached herewith. Static water table as recorded in the wells lies at 35 ft below the base of the hand pump.

Table 1: Particulars of Observation wells at Rajshahi (6 nos.)

Sl. no of well.	Location	Depth (ft)	Diameter of the well	Location of the strainer (ft)	Length of strainer (ft)	Type of pump	Static water table	Date of installation	Sand trap (ft)
1	Shown on the site plan	80'	2" dia, Upper well casing Thirty five ft above 1.5" dia blind pipe	67.5' to 77.5'	10'	Deep set manually operated hand Pump	35ft from the base of the pump	18.05.2013	2.5'
2	Shown on the site plan	80'	do	67.5' to 77.5'	10'	Deep set manually	35ft from the base of the	18.05.2013	2.5'

						operate d hand Pump	pump		
3	Shown on the site plan	120 '	do	107.5 ' to 117.5 '	10'	Deep set manuall y operate d hand Pump	35 ft from the base of the pump	19.05.20 13	2.5'
4	Shown on the site plan	100 '	do	87.5' to 97.5'	10'	Deep set manuall y operate d hand Pump	35ft from the base of the pump	19.05.20 13	2.5'
5	Shown on the site plan	90'	do"	77.5' to 87.5'	10'	Deep set manuall y operate d hand Pump	35ft from the base of the pump	20.05.20 13	2.5'
6	Shown on the site plan	140	3"dia, Upper well casing Thirty five ft above 1.5"dia blind pipe "	127.5 ' to 137.5 '	10'	Deep set manuall y operate d hand Pump	35ft from the base of the pump	21.05.20 13	2.5'

Deep set manually operated hand pump: Due to low water table the suction head is reduced to a considerable degree by lowering the piston rod in the upper well casing. The static water table was found at a depth of 25 ft from the base of the pump on 1st.August 2013, which is eight feet above the static water table found at the beginning of the monsoon as mentioned in the above table.

Soil samples were collected from two boreholes up to a depth of five meters from the ground level at an interval of 1.5ft. A representative sample for laboratory testing was chosen from each of the boreholes to ascertain the chemical contents to have an idea about the presence of pollutants of the wastes penetrated in the underlying soil strata.

Two soil samples from depths of 12ft and 15 ft were sent to the laboratory for testing. The soil samples were taken from borehole number one and six. For the purpose of waste characterization three current dumping spots were selected wherein the dump trucks are dropping the wastes at present. The location of the waste collection points are shown on the site map (C-1, C-2 & C-3). These points were selected for getting an impression about the character of the current waste stream.

Table 2: Calendar of the achieved work

Well site number/ Bore hole number	Start of drilling work	Completion of drilling and date of installation of observation well
1	18.05.2013	18.05.2013
2	19.05.2013	19.05.2013
3	19.05.2013	19.05.2013
4	20.05.2013	20.05.2013
5	20.05.2013	20.05.2013
6	21.05.2013	21.05.2013

3 ANALYSIS AND RESULTS

3.1 Groundwater samples

3.1.1 Way of sampling

Before taking ground water samples, the tube wells were sufficiently pumped to bail out the standing water in the well. After that one liter of water was collected in plastic bottles. Care was taken while filling the bottle with water so that no air bubble is entrapped in the bottle. The samples were sent to BCSIR laboratory for analysis on 15th July 2013. The laboratory test reports were received on 28th August 2013. Water samples were collected from five of the six tube wells installed at the site. The fifth well was submerged at the time of sample collection. Ground water sample was collected from two adjacent private tube wells marked as Borehole number 7 & 8. Labory test report has been presented along with the laboratory test reports of the ground water samples.

Particulars of this two adjacent private tube wells are provided in the tabular form below:

Bore hole number Year of installation Depth of well(ft) Distance(ft) from
the nearest Borehole

Bore number	hole	Year of installation	Depth of well(ft)	Distance(ft) from the nearest Borehole
7		2010	120'	400'fromBH no.5
8		2010	135'	100'fromBH no.6

3.1.2 Analysis

Testing of the water samples were done in Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratory in Dhaka. Test methods are mentioned in the test report against the parameters.

3.1.3 Results

Table 3: Results of analysis of groundwater sample B.H.-1

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-10018	Water(B.H.-1, Rajshahi)	pH at 25.9 deg. C	7.42	4500-H ⁺ .B
		E. Conductivity	606 μ S/cm	2510.B
		Lead (Pb)	Less than 0.01 mg/L	3113.B
		Cadmium (Cd)	Less than 0.001mg/L	3113.B
		Chromium (Cr)	0.008 mg/L	3113.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	4.68 mg/L	3111.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Fluoride (F)	Less than 0.5 mg/L	4110.B
		Chloride (Cl)	2.94 mg/L	4110.B
		Bromide (Br)	Less than 1mg/L	4110.B
		Nitrite (NO ₂)	Less than 1mg/L	4110.B
		Nitrate (NO ₃)	Less than 3 mg/L	4110.B
		Sulphate (SO ₄)	Less than 4mg/L	4110.B
		Sodium (Na)	24.1 mg/L	3500-Na.B
		Potassium (K)	2.12 mg/L	3500-K.B
		Calcium (Ca)	100 mg/L	3111.B
		Magnesium (Mg)	23.0 mg/L	3111.B
		Temperature	27.4 ⁰ C	2550.B
		BOD	Less than 0.2 mg/L	5210.B
		COD	Less than 2mg/L.	5220.B
		Ammonium(NH ₄)	2.37 mg/L	3500.B

Table 4: Results of analysis of groundwater sample B.H.-2

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-10019	Water(B.H.-2, Rajshahi)	pH at 25.1 deg. C	7.23	4500-H ⁺ .B
		E. Conductivity	656 μ S/cm	2510.B
		Lead (Pb)	Less than 0.01 mg/L	3113.B
		Cadmium (Cd)	Less than 0.001mg/L	3113.B
		Chromium (Cr)	0.011 mg/L	3113.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	3.03 mg/L	3111.B
		Mercury (Hg)	0.001 mg/L	3112.B
		Fluoride (F)	Less than 0.5 mg/L	4110.B
		Chloride (Cl)	15.1 mg/L	4110.B
		Bromide (Br)	Less than 1mg/L	4110.B
		Nitrite (NO ₂)	Less than 1mg/L	4110.B
		Nitrate (NO ₃)	Less than 3 mg/L	4110.B
		Sulphate (SO ₄)	Less than 4mg/L	4110.B
		Sodium (Na)	31.1 mg/L	3500-Na.B
		Potassium (K)	3.65 mg/L	3500-K.B
		Calcium (Ca)	103 mg/L	3111.B
		Magnesium (Mg)	24.8 mg/L	3111.B
		Temperature	27.2 ⁰ C	2550.B
		BOD	2.35 mg/L	5210.B
		COD	12 mg/L.	5220.B
		Ammonium(NH ₄)	2.06 mg/L	3500.B

Table 5: Results of analysis of groundwater sample B.H.-3

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-10020	Water(B.H.-3, Rajshahi)	pH at 25.1 deg. C	7.24	4500-H ⁺ .B
		E. Conductivity	679 μ S/cm	2510.B
		Lead (Pb)	0.02 mg/L	3113.B
		Cadmium (Cd)	Less than 0.001mg/L	3113.B
		Chromium (Cr)	0.028 mg/L	3113.B
		Arsenic (As)	0.008 mg/L	3114.C
		Iron (Fe)	27.4 mg/L	3111.B
		Mercury (Hg)	0.001 mg/L	3112.B
		Fluoride (F)	Less than 0.5 mg/L	4110.B
		Chloride (Cl)	8.03 mg/L	4110.B
		Bromide (Br)	Less than 1mg/L	4110.B
		Nitrite (NO ₂)	Less than 1mg/L	4110.B
		Nitrate (NO ₃)	Less than 3 mg/L	4110.B
		Sulphate (SO ₄)	Less than 4mg/L	4110.B
		Sodium (Na)	31.5 mg/L	3500-Na.B
		Potassium (K)	3.19 mg/L	3500-K.B
		Calcium (Ca)	120 mg/L	3111.B
		Magnesium (Mg)	32.5 mg/L	3111.B
		Temperature	27.1 ⁰ C	2550.B
		BOD	12 mg/L	5210.B
		COD	32 mg/L.	5220.B
		Ammonium(NH ₄)	2.22 mg/L	3500.B

Table 6: Results of analysis of groundwater sample B.H.-4

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)	
A-10021	Water(B.H.-4, Rajshahi)	pH at 25.3 deg. C	7.32	4500-H ⁺ .B	
		E. Conductivity	713 μ S/cm	2510.B	
		Lead (Pb)	0.02 mg/L	3113.B	
		Cadmium (Cd)	Less than 0.001mg/L	3113.B	
		Chromium (Cr)	0.016 mg/L	3113.B	
		Arsenic (As)	Less than 0.005 mg/L	3114.C	
		Iron (Fe)	16.9 mg/L	3111.B	
		Mercury (Hg)	Less than 0.001 mg/L	3112.B	
		Fluoride (F)	Less than 0.5 mg/L	4110.B	
		Chloride (Cl)	18.2 mg/L	4110.B	
		Bromide (Br)	Less than1mg/L	4110.B	
		Nitrite (NO2)	Less than1mg/L	4110.B	
		Nitrate (NO3)	Les than3 mg/L	4110.B	
		Sulphate (SO4)	Less than4mg/L	4110.B	
		Sodium (Na)	30.09 mg/L	3500-Na.B	
		Potassium (K)	3.11 mg/L	3500-K.B	
		Calcium (Ca)	141 mg/L	3111.B	
		Magnesium (Mg)	31.6 mg/L	3111.B	
			Temperature	27.40 ⁰ C	2550.B
			BOD	Less than 0.2 mg/L	5210.B
COD	4 mg/L.		5220.B		
Ammonium(NH4)	2.28 mg/L		3500.B		

Table 7: Results of analysis of groundwater sample B.H.-6

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)	
A-10022	Water(B.H.-6, Rajshahi)	pH at 26.0 deg. C	7.49	4500-H ⁺ .B	
		E. Conductivity	613 μ S/cm	2510.B	
		Lead (Pb)	0.05 mg/L	3113.B	
		Cadmium (Cd)	Less than 0.001mg/L	3113.B	
		Chromium (Cr)	0.005 mg/L	3113.B	
		Arsenic (As)	Less than 0.005 mg/L	3114.C	
		Iron (Fe)	0.41 mg/L	3111.B	
		Mercury (Hg)	Less than 0.001 mg/L	3112.B	
		Fluoride (F)	Less than 0.5 mg/L	4110.B	
		Chloride (Cl)	2.19 mg/L	4110.B	
		Bromide (Br)	Less than1mg/L	4110.B	
		Nitrite (NO2)	Less than1mg/L	4110.B	
		Nitrate (NO3)	Les than3 mg/L	4110.B	
		Sulphate (SO4)	Less than4mg/L	4110.B	
		Sodium (Na)	25.3 mg/L	3500-Na.B	
		Potassium (K)	2.08 mg/L	3500-K.B	
		Calcium (Ca)	97.8 mg/L	3111.B	
		Magnesium (Mg)	24.1 mg/L	3111.B	
			Temperature	27.3 ⁰ C	2550.B
			BOD	Less than 0.2 mg/L	5210.B
COD	Less than 2 mg/L.		5220.B		
Ammonium(NH4)	1.15 mg/L		3500.B		

Table 8: Results of analysis of groundwater sample B.H.-7

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)	
A-10023	Water(B.H.-7, Rajshahi)	pH at 26.0 deg. C	7.34	4500-H ⁺ .B	
		E. Conductivity	641 μ S/cm	2510.B	
		Lead (Pb)	Less than 0.01 mg/L	3113.B	
		Cadmium (Cd)	Less than 0.001mg/L	3113.B	
		Chromium (Cr)	0.005mg/L	3113.B	
		Arsenic (As)	Less than 0.005 mg/L	3114.C	
		Iron (Fe)	2.41 mg/L	3111.B	
		Mercury (Hg)	Less than 0.001 mg/L	3112.B	
		Fluoride (F)	Less than 0.5 mg/L	4110.B	
		Chloride (Cl)	3.28 mg/L	4110.B	
		Bromide (Br)	Less than1mg/L	4110.B	
		Nitrite (NO2)	Less than1mg/L	4110.B	
		Nitrate (NO3)	Les than3 mg/L	4110.B	
		Sulphate (SO4)	Less than4mg/L	4110.B	
		Sodium (Na)	31.1 mg/L	3500-Na.B	
		Potassium (K)	2.1 mg/L	3500-K.B	
		Calcium (Ca)	97.8 mg/L	3111.B	
		Magnesium (Mg)	23.3 mg/L	3111.B	
			Temperature	27.2 ⁰ C	2550.B
			BOD	Less than 0.2 mg/L	5210.B
COD	Less than 2mg/L.		5220.B		
Ammonium(NH4)	1.56 mg/L		3500.B		

Table 9: Results of analysis of groundwater sample B.H.-8

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)	
A-10024	Water(B.H.-8, Rajshahi)	pH at 25.9 deg. C	7.47	4500-H ⁺ .B	
		E. Conductivity	605 μ S/cm	2510.B	
		Lead (Pb)	Less than 0.01 mg/L	3113.B	
		Cadmium (Cd)	Less than 0.001mg/L	3113.B	
		Chromium (Cr)	0.006 mg/L	3113.B	
		Arsenic (As)	Less than 0.005 mg/L	3114.C	
		Iron (Fe)	0.21mg/L	3111.B	
		Mercury (Hg)	Less than 0.001 mg/L	3112.B	
		Fluoride (F)	Less than 0.5 mg/L	4110.B	
		Chloride (Cl)	3.03 mg/L	4110.B	
		Bromide (Br)	Less than1mg/L	4110.B	
		Nitrite (NO2)	Less than1mg/L	4110.B	
		Nitrate (NO3)	Les than3 mg/L	4110.B	
		Sulphate (SO4)	Less than4mg/L	4110.B	
		Sodium (Na)	30.1 mg/L	3500-Na.B	
		Potassium (K)	2.34 mg/L	3500-K.B	
		Calcium (Ca)	101 mg/L	3111.B	
		Magnesium (Mg)	23.1 mg/L	3111.B	
			Temperature	27.4 ⁰ C	2550.B
			BOD	1.2 mg/L	5210.B
COD	4 mg/L.		5220.B		
Ammonium(NH4)	0.94 mg/L		3500.B		

3.2 Surface water samples

3.2.1 Way of sampling

kNo surface water samples were collected from this site.]

3.2.2 Analysis

Not applicable

3.2.3 Results

Not applicable

3.3 Soil samples

3.3.1 Way of sampling

Soil sampling was done by driving a 1.5”inch diameter GI pipe with attachment for collection of soil sample at the driving end of the pipe. While driving the pipe into the ground soil enters into the attachment at the tip of the pipe. When the pipe with its attachment reaches the desired depth the pipe is withdrawn and soil entered into the attachment is collected in polythene bags (500gm)and sealed for handing over to the laboratory for testing.

3.3.2 Analysis

Testing of the sample was done in Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratory in Dhaka

3.3.3 Results

Table 10: Analytical results of soil sample

Sample ID			Results								
Bore Hole No.	Sample No.	Depth (ft)	pH	Clay Content	Organic Matter	Lead (Pb)	Cadmium (Cd)	Chromium (Cr)	Arsenic (As)	Iron (Ir)	Mercury (Hg)
06	D-10	15.00'	8.49	47.31%	0.23%	18.93 ppm	0.050 ppm	15.26ppm	2.21 ppm	0.152%	BDL
01	D-8	12.00'	8.64	33.86%	0.11%	14.40 ppm	0.041 ppm	10.29ppm	2.28 ppm	0.151%	BDL

BDL= below detection level

Methodology: (1) pH: pH meter,(2) Clay content: Hydrometer method, (3)Organic Matter: Wet oxidation method, (4) Pb, Cd & Cr: Atomic Absorption Spectrophotometer, (5) As: Atomic Absorption Spectrophotometer with HVG, (6) Hg: Atomic Absorption Spectrophotometer with MVU,

Table 11: Results of analysis of soils sample no. 01

Lab ID	Particulars of Supplied Sample	Name of Parameters		Concentration
A-10028	Soil Well No: 01 Sample No.D-8 Depth:12' City hat Rajshahi	Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthylene	3.5 mg/kg
			Anthracene	Not detectable
			Benzo(A) Anthracene	Not detectable
			Benzo(A)Pyrene	Not detectable
			Benzo (B)Fluoranthene	Not detectable
			Benzo (G,H,I)Perylene	Not detectable
			Benzo (K)Fluoranthene	Not detectable
			Chrysene	Not detectable
			Dibenz(A,H) Anthracene	Not detectable
			Fluorene	Not detectable
			Indeno (1,2,3-CD)Pyrene	Not detectable
			Phenanthrene	Not detectable
			Pyrene	Not detectable
A-10028	Soil	Poy	2,2',3,4,4',5,5'-	Not detectable

	Well No: 01 Sample No.D-8 Depth:12' City hat Rajshahi	Chlorobiphenyl (PCB)	Heptachlorobiphenyl	
			2,2',3,4,4',5'- Hexachlorobiphenyl	Not detectable
			2,2',4,4',5,5'- Hexachlorobiphenyl	Not detectable
			2,2',5,5'- Tetrachlorobiphenyl	Not detectable
			2,4,4'-Trychlorobiphenyl	Not detectable
			2,6-Dichlorobiphenyl	Not detectable
A-10028	Soil Well No: 01 Sample No.D-8 Depth:12' City hat Rajshahi	Volatile Organic Compounds (VOC)	Chlorobenzene	Not detectable
			<i>CIS-1,2-Dichloroethylene</i>	Not detectable
			Ethylbenzene	Not detectable
			O-Xylene	Not detectable
			P-Xylene	Not detectable
			Styrene	Not detectable
			Tetrachloroethene	Not detectable
			Toluene	Not detectable
			Trans-1,2- Dichloroethylene	Not detectable
			1,2-Dichlorobenzene	Not detectable
			1,2-Dichloropropane	Not detectable

Table 12: Results of analysis of soils sample no. 06

Lab ID	Particulars of Supplied Sample	Name of Parameters		Concentration
A-10029	Soil Well No: 06 Sample No.D-10 Depth:15' City hat Rajshahi	Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthylene	Not detectable
			Anthracene	Not detectable
			Benzo(A) Anthracene	Not detectable
			Benzo(A)Pyrene	Not detectable
			Benzo (B)Fluoranthene	Not detectable
			Benzo (G,H,I)Perylene	Not detectable
			Benzo (K)Fluoranthene	Not detectable
			Chrysene	Not detectable
			Dibenz(A,H) Anthracene	Not detectable
			Fluorene	Not detectable
			Indeno (1,2,3-CD)Pyrene	Not detectable
			Phenanthrene	Not detectable
			Pyrene	Not detectable
A-10029	Soil Well No: 06 Sample No.D-10 Depth:15' City hat Rajshahi	Poly Chlorobiphenyl (PCB)	2,2',3,4,4',5,5'- Heptachlorobiphenyl	Not detectable
			2,2',3,4,4',5'- Hexachlorobiphenyl	Not detectable
			2,2',4,4',5,5'- Hexachlorobiphenyl	Not detectable
			2,2',5,5'- Tetrachlorobiphenyl	Not detectable
			2,4,4'-Trychlorobiphenyl	Not detectable
			2,6-Dichlorobiphenyl	Not detectable
A-10029	Soil Well No: 06 Sample No.D-10 Depth:15' City hat	Volatile Organic Compounds (VOC)	Chlorobenzene	Not detectable
			<i>CIS-1,2-Dichloroethylene</i>	Not detectable
			Ethylbenzene	Not detectable
			O-Xylene	Not detectable
			P-Xylene	Not detectable

	Rajshahi		Styrene	Not detectable
			Tetrachloroethene	Not detectable
			Toluene	Not detectable
			Trans-1,2-Dichloroethylene	Not detectable
			1,2-Dichlorobenzene	Not detectable
			1,2-Dichloropropane	Not detectable

Table 13: Soil sample No 1 (drilling hole 1)

Depth of sample	Description
0 – 1.5 ft	Black Clay
1.5 – 3 ft	Black Clay
3 – 4.5 ft	Black Clay
4.5 – 6 ft	Black Clay
6 – 7.5 ft	Black Clay
7.5 – 9 ft	Black Clay
9 – 10.5 ft	Black Clay
10.5 – 12 ft	Light Black Clay
12 – 13.5 ft	Light Black Clay
13.5 – 15 ft	Light Black Clay

Table 14: Soil sample No 2 (drilling hole 3)

Depth of sample	Description
0 – 1.5 ft	Light Gray Clay
1.5 – 3 ft	Light Gray Clay
3 – 4.5 ft	Light Gray Clay
4.5 – 6 ft	Light Gray Clay
6 – 7.5 ft	Light Gray Clay
7.5 – 9 ft	Light Gray Clay
9 – 10.5 ft	Light Gray Clay
10.5 – 12 ft	Light Gray Clay
12 – 13.5 ft	Light Gray Clay
13.5 – 15 ft	Light Gray Clay

3.4 Waste Characterization

3.4.1 Way of analysis

Selection of sampling point: For ease of identification of different types of waste the city generates day to day, preliminarily locations are identified where the waste stream is deposited. Due to the non availability of heavy equipments for moving the waste deposited by hydraulic dump trucks at the site, wastes are unloaded around the periphery of the site on the edge of the dumping spot along the brick soling roads in the rainy season. Due to heavy rainfall and accumulation of rain water in and around the site, loaded trucks can't enter into the dumping site. For which the trucks are unloading the wastes along the roads around the site.

Collection of sample: For the purpose of characterization of waste three spots were chosen from the east and south-eastern side of the landfill site sufficiently apart from each other for ensuring representative samples. The location of the collection spot has been shown on the site plan by mark C-1(Sample-1), C-2 (Sample-2) and C-3 (Sample-3).

Waste samples weighing about 12 to 26kg roughly was collected in polythene bags from the spots. It was then segregated for the items mentioned in the table and put in polythene bags and weighed for each item individually on the spot and recorded.

3.4.2 Results

Waste Characterization							
Nawdapara Waste Dumping Site							
Rajshahi City Corporation							
Sample collection date: 01 August 2013							
Waste Fractions	Sample 1		Sample 2		Sample 3		Remarks
	Wt.(kg)	Percentage %	Wt.(kg)	Percentage %	Wt.(kg)	Percentage %	
Paper	0.400	3.013	1.675	6.405	0.675	2.660	
Glass	0.050	0.377	-	-	0.050	0.197	
Metal	0.050	0.377	-	-	-	-	
Plastic	0.700	5.273	1.975	7.553	0.800	3.153	
Organic Materials (food, green waste etc.)	10.800	81.356	19.500	74.570	21.900	86.305	
Textiles	0.425	3.202	1.000	3.824	0.250	0.985	
Construction waste(concrete, bricks etc)	0.850	6.403	2.000	7.648	1.700	6.700	
Hazardous household waste (paints, oil and fats, batteries, electronics, etc)	-	-	-	-	-	-	
Other fractions	-	-	-	-	-	-	
Total (kg)	13.275	100.000	26.150	100.000	25.375	100.000	
Samples for characterization was collected from the shown points. Serial starts from entrance. Sampling was done on 1st August 2013.							

4 CONCLUSIONS AND RECOMMENDATIONS

It has been considered remarkable that the analyzed samples show no degree of pollution since they were collected for a polluted environment. Therefore the results discussed in these report only provide a very basic analysis on the contamination level of the dumpsite. The reason is likely the questionable way of transportation, preservation and the time between sample taking and analysis. As such following concerns have been raised by the second opinion analysis done in the Belgian laboratory:

- During the sample taking: no preservatives were added so following parameters could not be determined: Cyanide, phenol index, mineral oils, volatile combinations.
- During the sample taking: no metals could be determined due to fact that the sample has not been filtrated and acified;
- During the sample taking: bottles were not filled out completely so determination of volatile combinations were impossible;
- The preservation term for following parameters has been expired, so following parameters could not be determined: Ammonia, Phenol index, cyanides, Ortho-phosphate, volatiles preparation, COD, Chloride, Fluoride, Sulphate, Nitrite, Nitrate;
- Unknown method of transportation and preservation: Samples have not been stored in a dark cooled places, which have an effect on the value of certain parameters.

It may be assumed that pollution is present or shall be present if no extra measurements are taken in the design of a controlled landfill. To minimize the negative effects of pollutants originating from the dumped household waste on the environment, the health of nearby inhabitants and on the quality and quantity of surrounding agricultural lands, at least the following measurements should be taken:

- Physical separation between the pollution and the environment;
- Draining and treatment of the polluted groundwater;
- Leachate reducing measurements (covering of waste, draining leachate, etc.);

During the design of the controlled landfill these recommendations will be taken into account.

Annex 1: Bore logs

BORE LOG OF OBSERVATION WELL

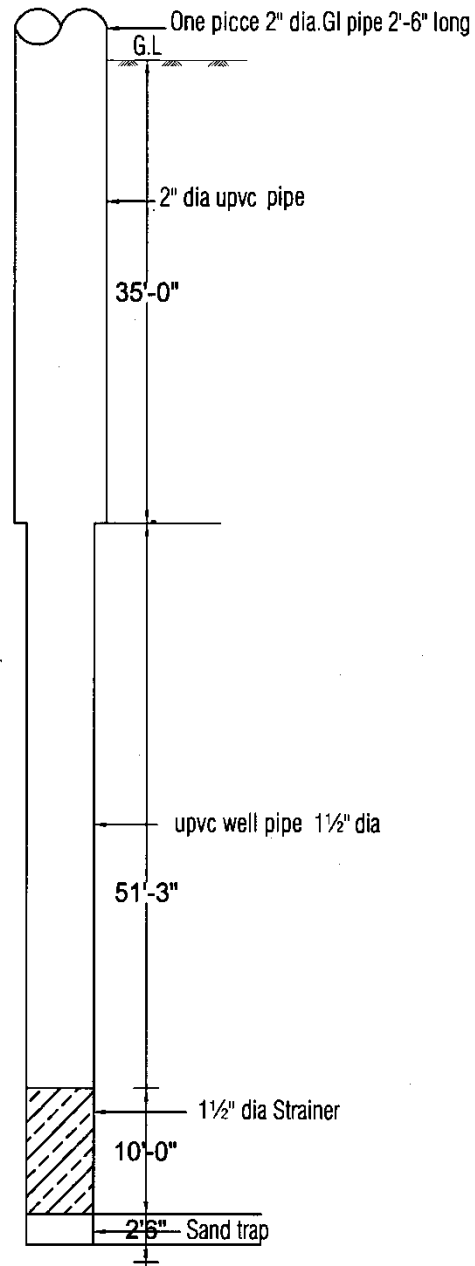
Project: Contamination pathway Study , UPEHSDP
Location: Landfill Site of Rajshahi City Corporation At Nawdapara
Bore Hole No.1

Depth in ft	Bore Log	
0'-10'	B C	
10'-20'	L B C	
20'-30'	L G C	
30'-40'	L G S C	
40'-50'	B S C	
50'-60'	LGSC	
60'-70'	C F C	
70'-80'	F M S	

Legend:-

B C=Black Clay
L B C=Light Black Clay
L G C=Light Gray Clay
L G S C=Light Gray Sticky Clay
B S C=Black Sticky Clay

C F C=clay With Fine Sand
F M S=Fine To medium Sand
Note=Not To Scale

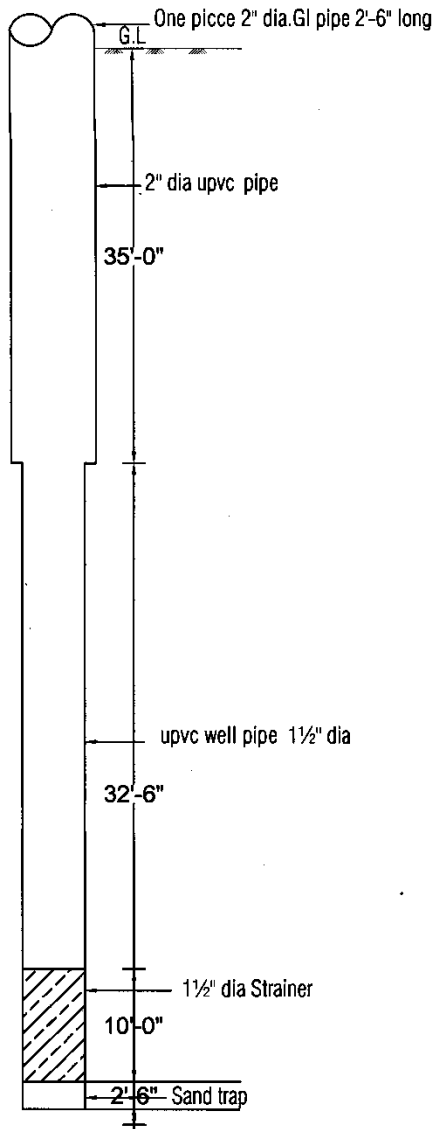


BORE LOG OF OBSERVATION WELL

Project: Contamination pathway Study , UPEHSDP
Location: Landfill Site of Rajshahi City Corporation At Nawdapara
Bore Hole No.2

Depth in ft	Bore Log	
0"-15'	LGC	
15'-20"	LGC	
15'-20"	LGC	
15'-20"	GSC	
15'-20"	BSC	
15'-20"	LBSS	
15'-20"	VFSC	
57'-60'	FMS	

Legend:-
LGC=Light Gray Clay
GSC=Gray Sticky Clay
BSC=Black Sticky Clay
LBSS=Light Black Sticky Clay
VFSC=Very Fine Sandy Clay
FMS=Fine TO Midium Sand

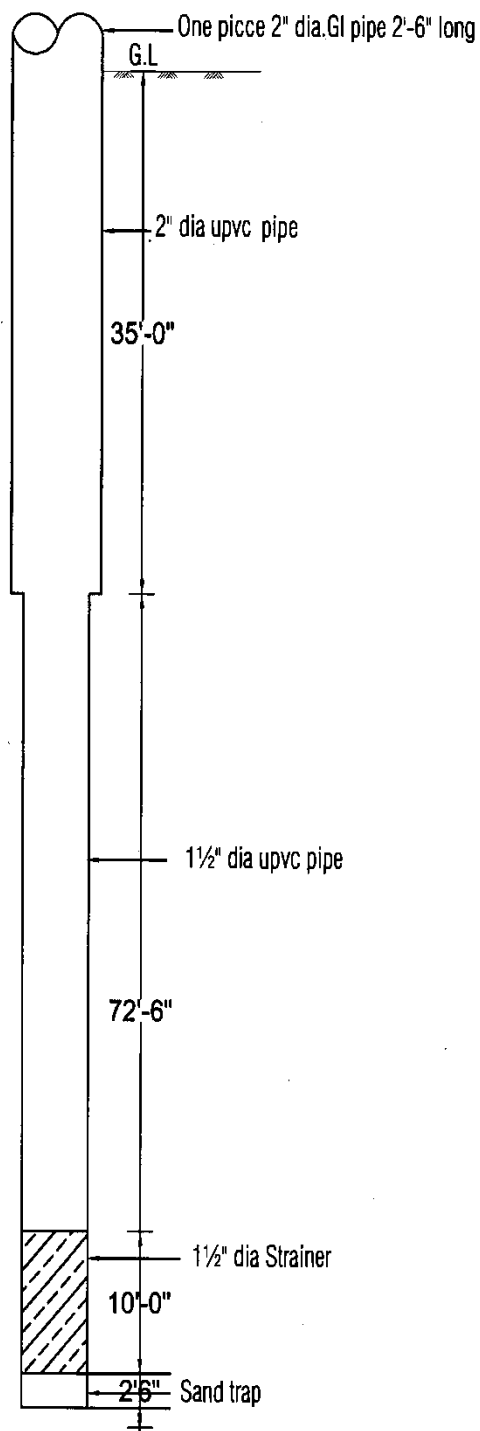


BORE LOG OF OBSERVATION WELL

Project: Contamination pathway Study, UPEHSDP
Location: Landfill Site of Rajshahi City Corporation At Nawdapara
Bore Hole No.3

G.L	Depth in ft	Bore Log
	0'-10'	LGC
	10'-20'	LGC
	20'-30'	LGC
	30'-40'	BSC
	40'-50'	BSC
	50'-60'	LGSC
	60'-70'	CFC
	70'-80'	FS
	80'-90'	FS
	90'-100'	MGS
	100'-110'	MGS
	110'-120'	MS

Legend:-
 LGC = Light Gray Caly MS = Medium Sand
 BSC = Brown Sticky Clay Note: Not to scale
 BSC = Black Sticky Caly
 LGSC = Light gray sticky caly
 CFS = Clay with fine sand
 FS = Fine sand
 MGS = Medium Gray Sand



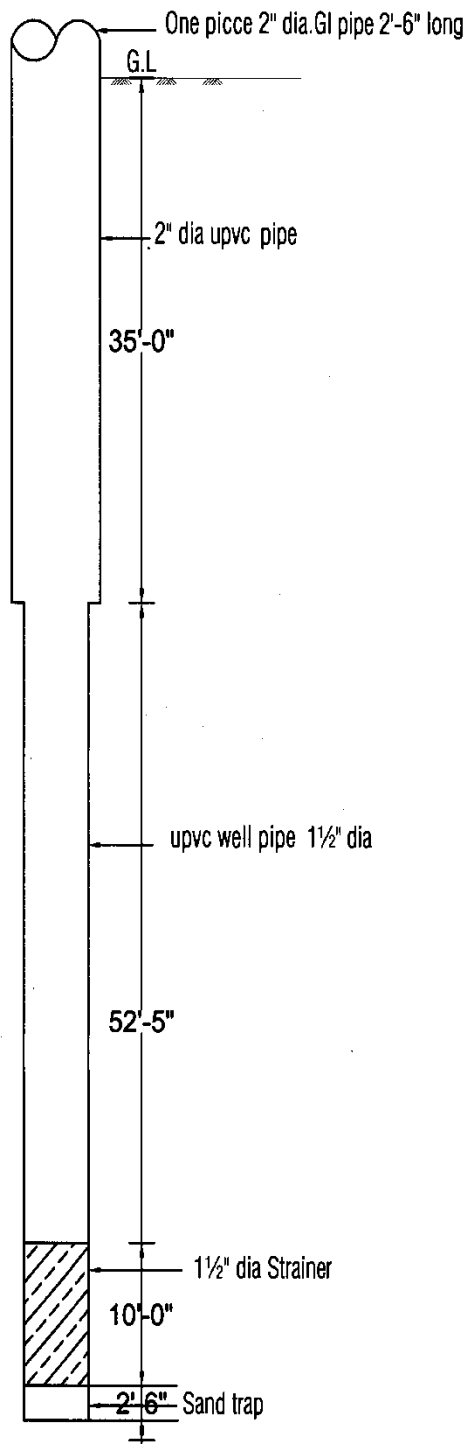
BORE LOG OF OBSERVATION WELL

Project: Contamination pathway Study, UPEHSDP
Location: Landfill Site of Rajshahi City Corporation At Nawdapara
Bore Hole No.4

Depth in ft	Bore Log	
0'-10'	LGC	
10'-20'	LGC	
20'-30'	LGC	
30'-40'	BSC	
40'-50'	BSC	
50'-60'	LGSC	
60'-70'	FS	
70'-80'	FS	
80'-90'	FS	
90'-100'	MS	

Legend:-

LGC=Light Gray Clay
BSC=Brown Sticky Clay
LGSC=Light Gray Sticky Clay
BSC=Black Sticky Clay
FS=Fine Sand
MS=Medium Sand
Not=Not To Scale

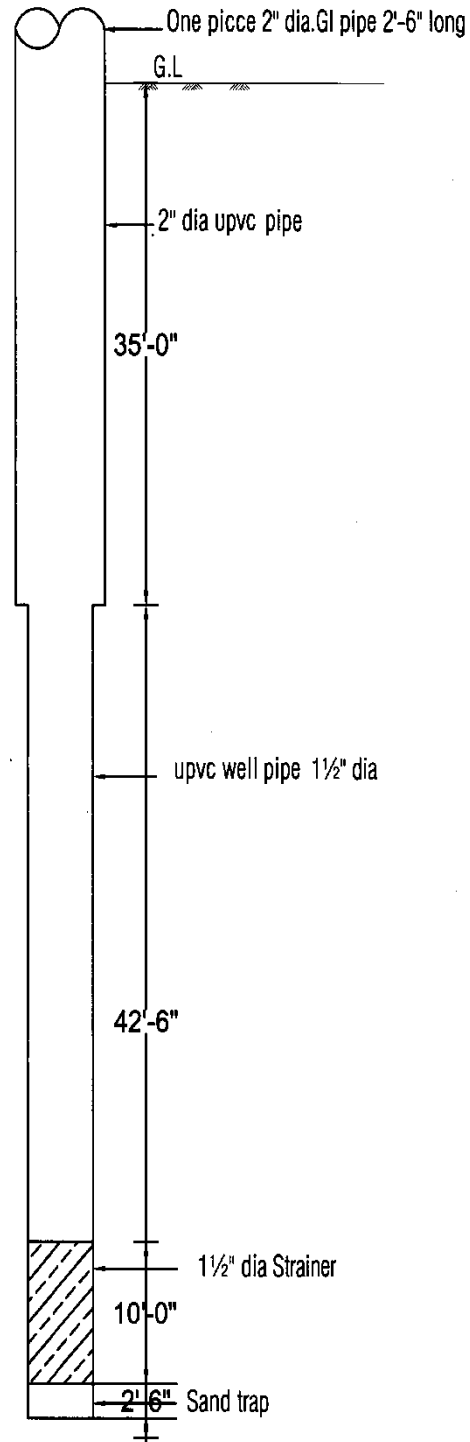


BORE LOG OF OBSERVATION WELL

Project: Contamination pathway Study , UPEHSDP
Location: Landfill Site of Rajshahi City Corporation At Nawdapara
Bore Hole No.5

Depth in ft	Bore Log	
0'-10'	LGC	
10'-20'	LGC	
20'-30'	LGC	
30'-40'	GSC	
40'-50'	BSC	
50'-60'	LGSC	
60'-70'	FS	
70'-80'	FS	
80'-90'	MS	

Legend:-
LGC=Light Gray Clay
GSC=Gray Sticky Clay
BSC=Black Sticky Clay
LGSC=Light gray Sticky Clay
FS=Fine Sand
MS=Medium Sand
Note: Not To Scale



Project: Contamination pathway Study, UPEHSDP
Location: Landfill Site of Rajshahi Citycorporatice At Nawdapara
Bore Hole No.6

Project: Contamination pathway Study , UPEHSDP
Location: Landfill Site of Rajshahi Citycorporatice At Nawdapara

Bore Hole NO. 6

Depth in ft	Bore Log	
0'-10'	LGC	
10'-20'	LGC	
20'-30'	LGC	
30'-40'	GSC	
40'-50'	BSC	
50'-60'	LGSC	
60'-70'	VFS	
70'-80'	FS	
80'-90'	FS	
90'-100'	MS	
100'-110'	MS	
110'-120'	MS	
120'-130'	MS	
130'-140'	MS	

Legend:

- LGC
- GSC
- BSC
- LGSC
- VFS
- FS
- MS

Legend:-
LGC=Light Gray Clay
GSC=Gray Sticky Caly
BSC=Black Sticky Clay
LGSC=Light gray Sticky Caly
VFN=Very Fine Sand
MS=Medium Sand
Note: Not To Scale

Annex 2: Analysis Report



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Certificate No:T-1676

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-10024	Water (B. H. No-8, Rajshahi)	pH at 25.9 ⁰ C	7.47	4500-H ⁺ .B
		E. Conductivity	605 μ S/cm	2510.B
		Lead (Pb)	Less than 0.01 mg/L	3113.B
		Cadmium (Cd)	Less than 0.001 mg/L	3113.B
		Chromium (Cr)	0.006 mg/L	3113.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	0.21 mg/L	3111.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Fluoride (F)	Less than 0.5 mg/L	4110.B
		Chloride (Cl)	3.03 mg/L	4110.B
		Bromide (Br)	Less than 1 mg/L	4110.B
		Nitrite (NO ₂)	Less than 1 mg/L	4110.B
		Nitrate (NO ₃)	Less than 3 mg/L	4110.B
		Sulphate (SO ₄)	Less than 4 mg/L	4110.B
		Sodium (Na)	30.1 mg/L	3500-Na.B
		Potassium (K)	2.34 mg/L	3500-K.B
		Calcium (Ca)	101 mg/L	3111.B
		Magnesium (Mg)	23.1 mg/L	3111.B

[Signature]
29-08-2013

Sig and Name of the Validator

Page 22 of 22

MD. Aminul Ahsan
Principal Scientific Officer
Analytical Research Division
BCSIR Laboratories, Dhaka

*The results relate only to the items tested.

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Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-10023	Water (B. H. No-7, Rajshahi)	pH at 26.0°C	7.34	4500-H ⁺ .B
		E. Conductivity	641 µS/cm	2510.B
		Lead (Pb)	Less than 0.01 mg/L	3113.B
		Cadmium (Cd)	Less than 0.001 mg/L	3113.B
		Chromium (Cr)	0.005 mg/L	3113.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	2.41 mg/L	3111.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Fluoride (F)	Less than 0.5 mg/L	4110.B
		Chloride (Cl)	3.28 mg/L	4110.B
		Bromide (Br)	Less than 1 mg/L	4110.B
		Nitrite (NO ₂)	Less than 1 mg/L	4110.B
		Nitrate (NO ₃)	Less than 3 mg/L	4110.B
		Sulphate (SO ₄)	Less than 4 mg/L	4110.B
		Sodium (Na)	31.1 mg/L	3500-Na.B
		Potassium (K)	2.1 mg/L	3500-K.B
		Calcium (Ca)	97.8 mg/L	3111.B
		Magnesium (Mg)	23.3 mg/L	3111.B

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Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-10022	Water (B. H. No-6, Rajshahi)	pH at 26.0°C	7.49	4500-H ⁺ .B
		E. Conductivity	613 µS/cm	2510.B
		Lead (Pb)	0.05 mg/L	3113.B
		Cadmium (Cd)	Less than 0.001 mg/L	3113.B
		Chromium (Cr)	0.005 mg/L	3113.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	0.41 mg/L	3111.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Fluoride (F)	Less than 0.5 mg/L	4110.B
		Chloride (Cl)	2.19 mg/L	4110.B
		Bromide (Br)	Less than 1 mg/L	4110.B
		Nitrite (NO ₂)	Less than 1 mg/L	4110.B
		Nitrate (NO ₃)	Less than 3 mg/L	4110.B
		Sulphate (SO ₄)	Less than 4 mg/L	4110.B
		Sodium (Na)	25.3 mg/L	3500-Na.B
		Potassium (K)	2.08 mg/L	3500-K.B
		Calcium (Ca)	97.8 mg/L	3111.B
		Magnesium (Mg)	24.1 mg/L	3111.B

Signature

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-10021	Water (B. H. No-4, Rajshahi)	pH at 25.3°C	7.32	4500-H ⁺ .B
		E. Conductivity	713 µS/cm	2510.B
		Lead (Pb)	0.02 mg/L	3113.B
		Cadmium (Cd)	Less than 0.001 mg/L	3113.B
		Chromium (Cr)	0.016 mg/L	3113.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	16.9 mg/L	3111.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Fluoride (F)	Less than 0.5 mg/L	4110.B
		Chloride (Cl)	18.2 mg/L	4110.B
		Bromide (Br)	Less than 1 mg/L	4110.B
		Nitrite (NO ₂)	Less than 1 mg/L	4110.B
		Nitrate (NO ₃)	Less than 3 mg/L	4110.B
		Sulphate (SO ₄)	Less than 4 mg/L	4110.B
		Sodium (Na)	30.9 mg/L	3500-Na.B
		Potassium (K)	3.11 mg/L	3500-K.B
		Calcium (Ca)	141 mg/L	3111.B
		Magnesium (Mg)	31.6 mg/L	3111.B

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Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-10020	Water (B. H. No-3, Rajshahi)	pH at 25.1°C	7.24	4500-H ⁺ .B
		E. Conductivity	679 µS/cm	2510.B
		Lead (Pb)	0.02 mg/L	3113.B
		Cadmium (Cd)	Less than 0.001 mg/L	3113.B
		Chromium (Cr)	0.028 mg/L	3113.B
		Arsenic (As)	0.008 mg/L	3114.C
		Iron (Fe)	27.4 mg/L	3111.B
		Mercury (Hg)	0.001 mg/L	3112.B
		Fluoride (F)	Less than 0.5 mg/L	4110.B
		Chloride (Cl)	8.03 mg/L	4110.B
		Bromide (Br)	Less than 1 mg/L	4110.B
		Nitrite (NO ₂)	Less than 1 mg/L	4110.B
		Nitrate (NO ₃)	Less than 3 mg/L	4110.B
		Sulphate (SO ₄)	Less than 4 mg/L	4110.B
		Sodium (Na)	31.5 mg/L	3500-Na.B
		Potassium (K)	3.19 mg/L	3500-K.B
		Calcium (Ca)	120 mg/L	3111.B
		Magnesium (Mg)	32.5 mg/L	3111.B

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Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-10019	Water (B. H. No-2, Rajshahi)	pH at 25.1°C	7.23	4500-H ⁺ .B
		E. Conductivity	656 µS/cm	2510.B
		Lead (Pb)	Less than 0.01 mg/L	3113.B
		Cadmium (Cd)	Less than 0.001 mg/L	3113.B
		Chromium (Cr)	0.011 mg/L	3113.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	3.03 mg/L	3111.B
		Mercury (Hg)	0.001 mg/L	3112.B
		Fluoride (F)	Less than 0.5 mg/L	4110.B
		Chloride (Cl)	15.1 mg/L	4110.B
		Bromide (Br)	Less than 1 mg/L	4110.B
		Nitrite (NO ₂)	Less than 1 mg/L	4110.B
		Nitrate (NO ₃)	Less than 3 mg/L	4110.B
		Sulphate (SO ₄)	Less than 4 mg/L	4110.B
		Sodium (Na)	31.1 mg/L	3500-Na.B
		Potassium (K)	3.65 mg/L	3500-K.B
		Calcium (Ca)	103 mg/L	3111.B
		Magnesium (Mg)	24.8 mg/L	3111.B

[Signature]

Page 17 of 22

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-10018	Water (B. H. No-1, Rajshahi)	pH at 25.9°C	7.42	4500-H ⁺ .B
		E. Conductivity	606 µS/cm	2510.B
		Lead (Pb)	Less than 0.01 mg/L	3113.B
		Cadmium (Cd)	Less than 0.001 mg/L	3113.B
		Chromium (Cr)	0.008 mg/L	3113.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	4.68 mg/L	3111.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Fluoride (F)	Less than 0.5 mg/L	4110.B
		Chloride (Cl)	2.94 mg/L	4110.B
		Bromide (Br)	Less than 1 mg/L	4110.B
		Nitrite (NO ₂)	Less than 1 mg/L	4110.B
		Nitrate (NO ₃)	Less than 3 mg/L	4110.B
		Sulphate (SO ₄)	Less than 4 mg/L	4110.B
		Sodium (Na)	24.1 mg/L	3500-Na.B
		Potassium (K)	2.12 mg/L	3500-K.B
		Calcium (Ca)	100 mg/L	3111.B
		Magnesium (Mg)	23.0 mg/L	3111.B

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Lab ID	Particulars of supplied sample	Name of Parameters		Concentration
A-10029	Soil Well No: 06 Sample No:D-10 Depth: 15' City hat Rajshahi	Polycyclic aromatic hydrocarbons (PAHs)	Acenaphthylene	Not detectable
			Anthracene	Not detectable
			Benzo (A) Anthracene	Not detectable
			Benzo (A) Pyrene	Not detectable
			Benzo (B) Fluoranthene	Not detectable
			Benzo (G, H, I) Perylene	Not detectable
			Benzo (K) Fluoranthene	Not detectable
			Chrysene	Not detectable
			Dibenz (A, H) Anthracene	Not detectable
			Fluorene	Not detectable
			Indeno (1, 2, 3-CD) Pyrene	Not detectable
			Phenanthrene	Not detectable
Pyrene	Not detectable			
A-10029	Soil Well No: 06 Sample No:D-10 Depth: 15' City hat Rajshahi	Poly chlorobiphenyl (PCB)	2,2',3,4,4',5,5'-Heptachlorobiphenyl	Not detectable
			2,2',3,4,4',5'-Hexachlorobiphenyl	Not detectable
			2,2',4,4',5,5'- Hexachlorobiphenyl	Not detectable
			2,2',5,5'- Tetrachlorobiphenyl	Not detectable
			2,4,4'- Trichlorobiphenyl	Not detectable
			2,6- Dichlorobiphenyl	Not detectable
A-10029	Soil Well No: 06 Sample No:D-10 Depth: 15' City hat Rajshahi	Volatile Organic Compounds (VOC)	Chlorobenzene	Not detectable
			CIS-1,2-Dichloroethylene	Not detectable
			Ethylbenzene	Not detectable
			O-Xylene	Not detectable
			P-Xylene	Not detectable
			Styrene	Not detectable
			Tetrachloroethene	Not detectable
			Toluene	Not detectable
			Trans-1,2-Dichloroethylene	Not detectable
			1,2-Dichlorobenzene	Not detectable
1,2-Dichloropropane	Not detectable			

Sig. and Name of the Validator

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Senior Scientific Officer
Analytical Research Division
BCSIR Laboratories, Dhaka.
Dhanmondi, Dhaka-1205

Counter Signature
(Research Coordinator)

Dr. Parvin Noor
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BCSIR, Dhaka.

Counter Signature
(Director)

MD. ABU ANIS JAHANGIR
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BCSIR LABORATORIES, DHAKA

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Name of Parameters		Concentration
A-10028	Soil Well No: 01 Sample No: D-8 Depth: 12' City hat Rajshahi	Polycyclic aromatic hydrocarbons (PAHs)	Acenaphthylene	3.5 mg/kg
			Anthracene	Not detectable
			Benzo (A) Anthracene	Not detectable
			Benzo (A) Pyrene	Not detectable
			Benzo (B) Fluoranthene	Not detectable
			Benzo (G, H, I) Perylene	Not detectable
			Benzo (K) Fluoranthene	Not detectable
			Chrysene	Not detectable
			Dibenz (A, H) Anthracene	Not detectable
			Fluorene	Not detectable
			Indeno (1, 2, 3-CD) Pyrene	Not detectable
			Phenanthrene	Not detectable
			Pyrene	Not detectable
A-10028	Soil Well No: 01 Sample No: D-8 Depth: 12' City hat Rajshahi	Poly chlorobiphenyl (PCB)	2,2',3,4,4',5,5'-Heptachlorobiphenyl	Not detectable
			2,2',3,4,4',5'-Hexachlorobiphenyl	Not detectable
			2,2',4,4',5,5'- Hexachlorobiphenyl	Not detectable
			2,2',5,5'- Tetrachlorobiphenyl	Not detectable
			2,4,4'- Trichlorobiphenyl	Not detectable
			2,6- Dichlorobiphenyl	Not detectable
A-10028	Soil Well No: 01 Sample No: D-8 Depth: 12' City hat Rajshahi	Volatile Organic Compounds (VOC))	Chlorobenzene	Not detectable
			CIS-1,2-Dichloroethylene	Not detectable
			Ethylbenzene	Not detectable
			O-Xylene	Not detectable
			P-Xylene	Not detectable
			Styrene	Not detectable
			Tetrachloroethene	Not detectable
			Toluene	Not detectable
			Trans-1,2-Dichloroethylene	Not detectable
			1,2-Dichlorobenzene	Not detectable
			1,2-Dichloropropane	Not detectable

Adhikari

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-10018	Water (B. H. No-1, Rajshahi)	Temperature	27.4 ⁰ C	2550.B
		BOD	Less than 0.2 mg/L	5210.B
		COD	Less than 2 mg/L	5220.B
		Ammonium (NH ₄)	2.37 mg/L	3500.B
A-10019	Water (B. H. No-2, Rajshahi)	Temperature	27.2 ⁰ C	2550.B
		BOD	2.35 mg/L	5210.B
		COD	12 mg/L	5220.B
		Ammonium (NH ₄)	2.06 mg/L	3500.B
A-10020	Water (B. H. No-3, Rajshahi)	Temperature	27.1 ⁰ C	2550.B
		BOD	12 mg/L	5210.B
		COD	32 mg/L	5220.B
		Ammonium (NH ₄)	2.22 mg/L	3500.B
A-10021	Water (B. H. No-4, Rajshahi)	Temperature	27.2 ⁰ C	2550.B
		BOD	Less than 0.2 mg/L	5210.B
		COD	4 mg/L	5220.B
		Ammonium (NH ₄)	2.28 mg/L	3500.B
A-10022	Water (B. H. No-6, Rajshahi)	Temperature	27.3 ⁰ C	2550.B
		BOD	Less than 0.2 mg/L	5210.B
		COD	Less than 2 mg/L	5220.B
		Ammonium (NH ₄)	1.15 mg/L	3500.B
A-10023	Water (B. H. No-7, Rajshahi)	Temperature	27.2 ⁰ C	2550.B
		BOD	Less than 0.2 mg/L	5210.B
		COD	Less than 2 mg/L	5220.B
		Ammonium (NH ₄)	1.56 mg/L	3500.B
A-10024	Water (B. H. No-8, Rajshahi)	Temperature	27.4 ⁰ C	2550.B
		BOD	1.2 mg/L	5210.B
		COD	4 mg/L	5220.B
		Ammonium (NH ₄)	0.94 mg/L	3500.B

Sig. and Name of the Validator

Md. Aminul Ahsan

Principal Scientific Officer

Analytical Research Division

BCSIR Laboratories, Dhaka

Counter Signature

(Research Coordinator)

Page 4 of 4

Counter Signature

(Director)

MD. ABU ANIS JAHANGIR

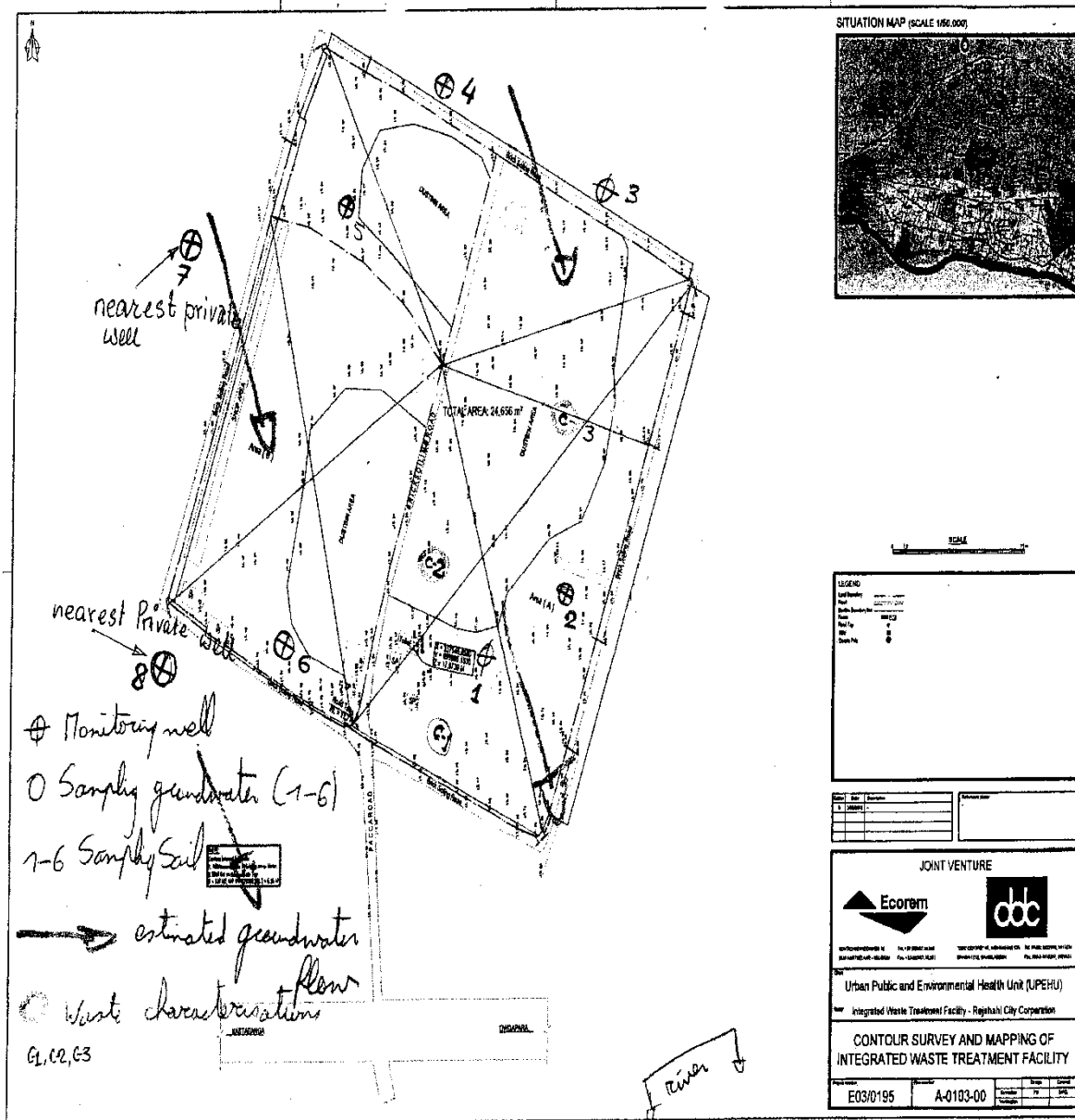
Director

BCSIR Laboratories

Dhaka-1205

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Annex 3: Map



ANNEX 5: Stakeholders Consultation Meetings in Rajshahi during Planning Phase

Stakeholders Meeting at Sanitary Land Fill (City Hat, Rajshahi); Date: 05.05. 2012 at 10.00 am

The meeting was held with affected persons, other local people and Chief Conservancy Officer (Mr. Jhontu) and Mr. Lutful Haider of Rajshahi City Corporation. Among others Kh. Khairul Matin, survey team leader and other survey members of the KM Consultants 20 affected persons and other stakeholders were present in the meeting.



Meeting at Sanitary Land Fill at City Hat Rajshahi

Kh. Khairul Matin welcomed all participants in the meeting and explained goals and objectives of the project. He told that the Government of Bangladesh through the Rajshahi City Corporation has undertaken a project to construct one scientific slaughter house, one sanitary land fill and 6 secondary transfer stations in Rajshahi City Corporation area to keep the city free from environmental pollution. This project will benefit the local people and protect them from environmental hazards.

It was discussed that the sanitary land fill would be established in the present dumping station adjacent to City Hat Cattle Market. Out of total 10 acres land of the dumping station about 3 acres have been handed over to City Hat cattle market and remaining 7 acres have been selected for sanitary land fill. Some of the small shops are found in the proposed area of the sanitary land fill. Two structures of City Corporation and one structure owned by City Hat cattle market found there. A total of 21 shops are enlisted in the sanitary land fill area of which 18 found running business and 3 found business closed.

It was disclosed in the meeting that the project would be implemented soon and the households are to be relocated in anywhere by themselves before civil construction is started. They would be paid compensation and other resettlement benefits for the affected structure and loss of livelihood (if any).

A detailed socioeconomic survey would be conducted with a structured questionnaire among the affected businessmen by a survey team. Cut-off date of the survey is May 06, 2012 and after this date no changes in category and quantity of structure would be entertained. The affected people were requested to provide required information during conducting survey so that profile of the affected households would be known and a resettlement plan for them would be prepared. The affected people would be entitled for compensation of the affected structure, relocation assistance, grants for vulnerability (if any), loss of business and wage, etc. according to the project policy. They would also be allowed to take salvage materials of the structures free of cost without delaying the project work.

There were no issues left for discussion and the meeting was closed with a vote of thanks to all participants.

Attendance Sheet

Date:05-05-2012	Time:
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Meeting Place: City Hat	Union: Rajshahi City	Thana: Shamokhdum
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Sl#	Name	F/H Name	Address	Mobile No.	Signature
1	Md. Ajahar	L. Kasim Uddin	Rajpara	01942197133	
2	Asadul Islam	Arez Mondal	Sha-Mukhdum	01825433220	
3	Golam Azom	Abdur Samad	Niyamotpur		
4	Moslem	L. Sayed Ali	Rajpara	01728996693	
5	Shahin	Saidul	Godagari	01945909585	
6	Zuwel	Sawshad Ali	Niyamotpur	01731266867	
7	Alauddin	L. Kasim Uddin	Niyamotpur	01761565214	
8	Nur Islam	L. Mukter	Godagari		
9	Zullu Rahman	Abu Hanif	Godagari	01737608802	
10	Rashed Ali	L. A. Rahman	Godagari	01816497433	
11	Azizul Islam	Abdul Mannan	Chapai	01733751413	
12	Sirajul Islam	Majibor Rahman	Sha-Mukhdum	01815763296	
13	Saiful Islam	Abdur Samad	Poba	01739706165	
14	Anwar Hossain	L. Bador Uddin	Poba	01723389958	
15	Arman Ali	L. Kefatullah	Poba		
16	Abdul Lotif	Abdur Sattar	Mohonpur		
17	Josimuddin	Abdul Kader	Sha-Mukhdum	01933406282	
18	Mannan	Esob	Tanor	01749807011	
19	Abdul Kuddus	L. Belal	Chapai		
20	Mahabul	L. Josimuddin	Poba	01740815426	

Ministry of Local Government Rural Development and Cooperatives
Urban Public and Environmental Health Sector Development Project (1/19 SAHSP)

সভায় উপস্থিত ব্যক্তি বর্ণের নাম
(Attendance Sheet)

সময়ঃ

তারিখঃ ৫.৫.১২

সভার স্থানঃ

সি.টি. হাউস

ইউনিটঃ বালুয়াখালী-১

থানাঃ মাগুরা

ক্রম নং	নামঃ	পিতার নামঃ	ঠিকানাঃ	মোবাইল নম্বরঃ	স্বাক্ষরঃ
১	শ্রী: বাবুল	শ্রী: কামাল হোসেন	বাগবাগ	০১৭৭২১৭১৩	স্বাক্ষর
২	আব্দুল হামিদ	আব্দুল হামিদ	মাগুরা	০১৮২৫৭৩৩২০	স্বাক্ষর
৩	আব্দুল বাবুল	শ্রী: মামুন	মিরাসপুর	-	স্বাক্ষর
৪	আব্দুল	শ্রী: মিরাসপুর	বাগবাগ	০১৭২৮৭৭৬৬৭৩	স্বাক্ষর
৫	আব্দুল	আব্দুল	আব্দুল	০১৭৫৭০৭৫৮৫	স্বাক্ষর
৬	আব্দুল	আব্দুল	মিরাসপুর	০১৭৩১২৬৬৮৬৭	স্বাক্ষর
৭	আব্দুল হোসেন	শ্রী: কামাল হোসেন	"	০১৭৬১৫৬৫২১৭	
৮	শ্রী: হামিদ	শ্রী: মামুন	আব্দুল	-	স্বাক্ষর
৯	শ্রী: বাবুল	আব্দুল হোসেন	"	০১৭৩৭৬০৮৮০২	স্বাক্ষর
১০	শ্রী: মামুন	শ্রী: মামুন	"	০১৮১৬৭৭৭৭৩	স্বাক্ষর
১১	আব্দুল হামিদ	শ্রী: মামুন	বাগবাগ	০১৭৩৩৭৫১৭৩	
১২	মিরাসপুর	মিরাসপুর	মাগুরা	০১৮১৫৭৬৫২৭৬	স্বাক্ষর
১৩	আব্দুল হামিদ	শ্রী: মামুন	বাগ	০১৭৩৭৭০৬১৬৫	স্বাক্ষর
১৪	আব্দুল হামিদ	শ্রী: মামুন	"	০১৭২৩৩৮৭৭৫৮	স্বাক্ষর
১৫	আব্দুল হামিদ	"	"	-	স্বাক্ষর
১৬	শ্রী: মামুন	শ্রী: মামুন	মাগুরা	-	স্বাক্ষর
১৭	আব্দুল হামিদ	শ্রী: মামুন	মাগুরা	০১৭৩৩৭০৬২৮২	স্বাক্ষর
১৮	আব্দুল	আব্দুল	বাগবাগ	০১৭৭৭৭৭৭৭	স্বাক্ষর
১৯	আব্দুল	শ্রী: মামুন	বাগবাগ	-	স্বাক্ষর
২০	আব্দুল	"	বাগবাগ	০১৭৭০৭১৫৭২৬	স্বাক্ষর