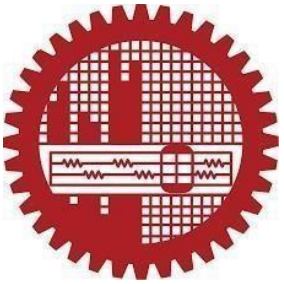

Bangladesh University of Engineering and Technology
Department of Civil Engineering

Feasibility Study Report of

A Model Solid Waste Management System at Community Level

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Government of the People's Republic of Bangladesh
Ministry of Local Government, Rural Development and Co-operatives
Local Government Engineering Department (LGED)

Feasibility Study for A Model Solid Waste Management System at Community Level

September, 2024

Executive Summary

The capital city of Bangladesh, Dhaka, is experiencing a tremendous increase in population due to its fast development and people's aspiration for a better lifestyle. With rapid population growth the solid waste management has become a significant concern for Dhaka metropolitan. The current municipal solid waste management is not sustainable as well as it is polluting the environment, wasting a huge land resource and incorporating inconveniences to the daily city-life. To emerge a sustainable solid waste management system, the prime challenges are increasing awareness among citizens, encouraging waste segregation, doorstep waste collection, reducing & recycling waste, introducing better treatment technologies and finally safely disposal. In this regard this project introduces a better infrastructure, a doorstep segregated waste collection system, a better technology of waste compaction, segregation and recycling, a better waste transport facility and a way to reduce environmental pollution from this solid wastes. To analyze the structural, environmental, financial, economical & socio-economical aspects and viability of this project throughout its lifetime, this feasibility study is conducted. This study explains the project feasibility of a model solid waste management system at community level in Lalbag, Dhaka through cost-demand survey, technical analysis, EIA, TIA, preliminary cost-benefit analysis, alternate solution analysis and some socio-economic aspect analysis. This project focus on implementing a solid waste management system of door-to-door segregated waste collection, waste compaction, recycling, efficiently waste transport and dispose waste as less as possible to waste yard. The market/demand analysis including physical demand & service condition survey, 3 relevant case studies, SWOT analysis picturize the necessity of the project and its visionary. The technical & engineering analysis illustrate the site planning, new infrastructures, preliminary and final design of the secondary waste transfer station through structural design analysis using SAP2000 engineering program software as well as probable traffic impact & mitigation analysis through TIA. This analysis provides an efficient and large capacity infrastructure with the systematic waste transportation where the traffic impact is low. A detail EIA with disaster resilience & risk analysis depicts the impacts of this project on environment and its mitigation, monitoring measures and long period environmental benefits. The cost-benefit analysis explicit the idea of the financial and economic aspects of this project which clearly show that even though the project is not feasible in the financial aspects for its 20 years lifespan, the project will be economically viable throughout its lifetime and socio-economically advantageous. This 4.63 Crores BDT budgeted project, will be constructed within 12 months, is also credible beneficial through some other aspects (Human resource & administrative analysis, Institutional & legal analysis and Risk & sensitivity analysis). A few alternate analyses determine the most efficiency and viability of this proposed project through detail comparison among them. If this project will be implemented, it would be a model to the solid waste management system at community level with the ultimate success of less amount of solid waste dispose and make environment more livable than today's progression of making huge waste heap at waste yard. In conclusion, this feasibility study thoroughly examines every aspect and finds that there is no reason for the authority of Dhaka South City Corporation under Ministry of Local Government to reject this project which will secure the environment for future generations. To emerge the full sustainable solid waste management and zero disposal of waste, it is recommended to incorporate this project in every community level as well as implement some incredible technologies of solid waste treatment like Composting, Bio-methanation, Bio-remediation etc. in a large scale.

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Full Documentation & Formatting	**1904072 &1904075**

Section 1: Basic Information

1.	Name of the Project	:	A Model Solid Waste Management System at Community Level
2.	(a) Sponsoring Ministry/Division (b) Implementing Agency	: :	Ministry of Local Government Dhaka South City Corporation
3.	Project Objectives (Project to be taken based on the study)	:	1. Reconstruction and extension of STS at Lalbag, Dhaka. 2. Implement doorstep segregated waste collection 3. Integrate modern waste compaction 4. Improve waste transport facilities 5. Waste segregation and recycling 6. Fulfill the current and future demands
4.	Estimated Project Cost (Taka in Crore)	:	4.63 Crore
5.	Sector & Sub-Sector	:	Environment
6.	Project Category (Based on Environment Conservation Rules 1997)	:	Yellow
7.	Project Geographic Location (a) Countrywide (b) Division (c) District (d) Upazila (e) Others (City Corporation/Pourashva)		 Bangladesh Dhaka Dhaka Dhaka South, Ward 20
8.	Project Duration	:	1 Year

Section 2: Introduction

2.1 Project Background

STS is a part of waste collection system and works as secondary shed for the wastes before landfilling. Dhaka South City Corporation has built secondary transfer station for each ward. The Secondary Transfer Station of ward 20 is located at Lalbagh. Wastes are collected from Dhaka Medical College Hospital, Fazle Rabbi Hall, Suhrawardy Udyan, Fulbaria Station East Area & Secretariat Road, Ramna Green House, BUET main academic & administrative buildings, BUET residential area, all the halls of BUET and stored at the station for approximately 11/12 hrs. After that they are transferred finally to landfill. But the problem is that existing STS does not contain modern facilities and efficient waste transportation system. Therefore, this project of redevelopment of the STS is necessary.

Redevelopment will be done by few steps. First, the station will be expanded according to the growing demand of the ward (the station building will be rebuilt). Next, waste and garbage will be collected by modern container trucks/vans with multiple compartment facilities for proper segregation of different type of wastes. Then, the station will be equipped with modern imported containers and compactors. As we dump waste in landfills without any volume reduction so, our landfills are almost out of their capacity. Therefore, compaction is needed at STS which will decrease the volume of solid wet waste whereas, their reduced water content will also cause less leachate problem, odor and insect nuisance. Besides, segregatedand compacted dry waste like papers and polythene can be directly reused or recycled from here.

2.2 Vision and Objectives

A project should have valid objective considering the overall benefit of the stakeholder and local people. The major objectives of this project are shown below:

a. **Reconstruction and Extension of Existing Secondary Transfer Station (STS):** This involves upgrading the existing infrastructure to increase its capacity and efficiency. It may include expanding the physical space, improving the equipment used, and implementing new technologies to enhance the waste management process.
b. **Doorstep Segregated Waste Collection by Two Compartment Van:** Modern waste collection vehicles are designed to separate different types of waste at the source. A two-compartment truck or van allows for the segregation of waste into two categories, such as organic and inorganic, right at the collection point. This can improve the efficiency of waste management and recycling processes.
c. **Waste Segregation and Recycling:** This refers to the process of separating waste into different categories (like organic, inorganic, recyclable, non-recyclable) to facilitate recycling. Proper waste segregation can reduce the amount of waste that ends up in landfills and promote the recycling of materials, which is more

environmentally friendly.

d. **Waste Compaction:** Waste compaction is the process of reducing the size of waste materials to make them easier to transport and dispose of. Compacted waste takes up less space, allowing more waste to be transported at once, reducing the number of trips needed and thus the overall carbon footprint.
e. **Efficient Transportation and Transfer to Landfill:** This involves optimizing the routes and methods used to transport waste from the STS to the landfill. The goal is to minimize transportation costs and environmental impact while ensuring that waste is disposed of safely and efficiently.

These objectives are all aimed at improving the efficiency and sustainability of waste management processes. They can help to reduce the environmental impact of waste, promote recycling, and improve the overall efficiency of waste management operations.

2.3 Methodology

The approach and methodology of this study are the following steps-

a. **Define the Project Scopes:** Determining the purpose of the project considering the factors suchas scope and timeline.
b. **Conducting Survey and Analyze the Market Demand:** We need to analyze the exact demand for the station. For this, different survey will be conducted. Also, annual waste management report and previous wastecollection data (no of houses, no of trucks/vans used, no of containers at trucks, no of containers present at the existing station, volume of the containers, waste collection frequency etc.) must be collected from the city corporation office.
c. **Technical Analysis including Costs and Revenue:** Analyze the structural model and determine the preliminary design. Create a detailed financial plan, including sources of funding, construction costs, import costs and operational expenses.
d. **Risk Analysis followed by Legal and Regulatory Compliances:** Seek the required approvals and permits from local authorities and regulatory bodies. This may include building permits, environmental impact assessments and other legal clearances from Dhaka South City Corporation, WMD, Transport Department, Matuail Landfill Authority etc.
e. **Impact Analysis for Environment and Society:** Environmental and social impact is alkalized for construction phase and post construction phase. Project management team oversee construction, import ofhigh-quality compactors, buy conventional and arm roll containers ensuring adherence to timelines, quality standards, and budgetary constraints.
f. **Alternate Analysis:** Structural as well as technical alternates are analyzed through detail comparison among the alternates considering the stakeholders demands.
g. **Project Handover and Evaluation:** Once construction is complete, the project will be handed over to the Authority and they will evaluate the entire project to identify the successes and areas for improvement. Also need to evaluate the financial performance, customer feedback, and market response. After that they will recruit skillful employee to run the station effectively.

The significant resources will be needed for this project are-

Design and Engineering:

a. -Environmental engineers to design the station according to the waste demand.
b. -Drafting and design software.
c. -Structural engineers for designing the station's foundation and structure.
d. -Electrical and plumbing engineers for designing utility systems.
e. -Transportation engineers for incorporating the integrated modern waste transport facility.

Materials:

a. -Cement, concrete, steel, bricks, and other necessary building materials.
b. -Construction equipment such as cranes, excavators, and trucks.
c. -Safety equipment for workers.
d. -Imported Compactors (self-contained, stationary, auger compactor)
e. -Conventional and Arm roll containers for station.
f. -Modern container vans or garbage trucks with segregation facility.

Manpower:

a. -Project manager to oversee the entire construction process.
b. -Construction workers, including masons, carpenters, electricians, plumbers, and generallaborers.
c. -Supervisors to coordinate and manage different teams.
d. -Skilled workers for specialized equipment management.

2.4 Organization of The Feasibility Study

Section 1: It gives the basic information and overall scenery of the project.

Section 2: Provides project breakdown, its purpose and methodology of the feasibility study.

Section 3: Survey and market/demand analysis is covered in this Section.

Section 4: Technical and engineering analysis are shown in this Section.

Section 5: Full Environmental Impact Assessment, Environmental Sustainability, Climate Resilience and Disaster Risk Analysis of this project are covered in this Section.

Section 6: Benefit-Cost Analysis (financially and economically) is covered in this Section.

Section 7: Human Resources and Administrative Support Analysis is described in this Section.

Section 8: Institutional and Legal analysis is covered in this Section.

Section 9: Risk (Uncertainty) and Sensitivity Analysis is depicted in this Section.

Section 10: In this section, alternates are examined through detail comparisons.

Section 11: Recommendations and Conclusion are provided in this Section.

Section 12 A-C: Relevant calculations, tables and graphs are presented in annexes and the study ends.

Section 3: Market/Demand Analysis

This section assesses the need for public investments and involves the elements listed below:

(a) Problem Statement: The core issue in Lalbag, Dhaka, is the inefficient and unsanitary operation of the existing secondary waste transfer station. This station is unable to manage the growing volume of waste generated by the area's dense population. The direct causes include inadequate infrastructure, no waste compaction capabilities, and inconsistent waste collection schedules. Indirect causes include rapid urbanization, lack of community awareness, and ineffective waste management policies.

Without public sector intervention, the current system will likely lead to worsened sanitation conditions, environmental degradation, public health risks, and increased operational costs for waste management. Additionally, the strain on the existing waste infrastructure may further disrupt urban livability and worsen traffic congestion around waste collection points.

(b) Relevance of the Project Idea: The redevelopment of the waste transfer station at Lalbag with waste compaction features is aligned with both global and national waste management policies, such as the United Nations Sustainable Development Goals (SDG 11: Sustainable Cities and Communities, and SDG 12: Responsible Consumption and Production). On a national level, this project supports Bangladesh's commitment to improving solid waste management under its 8th Five-Year Plan, contributing to environmental sustainability and public health.

By improving waste management at the community level, the project directly addresses sectoral objectives, including reducing waste disposal inefficiencies, enhancing urban cleanliness, and promoting a healthier living environment for citizens. The outcomes—such as reduced waste volumes, better resource recovery, and lower emissions—reflect national development priorities.

Comparative analysis of Case Study:

In order to redevelop the secondary waste transfer station, three case studies of well-established waste transfer station were chosen to examine the features of a good transfer station. A brief introduction of the cases is given below:

Case study 1

Star Square Ultra-Modern Mechanized Garbage Transfer Station, Indore

Fig-3.1: View of the Station

a. Site Description: With 1000 sqm area the Star Square Ultra-Modern Mechanical Garbage Transfer Station situated 600 m away from Star Square at Indore. This bearing address of this STS is 782, MR 10 Rd, Indore, Madhya Pradesh, India. Though the station is beside the main road and in the STS, there is only one way movement, the maneuver of the waste trucks never interferes the traffic movement in the road. Furthermore, the station is away from residential area which make the garbage station environmentally quarantine from the resident of Indore. The roadside bay of this STS also helps an easy maneuver of the waste transport. This waste transfer station is now running successfully and has become a model for waste handling in India.

Fig-3.2: Location and top view of STS from Google Map

b. Station Overview:

a. Part of city's decentralized waste management system
b. Efficient transfer of waste from smaller vehicles to larger ones
c. Wet waste and decentralized processing units

c. Waste Collection System

a. Two types of hoppers used: Blue- Dry Waste; Green- Wet Waste
b. Containers are compacted with the segregated municipal solid waste
c. Containers are lifted through a special hook loader and transported to the disposal site individually
d. Dry waste is transported to the Material Recovery Facility
e. Wet waste is transferred directly to the Centralized Composting Unit via the hook loader

Fig-3.3: Waste Collection System

d. Waste Transfer System:

Three major parts including compactor, bucket and hook-loader

1. Cost: Rs 1.75 crore per station
2. Previous Capacity: 30 vehicles per container
3. Present Capacity: 45 Vehicles per container

Collection of more garbage and savings of 20 lakhs per month

e. Waste Compaction:

The municipal waste is collected through the two compartment trucks which bring the wastes into this STS. In **Fig-3.4** the process of compacting is shown. Then the wet wastes are dropped into the compaction machine and an operator who always present in the STS start the compactor machine. The machine turns the bulk wet waste into small volume

compacted waste in a few minutes and the lichgates are drained into specialize waste water drain. Then this compacted waste is filled into another transport truck which transport them to the treatment plant.

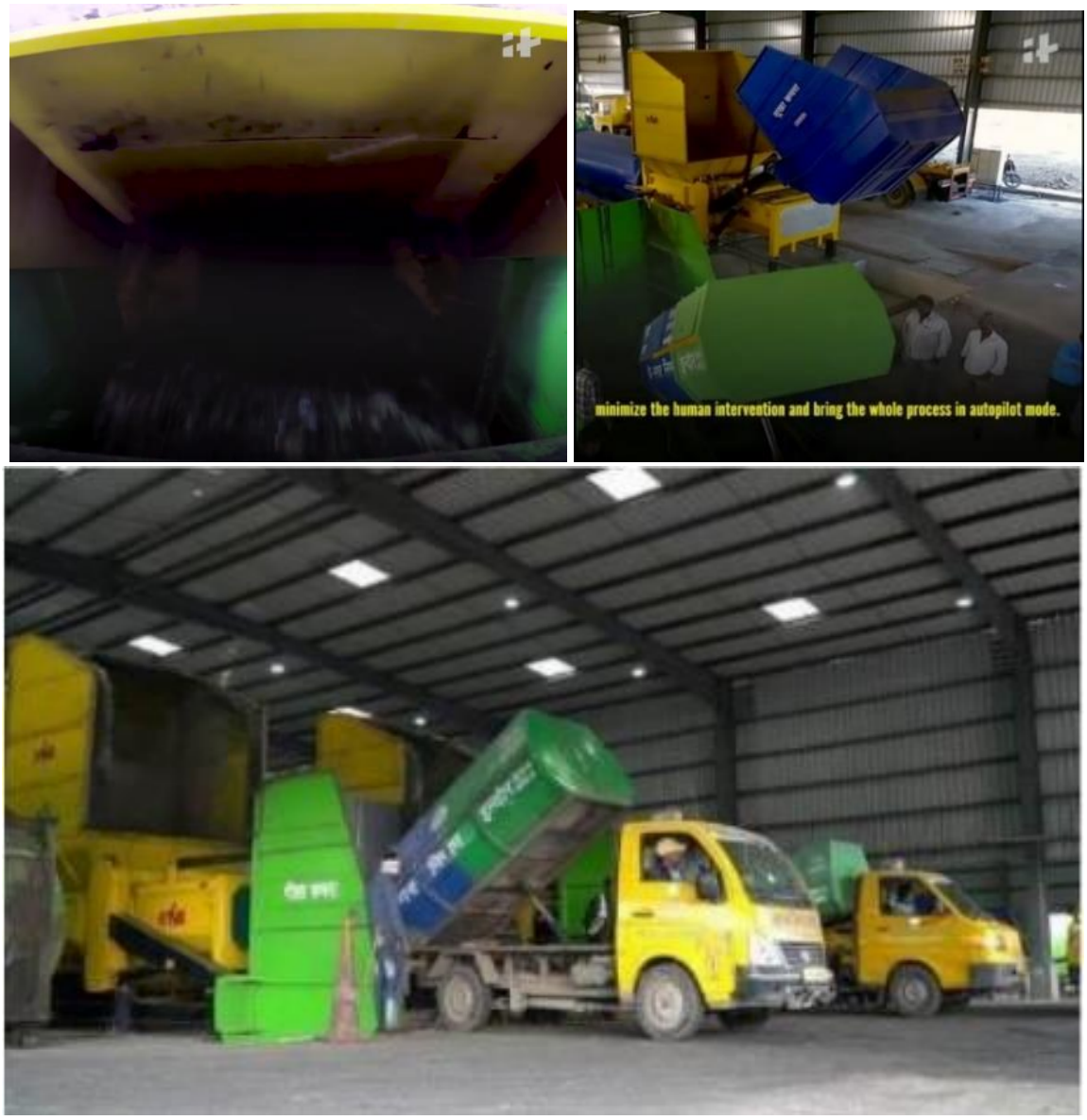


Fig-3.4: Process of waste compacting in a Waste Compactor

f. Segregation of Dry Waste:

The dry wastes from two compartment trucks are gathered in a separate zone in the STS. In **Fig-3.5** The dry waste segregation process is shown. The dry waste is segregated manually which takes a few hours. They separate and sort out different types of dry waste (paper, plastic, rubber, garments, steel, e-waste etc.) and then this waste are moved to another stockyard by manually or mechanically. From the stockyard the recyclable wastes are transported for recycling and rest are transport to a shredder where these wastes are shredded into small pieces. After all these rest wastes are transported to the treatment plant.

Fig-3.5: Process of dry waste segregation

g. Waste Recycling or Material Recovery Facility (MRF):

In **Fig-3.6** the recycling process which is also nade the MRF (Material Recovey Facility) is shown. In this STS there are 2 Material MRF of 300 ton per day capacity which are established by IMC. Around 700 rag pickers will be provided livelihood through IMC in this MRF process. At MRF, sorting of all type of dry waste such as paper, plastic, iron, glass, e-waste, polythene, rugs, leather, shoes, pet bottles, rubber etc. are done. Some places this process is conducted automitically which is more efficient than this manual process. But the automatic MRF takes the job of this 700 rags, which will impact on socio-economy of the socity. So, this STS continues the manual MRF.

Fig 3.6: Material Recovery Facility (MRF) with process of sorting recyclable waste

h. Onsite Compost:

Indore has also found out an idea to utilize the vegetable wastes and dried leaf of plants. They implement a program, costs Rs. 0.75 crores, to convert this waste into compost within the site. The full process of composting onsite is shown in **Fig-3.7**. First these wastes are dried into sunbath, second chop them into small pieces and third put them into the compost machine. After 24 hour the waste turn out into wet compost and then these wet composts are poured in some long chamber where they are kept open in air for 3 days for removing the unwanted microorganism in the compost. After that, these dry composts are packed and transfer them to market for selling as natural fertilizer for trees and crops. This incredible work generates an good amount of revenue into the waste treatment program of Indore.

Fig-3.7: Process of waste compaction on site

i. Success:

After all these process (compacting, recycling, MRF, composting and primary treatment), the wastes which cannot be processed are dumped into dump yard of Indore. But in the dump yard they also apply another incredible bioremediation technique. In this technique they spray a specialized bacteria over the wastes of dump yard and agitate the waste in every day. In a few days the bacteria eat all the waste and make the place empty and become extinct. So, there is no chance to spread diseases through these bacteria. In **Fig-3.8** the transformation of the waste dump yard is shown. The municipality saves 100 acres land which worths Rs. 300 crores through the entire waste treatment process. So, this is the real success of these kind of waste treatment process which inspires the other states of India to apply such systematic approach to deal with the waste.

Fig-3.8: The success achieved in Indore through this full waste handling process

Case Study 2
Jinxiang Wet Garbage Station, Changsha, China

a. Location and Station Overview: Recently, Changsha (the capital of Hunan Province) Wet Garbage Transfer Station, with its equipment, processes and technologies provided by Infore Environment Technology Stock Co., Ltd. (Abb: Infore Enviro), has been run to dehydrate and transfer the city's wet garbage and kitchen waste.

It is reported that the Station is China's first ultra-large centralized transfer project of wet garbage and kitchen waste. Covering an area of 3,900 square meters, the Station each day transfers 1,600 tons of refuse, including 1,200 tons of wet waste and 400 tons of kitchen waste.

Fig 3.9 View of the station

b. Equipment:
The Station's transfer system is composed of garbage bag-breaking machines, waste presses, semi-trailer transfer trucks, kitchen residue processing equipment, medical residue processing equipment, spray deodorization system and other equipment. Pioneering the mode of wet waste dehydration, reduction and transfer in China, its press system adopts the combined process of "fully crushing and horizontally pressing" to get wet waste pressed, dehydrated, compressed, and transported to the waste incinerator by semi-trailer transfer truck.

c. Mechanism- Wet Waste Processing:
The wet waste includes vegetable leaves, peels, eggshells, tea residue, bones, animals' offal, fish scales, tree leaves, weeds and so on, which come from home kitchens, dining rooms, restaurants, canteens, markets and other places. The waste has very high moisture content. In processing wet waste, the key is the bag breaking technique. Only after all the

garbage's bags are broken can the waste be horizontally pressed and achieve more than 15% of dehydration rate, and thus meet Changsha's standard for wet garbage processing.

Fig 3.10: Waste Garbage Processing Compactor

d. Mechanism- Kitchen Residue Processing:

Another system of the Station, kitchen residue transfer system, consists of the vertical direct-pressure compressor, garbage bin positioner, garbage bin and removable garbage truck, and utilizes the new process of "combining vertical direct-pressure trucks with hook arm trucks" to transfer dehydrated refuse and incinerate it at last.

Fig 3.11: Vertical compactor for kitchen waste processing

e. Mechanism- Medical Waste Processing:

Fig 3.12: Medical Waste Processing

f. Specialized Facilities- Double Protections to Comprehensively Remove Dust and Odor

During collection and transportation, rubbish, which is corroded and fermented after a period of time, can produce a certain odor. The Changsha project has many innovations in deodorizing waste during transfer. In the transfer system for wet waste, the joint of horizontal press and locomotive has been equipped with the fully closed sewage collection system, making it impossible for the sewage and odor to get leaked during transfer. In addition, in the kitchen waste transfer system, vertical waste bins are equipped with the single-sided door. Its good overall rigidity and full closure ensure that there is no leakage when transferring rubbish. Apart from strong closure of the equipment itself, the Station's discharge hall, discharge port and transfer hall all have introduced the negative-pressure wind-drawing dedusting and deodorization system and the spray deodorization system to remove dust and odor in an across-the-board way.

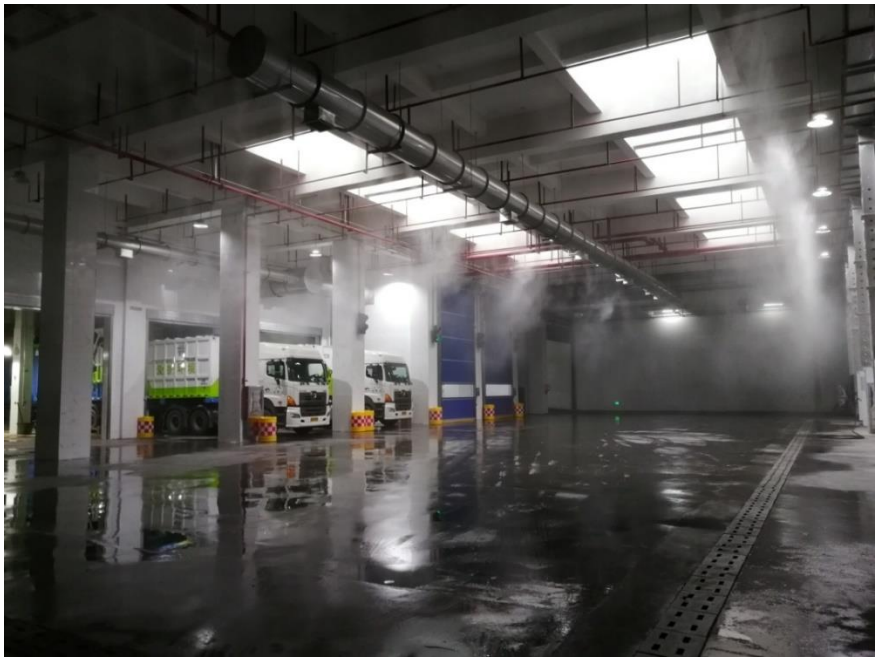


Fig 3.13: Spray Deodorizing System

Fig 3.14: Negative Pressure Wind Drawing Dedusting

g. Specialized Facilities- Intelligent and Efficient Digital Centralized Control

The Station is intelligent and highly automated. It has established the digital centralized control center, integrating systems such as the system of waste compression, traffic command, intelligent weighing and dedusting and deodorization and so on, managing sanitation operations in a systematic, intelligent and highly efficient way.

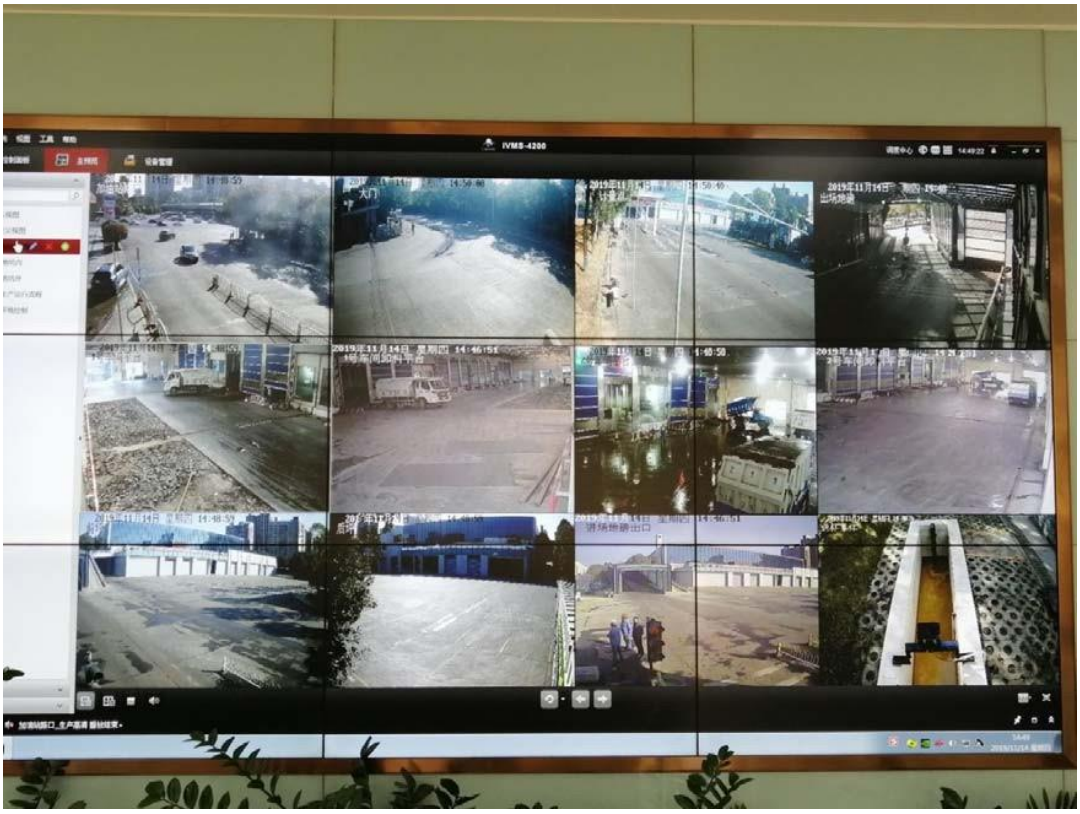


Fig 3.15: Digital Monitoring

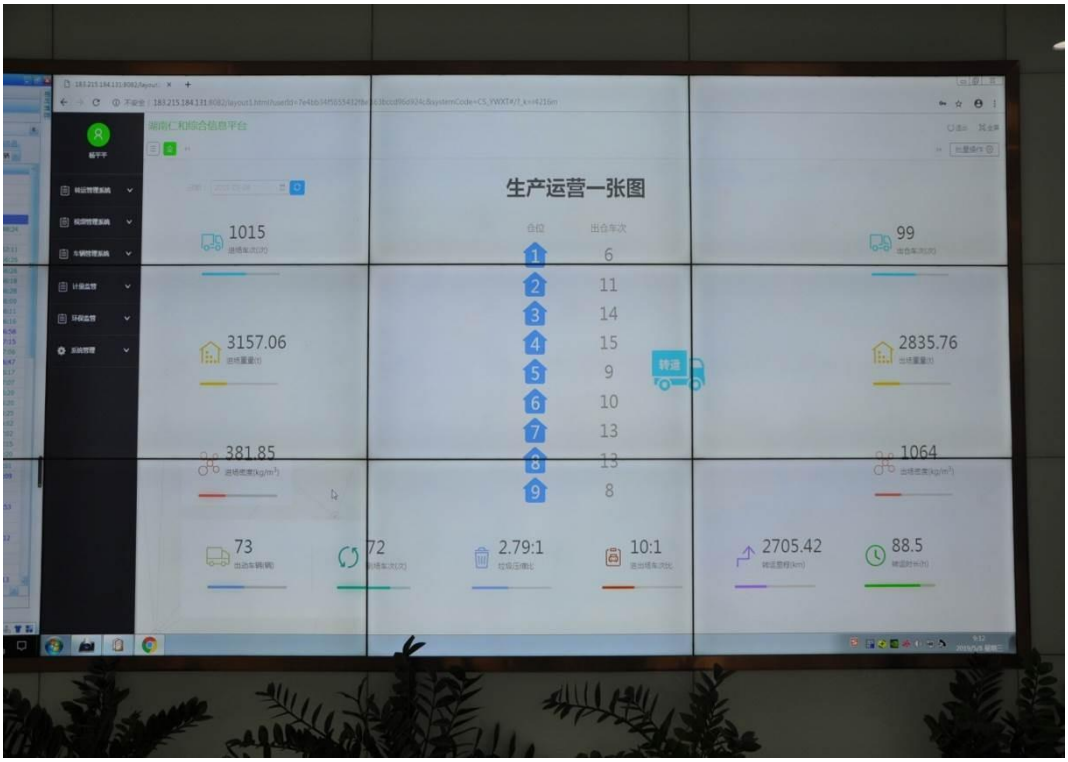


Fig 3.16: Digital Centralized Control

h. Success:

In recent years, with accelerated implementation of the waste classification system across China, efforts to categorize rubbish have been made in more and more places, and begun to show results. It is expected that the industry of wet garbage transfer and processing has a promising future. The Station in Changsha adopts a number of new technologies and processes, initiating a completely new mode of transferring and processing wet garbage. With a total investment of 4.5 million CNY, the station can handle as much as 96 tons of trash daily.

Establishment of the main construction, with a total capacity of 45 million cubic meters of solid waste, signified the end to Changsha's three open-air garbage dumps and direct discharges of urban waste into the Xiangjiang River. The project is one of 22 pollution treatment projects assisted by Japanese loans in the Xiangjiang river valley. Xiangjiang is believed to be "the mother river" of Hunan. Over 2.3 billion yuan (US$277) was spent on pollution treatment in the river valley in the last century, 35 percent of which came from Japanese loans.

It will become a model in the field of collecting and transferring wet garbage in China, and a new highlight in waste classification and processing.

Case Study 3

Secondary Waste Transfer Station at Kolkata

a. Location and Station Overview

Kolkata is one of oldest and largest metropolitan city in eastern part of India with population of 1,53,32,793 and population density of 24252 per km2. The city of Kolkata generates almost 4500 MT of municipal solid waste (MSW) per day. The waste of the city is maintained by Kolkata Municipal Corporation (KMC) and around 80% of this waste is collected by corporation waste management system. KMC has introduced the Modern Scientific Waste Compacting Stations (MSWCS) under the Clean City initiative. The MSW thus collected were taken to the nearest compactor station which houses around two to five compactors depending upon the area, in total there are 119 compactors and 95 mobile compactors functioning till date.

Fig 3.17: General View of the Station

b. Previous Condition

Fig 3.19: Previously Used Vat in KMC Areas Presently Substituted by MSWCS

c. Type of Compactor

1. Automatic Compacting Receptacles (ACR'S) e.g. SmartPacks
2. Regular or indoor Trash Compactors
3. Outdoor Trash Compactors e.g. Stationary, Dumpster type,Vertical outdoor

Fig 3.20: Types of compactors

d. Process Flow Chart

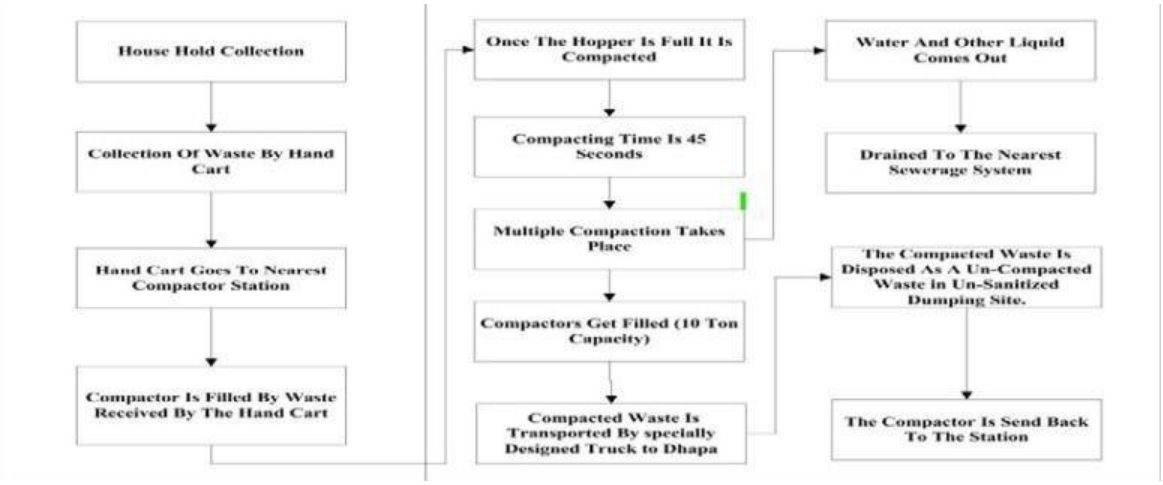


Fig 3.21 Process Flow Chart

e. Leachate Management:

Fig 3.22 Leachate Management

f. Transportation of waste and dumping in Landfill

Fig 3.23: Transportation and dumping of waste

Comparison of other cities with Dhaka

Topic of Comparison	**Star Square Ultra-Modern Mechanized Garbage Transfer Station at Indore, India**	**Jinxiang Wet Garbage Station at Changsha, China**	**Waste Compaction Station at the city of Kolkata**	**Secondary Waste Transfer Station at Lalbagh, Dhaka**
Location	Away from city, beside a highway	Away from city	Inside city	Inside main city
Compactor	Auto-pilot mode	Present	Automatic Compacting Receptacles (ACR'S)	Absent
Waste Segregation System	Both Manual and Auto segregation	Present	Present	Absent
Waste Collection Process	Dry and Wet waste are collected separately	Separately collected	Collected by Hand Cart	Collected by tricycle not separately
Waste Recycling Process	Present	Present	Present	Absent

(c) Proposed Project Interventions: To address the identified waste management challenges, the following interventions are proposed:

Infrastructure Upgrade: Installation of 2 modern waste compactors at the secondary transfer station to reduce waste volume and increase storage capacity.

Operational Efficiency: Regularizing waste collection schedules to prevent overflow and improve the efficiency of waste transfer to final disposal sites.

Community Engagement: Initiating public awareness campaigns to educate the local population on waste segregation and proper disposal practices.

Earlier interventions by various government agencies and NGOs involved pilot projects for community waste management, focusing on waste segregation and composting. However, these efforts have been limited in scale and sustainability, lacking integration into a broader waste management system. The proposed project aims to build on these initiatives with a more robust and scalable approach.

(d) Stakeholders:

Key stakeholders associated with the project interventions include:
Dhaka South City Corporation (DSCC): Responsible for managing urban waste and overseeing the redevelopment of the transfer station.
Local Community and Businesses: Direct beneficiaries of the improved waste management system.
NGOs and Environmental Organizations: Partners in raising awareness and implementing community-based waste management practices.
Private Contractors: Involved in the operation and maintenance of the waste compaction technology.
Government Agencies: Providing regulatory oversight and ensuring alignment with national waste management policies.

(e) Demand Analysis:

(i) Current Demand:
Based on data from DSCC, the current daily waste generation in Lalbag is estimated to be around 75 tons **(Ref: Annexes A, Fig 3.24)**, with the existing transfer station handling most of it, often operating beyond capacity. The station's inefficiencies result in frequent overflow and improper waste disposal, highlighting the need for investment in waste management infrastructure.

(ii) Future Demand:
Using reliable demand forecasting models, waste generation in the area is projected to increase by 3-5% annually due to urban population growth. With the project in place, the transfer station will be able to handle up to 300 tons per day, accommodating future demand for at least the next decade. In contrast, without the project, the waste overflow situation will worsen, requiring costly emergency solutions and additional resources to mitigate environmental and public health risks.

(iii) Constraints and Solutions:
Regulatory Constraints: Current waste management policies are outdated and may need revisions to facilitate the integration of new technologies and sustainable practices.
Technological Constraints: Limited access to advanced waste compaction technology might pose a challenge; however, partnerships with international organizations and private sector investment could alleviate this issue.
Community Resistance: Resistance to change may slow the adoption of waste segregation and management practices. A robust public awareness campaign and community participation are essential to overcoming this challenge.

(f) SWOT Analysis:

Strengths

1. **Existing infrastructure:** The presence of an existing secondary transfer station provides a foundation for redevelopment, saving time and resources compared to building a new facility from scratch.
2. **Government support**: Dhaka South City Corporation's initiative to build secondary transfer stations indicates potential government support for the project.
3. **Strategic Location:** The location of the station in Dhakeswari road, close to residential areas and educational institutions, presents an opportunity to serve a significant population and address local waste management challenges.

Weaknesses

1. **Limited Technology**: The existing secondary transfer station may lack modern technologies for efficient waste handling, sorting, and compaction. This can lead to inefficiencies and increased operational costs.

2. **Odor Pollution**: Improper waste storage and handling can result in odor pollution, which can negatively impact the surrounding community and environment.

3. **Lack of Proper Waste Segregation:** The existing station may doesn't have adequate facilities for segregating different types of waste, hindering recycling efforts and increasing landfill waste

Opportunities

1. **Improved waste management:** Redevelopment can lead to more efficient waste collection, segregation, and disposal.

2. **Reduced environmental impact:** Proper waste handling and recycling can minimize pollution and preserve natural resources.

3. **Public health benefits**: Improved waste management can contribute to better public health by reducing disease vectors and improving sanitation.

Threats

1. **Funding constraints:** Insufficient funding can hinder the project's implementation or scale.

2. **Technical difficulties:** Challenges in implementing new technologies or infrastructure can delay the project.

3. **Community opposition:** Resistance from local residents or businesses may hinder progress.

Section 4: Technical/Technological & Engineering analysis

4.1 Location:

Figure 4.1: Location from google map

The site is located on Dhakeshwari Road, falling under Ward No. 26 of the Dhaka South City Corporation. The specific geographical coordinates are Latitude 23° 72' 42" and Longitude 90° 38' 86". Dhakeshwari Road is named after the famous Dhakeshwari Temple, a revered Hindu temple and a key cultural landmark in Dhaka.

It serves as anintermediate point for temporarily disposing of waste from various residential, business, and other areas. However, given that DSCC is the most densely populated area in the capital, it must accommodate the increasing demand for waste collection capacity due to ongoing mass urbanization and development

Ownership of Land: The 1972 Bangladesh Constitution (last amended in 2018) states that all citizens have the right to hold, acquire, transfer and dispose of property.(Reference-1)

There are two main agencies governing land in Bangladesh:

- The Ministry of Lands is responsible for land administration through its divisions: the Directorate of Land Record and Survey, the Land Reform Board, and the Land Appeal Board.
- Through the Ministry of Law, Justice and Parliamentary affairs, the Directorate of Registration is responsible for changes in ownership and taxation.

According to the official site of Ministry of land, Bangladesh, Dhaka South City Corporation (DSCC) owns the land.(Reference-2) Therefore no need to further acquisition of land.

4.2 Technical design:

Standards and Specifications: The project will adopt Reinforced Cement Concrete frame, adhering to BNBC 2020 and ACI 318-08 standards. (Reference-3)

Description of the project: The project entails the redevelopment of the existing structure with minimal modifications to its original form. The office building will be repositioned to the front of the station, and the interior workspace will be expanded from 45x44 square feet to 55x49 square feet. The entrance gate will also be widened from 15 feet to 22 feet, ensuring better accessibility. Additionally, improvements in ventilation and air circulation will be implemented to enhance the working environment.

Upgraded leachate and drainage systems will be incorporated, including the installation of a peripheral drain to manage runoff more effectively. A freshwater basin will be added for convenient use, and washroom facilities will be provided for the staff. The project also includes the construction of a dedicated staff room and an office room, significantly improving the overall infrastructure of the station.

Designs: The following figures will be included in the Technical Design section of the secondary waste transfer station to provide a comprehensive visualization of the project's structural improvements:

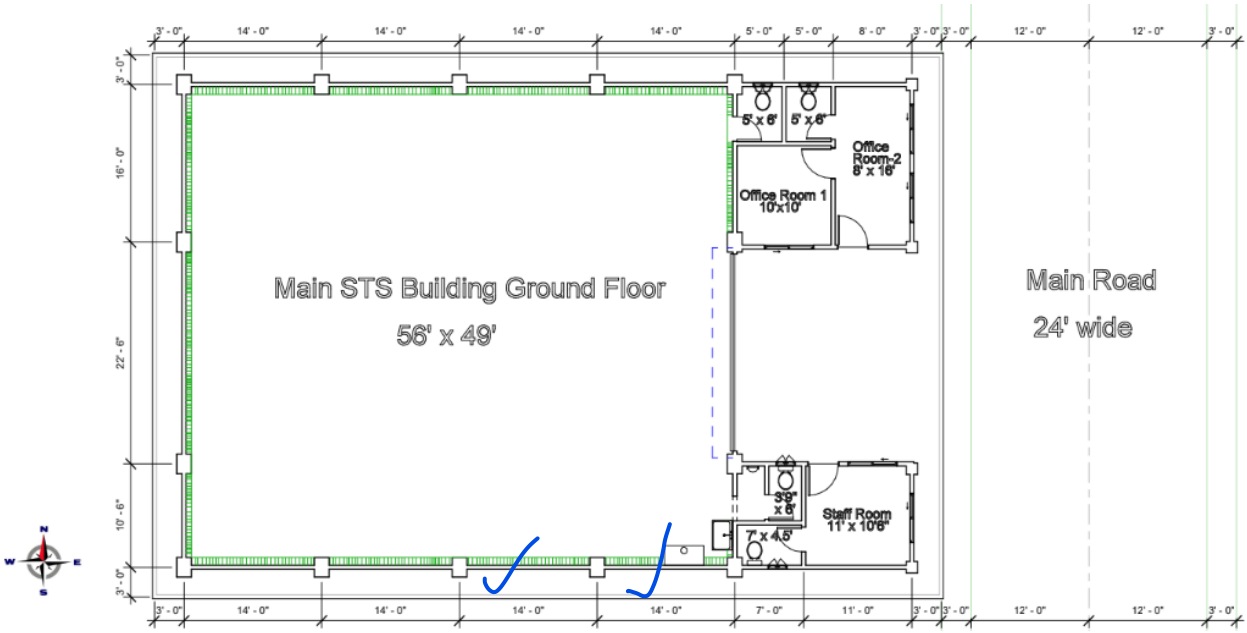


Figure 4.2: Plan view

Table-4.1: Final sizes of the structural member

STS Building's Howe Truss	W 14X90
STS Building's Rafter	W 14X90
STS Building's Purlin	C 10x20
STS Building's Bracing	L 6x6x1
STS Building's Beam	12'' x 18''
STS Building's Graded Beam	12'' x 18''
STS Building's Column	16'' x 16''
Office & Dormitory Building's Column	12'' x 12''
Office & Dormitory Building's Beam	12'' x 12''
Office & Dormitory Building's Graded Beam	12'' x 18''
Office & Dormitory Building's Slab	5''

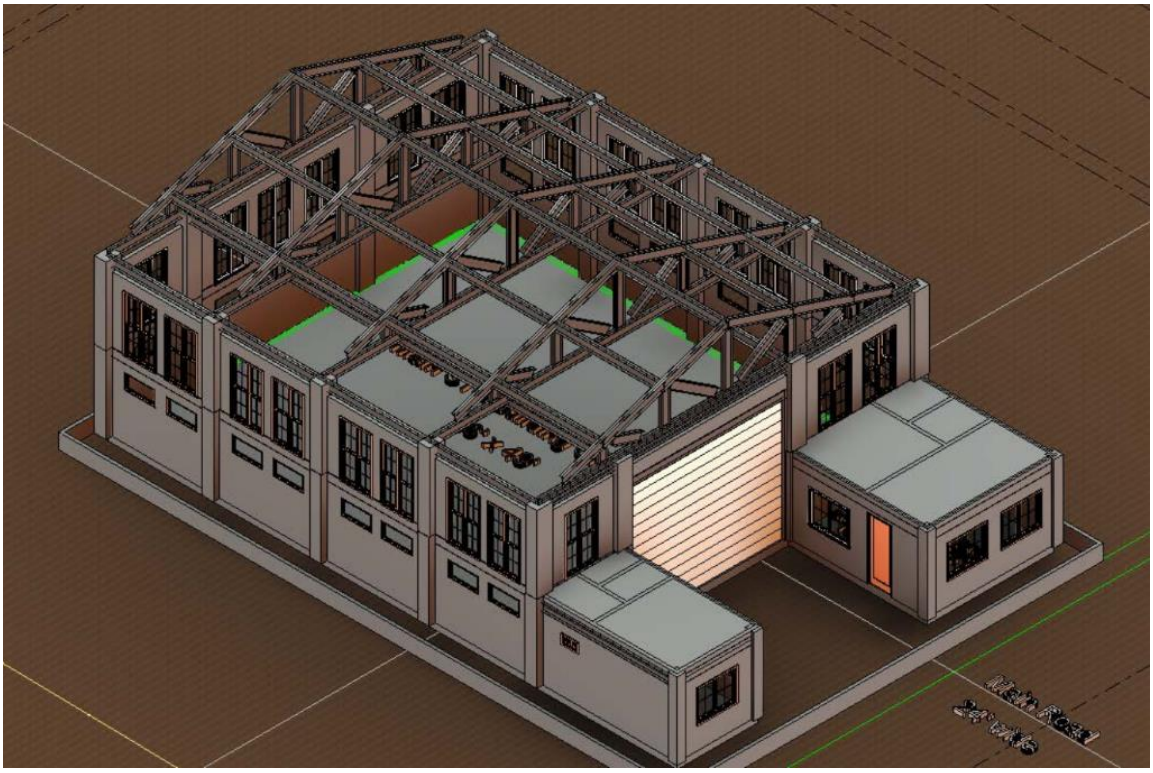


Figure 4.3: Steel roof 3D view

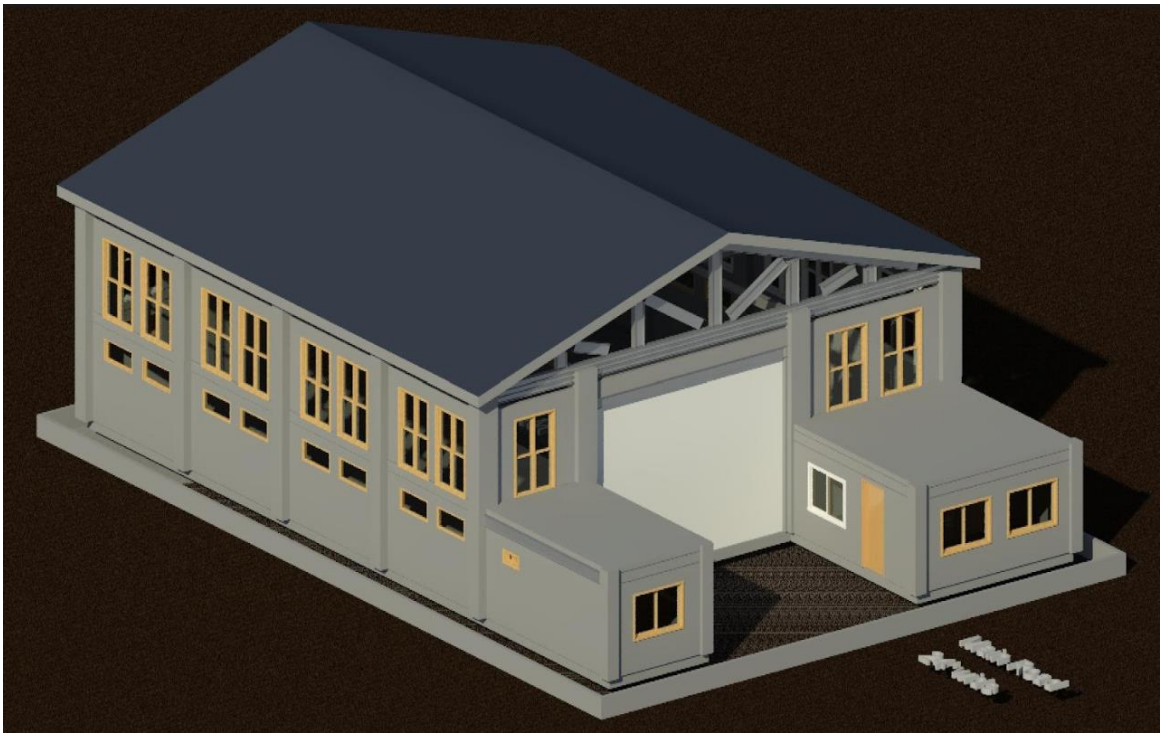


Figure 4.4: Final 3D view

Technology adopted: A new, advanced compactor machine will be purchased as part of the technological upgrades aimed at enhancing the efficiency of waste compaction operations. This cutting-edge equipment is designed to significantly reduce the volume of waste, enabling better storage and handling. By adopting this technology, the overall waste management process will be streamlined, reducing the need for frequent disposal trips and contributing to more sustainable waste processing methods. The machines improved compaction capabilities will also lead to cost savings and environmental benefits by minimizing landfill space requirements and optimizing resource us

Disaster and climate impact analysis: Dhaka city is located in Seismic Zone 2 of Bangladesh (Reference-3_bnbc). Eventually, the descripted site falls under zone. This classification means that it is in a moderate seismic risk area with a basic seismic coefficient, Z=0.20 according to the Bangladesh National Building Code (BNBC). The inclusion of RCC Frame systems ensures earthquake resilience, crucial in this seismic zone.

The project is situated in seismic zone category 2, which indicates a low to moderate risk of seismic activity. As a result, no specialized seismic design measures are necessary. Additionally, the site experiences moderate rainfall, meaning standard drainage solutions will suffice without the need for any complex modifications. Since the facility is a secondary waste transfer station with relatively simple operational requirements, it is not connected to a heavy or complex power grid system. This further ensures that the project is free from any significant technical challenges, and no additional specialized designs are required for power or environmental concerns

4.3 Output plan:

Improved Infrastructure: The project focuses on improving the structural layout and functionality of the existing facility. By repositioning the office building to the front, the redevelopment maximizes operational efficiency. The expansion of the interior workspace provides enhanced room for operations, allowing for greater flexibility and comfort. The entrance gate is being widened, significantly improving access for larger vehicles and equipment. Enhanced ventilation and air circulation systems will ensure a healthier and more comfortable working environment, promoting productivity and safety within the improved structure

Technological update: The acquisition of a new, advanced compactor machine will bring significant positive outcomes to the waste management process. By boosting compaction efficiency, this machine will drastically reduce waste volume, enabling improved storage and more effective handling. This technological upgrade will not only streamline daily operations but also reduce the frequency of waste disposal trips, cutting down transportation costs and associated emissions. Furthermore, by optimizing waste compaction, the machine will help save landfill space, contributing to more sustainable environmental practices and reducing the overall ecological impact. These improvements, paired with enhanced resource utilization, will lead to long-term cost savings and operational efficiency.

4.4 Costs estimates:

The construction cost for this development project is primarily based on the PWD Schedule of Rate 2022 (revised)(Reference of PWD-4). The detailed calculation of the cost is described in section 6

Building type	**:** Non-Residential Building (Light industrial building)
Building Category	: Special (2744 sft STS building, 477 sft office & staff room)
Type of structure	**:** R. C. C. frame structure with a steel truss pitched roof
Soil type	**:** Bearing capacity of soil = 3 ksf
Foundation	**:** Shallow foundation, single storey
Plinth Area	**:** 3362.6 sft (312.56 sqm) or (2832.2sft+530.4sft or 263.25sqm+49.3sqm)
Site	**:** Lalbag, Dhaka (earth-quake zone-2)

1. Soil investigation including Mobilization and demobilization of boring equipment: TK. 184,057.00
2. Construction of building cost:
    a. Foundation cost: Tk. 3,743,106.00
    b. Superstructure cost including STS building, member weight, office & staff room: Tk. 10,932,390.60
    c. Additional superstructure cost: Tk. 7,194,753.00

Therefor construction cost of building = (3,743,106+10,932,390.60+7,194,753)= Tk. 21,870,249.00

3. Other building cost: Tk. 2,751,890.00

Sub total cost (184,057+21,870,249+2,751,890) = Tk. 24,806,196
Considering the inflation rate of 12% the present value of subtotal cost = Tk. 31,116,892.26

4. Quality assurance, administrative expense, contingency and environmental monitoring cost = Tk. 7960689.23

The sub total cost (from 1 to 4) = Tk. 39,077,583.00

5. STS and office equipment cost : Tk. 7,225,040.00

The Grand total cost (from 1 to 5) is estimated Tk. 46,302,623.00

4.5 Implementation timeline:

The project implementation will follow a structured approach, beginning with the project proposal and feasibility analysis, which includes engineering surveys and financial evaluations. Following ECNEC approval, detailed design and tender processing will take place, leading to the start of construction that will last for three years. The project will conclude with the commissioning phase, followed by the operation of the academic hub.

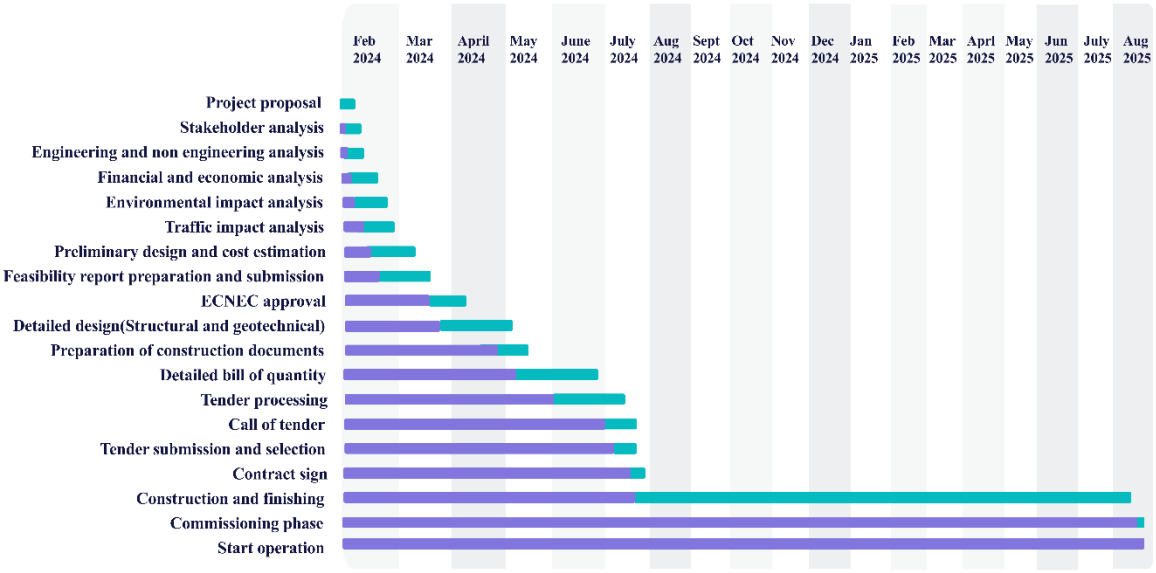


Figure 4.5: Project Timeline

4.6 Traffic Impact Analysis

Project Description:

Our proposal aims to redevelop the secondary transfer station in Lalbagh (DSCC Ward No. 20) by integrating compaction and waste transport facilities. This redevelopment will enable the station to meet the growing disposal demands resulting from increased waste generation in this region of the capital.The upgraded structure will feature proper compaction facilities for waste and provide ample space for maneuvering transport trucks. These trucks will transport waste from various collection points within the concerned areas for disposal, as

well as facilitate the transfer of waste from the secondary station to the landfill at Matuali.

Project Area and Area of Influence:

The waste transfer Station situated in Dhakeswari Road. The Influence area of the Project are those from which waste are collected and Transferred for further disposal. Conventional Waste Transportation System are used to collect the waste from three different location namely

1. Chawkbajar
2. Lalbagh
3. Azimpur colony

The following figures show the collection points collected from google map:

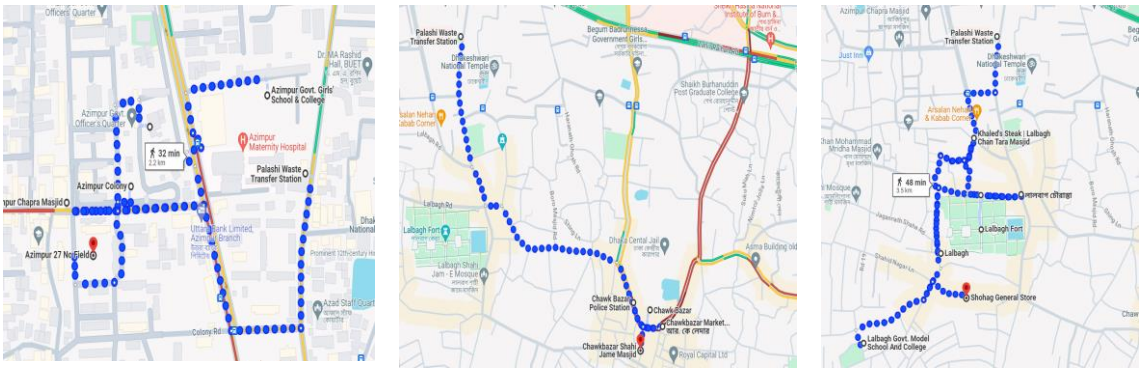


Fig 4.6.: Routes of collection points

The wastages are transferred to Matuali for disposal. The Fig-4.7 shows the route of disposal point.

Study Methodology:

1. **Trip Generation**: This involves estimating the number of trips that originate or attract at a specific location, such as a residential area, commercial center, or industrial zone. It helps in understanding the travel demand generated by different land uses. 30 vans operate daily for waste collection. Each van makes 2 trips per day. Total Trips Generated = 30 vans × 2 trips = 60 trips/day. An additional trip is made at around 11 pm by truck to transfer the compacted wastages to disposal point Matuail.

2. **Trip Distribution**: After determining the total number of trips, the next step is to distribute them across different destinations or zones. This phase explores the patterns of travel between origins and destinations, indicating how trips move throughthe transportation network. The trips are distributed across three locations, indicating the service area for waste collection is localized but involves a specific set of area namely Lalbagh, Chawkbazar, Azimpur colony.

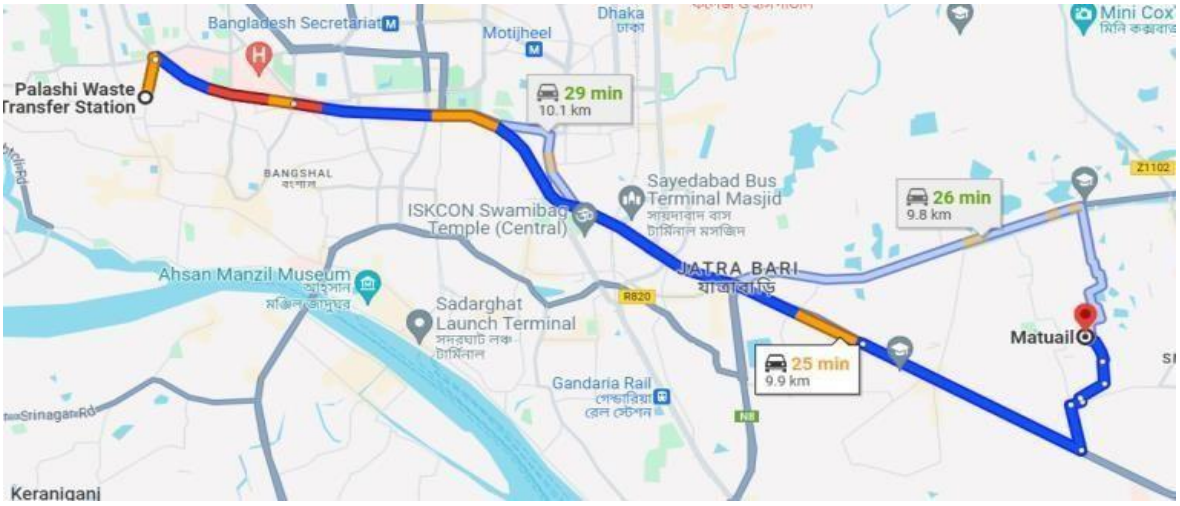


Fig 4.7: Routes of disposal point.

3. **Modal Split:** Modal split analyzes the distribution of trips among various transportation modes, such as cars, buses, bicycles, or walking. It helps in understanding the preferences of travelers and guides decisions on infrastructure and transit services. Only vans are used, indicating a monomodal transportation system for waste collection. There is no diversification into other modes, such as pedestrian collection or smaller vehicles.

4. **Trip Assignment:** This step allocates the trips to specific routes within the transportation network. It addresses the question of how travelers choose specific paths to reach their destinations, considering factors like travel time, cost, and convenience. Since vans are the only mode of transport, the system follows a fixed-route trip assignment, meaning each van is likely assigned a specific route to minimize travel time and maximize waste collection efficiency. From survey data and existing traffic analysis, the existing route of waste collection and transportation to landfill is satisfactory for operation. Hence, further new route optimization isn't necessary. For chawkbazar collection point, the local gully could to use as an alternative.

Existing Traffic Condition:

Road Network: The Secondary Transfer Station that we are working on is located at the Dhakeshwari Road. Dhakeshwari road is a 2 lane 2-way road which is occupied mainly by rikshaws, taxis, cars, human haulers and other light vehicles. Our main concern of this project is traffic flow of Dhakeshwari road. Traffic condition of this road in front of the station is moderate to heavy depending on time. This road intersects at a distance of 330 meter on the North side with Zahir Raihan Road, Azimpur to Palashi connecting road and Fuller Road at Palashi circle which is a roundabout of 5 roads. On the South side, at a distance of 180 meter, this road intersects with the Orphanage Road and Azimpur road. Traffic congestion is usual in these two inter Chapters.

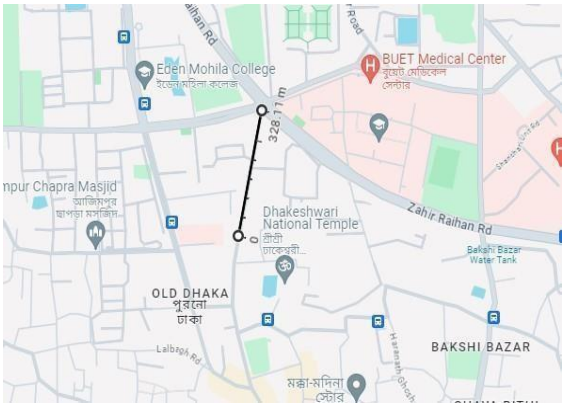


Fig 4.8: Distance of Palashi circle to STS

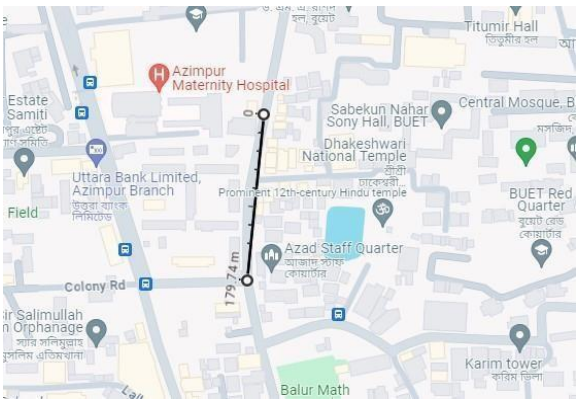


Fig 4.9: Distance of Azimpur road to STS

At the opposite of transfer station there are some fast-food shops and restaurants where people usually comein the afternoon and the evening and customers park their vehicles at the side of the road which causes congestion in front of the station. When vans arrive at the station or depart from the station, it may hinder the traffic flow to some extent. Trucks arrive at the station at around 11:30 pm. At that time traffic flow in Dhakeshwari road is not that much that heavy. That's why, impact of truck is low compared to vans. Vans collect waste from Lalbagh Area, Chawkbazar area and Azimpur

Traffic Flow:

As mentioned earlier, only traffic associated with the transfer station are vans and trucks. As the vans and trucks use the Dhakeshwari road to arrive at the station, traffic flow in the Dhakeshwari road is our main concern. But at this road connects with the Lalbagh road and Azimpur, we have collected data fromgoogle maps of the routes that vans and trucks use.

The following Table depicts the Weekly Traffic Conditions on the Selected Route from Saturday to Friday, segmented by Time Periods (8 am to 12 pm, 12pm to 4 pm, 4 pm to 8 pm, 8 pm to 12 am). The data provides insights into varying traffic patterns throughout the day, aiding in the assessment and planning of transportation during different time slots.

From the table it is evident that the traffic flow in the Chawkbazar to Transfer Station Road is heavy duringmaximum time of the day. Lalbagh road is quite congested after 8 Pm until midnight. Whereas traffic flowin the Dhakeshwari road is light only after 8 Am to 12 Pm.

Dataset from field survey: Again, we had conducted on field survey to find out the demand of the traffic flow in Dhakeshwari road as well as operating speed. The next two tables show the detailed hand on calculation of flow demand and operating speed in excel sheet. **(Annexes B, Table 4.3 & 4.4)**

Table 4.2: Traffic Flow situation

Route	Time	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Dhakeswari road	8.00 Am to 12.00 Pm	light	light	moderate	light	light	light	light
	12.00 Pm to 4.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	light
	4.00 Pm to 8.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	moderate
	8.00 Pm to 12.00 Am	moderate	moderate	moderate	moderate	moderate	moderate	moderate
Lalbagh	8.00 Am to 12.00 Pm	light	moderate	moderate	moderate	moderate	moderate	moderate
	12.00 Pm to 4.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	moderate
	4.00 Pm to 8.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	moderate
	8.00 Pm to 12.00 Am	heavy	moderate	heavy	heavy	heavy	heavy	heavy
Azimpur	8.00 Am to 12.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	moderate
	12.00 Pm to 4.00 Pm	moderate	moderate	heavy	moderate	moderate	moderate	moderate
	4.00 Pm to 8.00 Pm	heavy	heavy	heavy	moderate	moderate	moderate	moderate
	8.00 Pm to 12.00 Am	moderate	moderate	moderate	moderate	moderate	moderate	moderate
Chowkbazar	8.00 Am to 12.00 Pm	heavy	heavy	heavy	heavy	heavy	moderate	moderate
	12.00 Pm to 4.00 Pm	heavy	heavy	heavy	heavy	heavy	heavy	moderate
	4.00 Pm to 8.00 Pm	heavy	heavy	heavy	heavy	heavy	heavy	moderate
	8.00 Pm to 12.00 Am	moderate	moderate	moderate	moderate	moderate	moderate	moderate
Palashi transfer Station to Matuali	8.00 Am to 12.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	light
	12.00 Pm to 4.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	light
	4.00 Pm to 8.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	moderate
	8.00 Pm to 12.00 Am	moderate	moderate	moderate	moderate	moderate	moderate	moderate

Roadway Capacity Calculation (Highway Capacity Manual)(Reference-5)

For Dhakeshwari road,

According to the operating speed 17 mph, the Level of service fall under "F" category but from the field observation the traffic condition isn't forced flow at all. Rather it shows the tendency of approaching unstable flow. Hence, we have considered LOS (level of service) C

2 lane, 2 way

Operating speed 17.1 mph, LOS C

Lane width 8 ft

Shoulder width 2 ft

Roadway Capacity=Capacity from Table 1 * factor for LOS (from table 2) * factor for lane width (from table 3) * factor for shoulder width (from table 4)

Road Capacity = 2000*0.68*0.97*0.92

=1213 pcu/hr/lane

=1213*2 pcu/hr

=2424 pcu/hr (2 lanes)

Capacity for this road is 2424 PCU per hour and from the field survey the demand of the road has found 2041 PCU/hour. So, the demand is not exceeded in this road for these vehicles.

Parking Facility

There are 20 vans at present in the station and they are kept inside the station when idle. There are no extra parking facilities for vans outside the station. While collecting the container, trucks enter the station and collect container. Sometimes vans are parked at the roadside in front of the station but they are kept inside at night.

Current Public Transport Facility

The only Public Transport that use the Dhakeshwari road in front of the station is human hauler which usually departs from Nilkhet or Azimpur and uses the Dhakeshwari road to reach Gulistan or Lalbagh or Chawkbazar. But the inter Chapter point of Dhakeshwari road, Azimpur road and Orphanage Road located at180 meter south of the transfer station is quite congested all the time because of the city buses.

Pedestrian and Bicycle Facility

Almost 30-35 people work in this station. They enter and exit the station through the main gate. There are noextra bicycle facilities in the Dhakeshwari road. There are footpaths on both side of the road for pedestrians. But some portions of the footpaths are occupied by the garages or food shops.

Present and Future Development

At present, there is no ongoing development project is not running in the surrounding of our project. In ourproject, there will be parking facilities for the vans inside the station. So, congestion created by parked vans outside will be mitigated. In future the notable development project will MRT Line-2 which will pass through the Palashi circle. Thiswill result in generation of new traffic which may cause traffic congestion in the Dhakeshwari road. Condition of Dhakeshwari road at two interchapters points is not up to the mark. This road must be repaired and at the interchapter of Azimpur road and Orphanage Road, a roundabout should be constructed to mitigate congestion.

Mitigation Measures:

Daily traffic mitigation The use of 20 vans for daily waste collection over short distances (3-4 km) does not significantly increase traffic in the area. The vans follow fixed routes and operate consistently, which minimizes sudden or unexpected traffic congestion.
The additional trip by truck at 11 PM to transfer compacted waste to Matuali occurs during non-peak traffic hours. This is a strategic measure to avoid adding congestion to the area's daytime traffic load.

Mitigation during Construction

The construction work is supposed to be continued for 6 months. The construction materials, equipment, utilities like aggregates, cement, concrete, bricks, steel, bulldozers, concrete mixers will be placed inside the station. A 60’x45’ inside area and a 3.5’x7’ behind area is available for working purpose. Eventually the traffic flow in Dhakeswari will prevails as normal.

Conclusion and Recommendations:

According to the analysis, the current roads are sufficient for the projected traffic levels. However, traffic may grow in the future and exceed their capacity. To guarantee a safe and pleasant journey to the multiplex building, the following measures are suggested:

1. **Broaden Sidewalks:** Expand sidewalks to better serve pedestrians and

accommodate the influx of customers and employees walking from nearby areas.

2. **Enforce Anti-Encroachment Regulations:** Rigorously apply regulations to clear any obstructions that hinder smooth traffic movement.
3. **Adopt Intelligent Traffic Management Systems:** Deploy advanced traffic signal systems and optimize their operation to enhance traffic flow and minimize delays during peak times.
4. **For Future Growth:** Designate areas for potential road enhancements, such as widening, adding lanes, or integrating future public transit options to support long-term development.
5. **Enhance Bike Infrastructure:** Develop dedicated bike lanes and secure bike parking to encourage cycling and reduce vehicular traffic.
6. **Implement Real-Time Traffic Monitoring:** Use real-time traffic data to manage congestion, provide timely information to drivers, and adjust traffic signals as needed.

The redevelopment of secondary waste transfer station is not anticipated to immediately affect the surrounding roads, as the current road conditions and infrastructure are adequately equipped to manage the projected traffic increase to a certain degree. Planned future road expansions, including widening and reserving space for extra lanes, will ensure the road network remains capable of accommodating increasing traffic volumes.

Section 5: Environmental Sustainability, Climate Resilience and Disaster Risk Analysis

5.1 Environmental, Climate Change and Disaster Risk Analysis

5.1.1 Introduction

(a) Background

Our proposal is the Redevelopment of the Secondary Transfer Station at Lalbagh (DSCC-Ward- 20) with Integrated Compaction and Waste Transport Facility. The STS is built by Dhaka South City Corporation. It collects wastes from Suhrawardy Udyan, Fulbaria Station East Area & Secretariat Road, Ramna Green House, BUET main academic & administrative buildings, BUET residential area, all the halls of BUET and stored at the station for approximately 11/12 hours before finally transferring to the landfill (Matuail). But the problem is that existing STS does not contain modern facilities and efficient waste transportation system. Therefore, this project of establishing a model STS is necessary to expand the capacity of the station and change the collection and transportation system from the community level. As our landfills are almost out of their capacity, this compaction system will solve the problem. Also, reduced volume and water content will cause less leachate and odor problems.

(b) Objective

This project seeks to achieve the following objectives:

1. Expand the station building where more waste can be treated.
2. Reduce the volume of the waste by using modern imported compactors.
3. Recycle/ reuse the dry waste like paper or plastic and earn revenue from vendors.
4. Solve the problem of our out of capacity landfills.
5. Change the system at community level by segregating dry and wet waste using two different kinds of garbage bags (one for dry and one for wet)
6. Maintain proper segregation at transportation level by using compartmental trucks/vans so that they can be treated differently at the station.
7. Overall, set a model station which can be followed by other transfer stations of the city.

(c) Outline of Methodology

This EIA report will follow a comprehensive approach, encompassing the following key steps:

Baseline Assessment: This stage involves gathering baseline data on the existing environmental and social conditions of the project area. This will include data collection on air quality, noise levels, water resources, soil quality, flora and fauna, socio-economic conditions, and cultural resources.

Impact Identification and Assessment: Potential environmental and social impacts associated with the project's construction and operation will be identified. This will involve analyzing the potential for impacts on air quality, noise levels, water, soil, flora and fauna,

and socio-economic factors.

Mitigation Measures: Based on the identified impacts, appropriate mitigation measures will be proposed to minimize or eliminate any negative effects. This may include measures like dust suppression during construction, proper waste management, and noise reduction strategies.

5.1.2 Policy, Legal and Administrative Framework

(a) Framework

The environmental, social and legal codes and policies that must be strictly adhered to ensure protection of resources from adverse impacts of this project are listed below:

National Environmental Laws and Regulations

National Environmental Policy 1992

Bangladesh Environmental Conservation Act (ECA), 1995 amended 2002

Environment Conservation Rules (ECR) 2023

National Land-use Policy, 2001 2.2.5 Environment Court Act, 2000

Bangladesh Labor Act, 2006

Public Procurement Rule (PPR), 2008

Bangladesh National Building Code (BNBC), 2020

Noise Pollution Rules, 2006

Air Pollution Control Rules, 2022

National Social Policies Laws and Regulations

The Acquisition and Requisition of Immovable Property Ordinance, 1982

Water Supply and Sanitation Act, 1996

The Ground Water Management Ordinance, 1985

The Vehicle Act, 1927 The Motor Vehicles Ordinance, 1983 The Bengal Motor Vehicle Rules, 1940

Public Health Emergency Provisions Ordinance, 1994

The Employer's Liability Act, 1938

IPFF Environmental and Social Safeguard Policies

OP/BP 4.01 Environmental Assessment

OP/BP 4.04 Natural Habitats

OP/BP 4.11 Physical Cultural Resources

IFC Environmental, Health and Safety Guidelines

(b) Implications of Policies and Regulations on the Project

The ECR-2023 classifies projects into four categories according to potential environmental impacts: (1) Green; (2) Yellow; (3) Orange; and (4) Red.

Projects categorized as green exhibit predominantly positive environmental effects or minimal negative consequences.

Yellow category projects entail minor and typically temporary environmental impacts, for which standard mitigation measures are applicable.

Orange category projects are characterized by moderately significant environmental impacts.

Red category projects involve substantial adverse environmental impacts.
According to Schedule-1 of ECR-2023, our proposed project is classified under the "Yellow" category. Here's the direct mentioning of STS in the yellow category of institutes.

হলুদ শ্রেণিভুক্ত শিল্প প্রতিষ্ঠান বা প্রকল্প বলিতে এইরূপ সকল শিল্প প্রতিষ্ঠান বা প্রকল্পকে বুঝাইবে যাহার পরিবেশ এবং মানব স্বাস্থ্যের উপর মধ্যম মাত্রায় প্রভাব রহিয়াছে এবং উক্ত প্রভাব পরিহার করিবার জন্য এই শ্রেণির শিল্প প্রতিষ্ঠান বা প্রকল্পসমূহের পরিবেশ দূষণ প্রশমনমূলক ব্যবস্থা গ্রহণের প্রয়োজন;

ক্রমিক নং	শিল্প প্রতিষ্ঠান/প্রকল্পের নাম
(১)	(২)
২৫।	মৎস্য চাষ (জমির পরিমাণ ৫ একরের উর্ধ্বে)।
২৬।	ডিজেলচালিত জেনারেটর স্থাপন (১০০ হইতে ৫০০ কেভিএ পর্যন্ত)*।
২৭।	নৌযান প্রস্তুত (কাঠের নৌযান ব্যতীত)।
২৮।	সিমেন্ট কংক্রিট সামগ্রী (যেমন, রেলওয়ে স্লিপার, বৈদ্যুতিক খুঁটি তৈরি, পাইপ, ব্লক, টাইলস ইত্যাদি)।
২৯।	সিএনজি/এলপিজি/এলএনজি কনভারসন ওয়ার্কশপ।
৩০।	Metal finishing, painting and annealing units, excluding metal and machine fabrication.
৩১।	আবাসিক হোটেল (কক্ষ সংখ্যা ২০টির অধিক কিন্তু ১০০টির হইতে কম)।
৩২।	স্থালানি তৈল ফিলিং স্টেশন।
৩৩।	স্থালানি গ্যাস (সিএনজি, এলপিজি, এলএনজি ইত্যাদি) বোতলজাতকরণ।
৩৪।	সোলার পাওয়ার প্লান্ট (১ মেগাওয়াট হইতে ৫০ মেগাওয়াট পর্যন্ত)।
৩৫।	লুব অয়েল ব্লেন্ডিং।
৩৬।	সৌর বর্জ্যের সেকেন্ডারি ট্রান্সফার স্টেশন।
৩৭।	করাতকল।

3 Conditions for Quality Check-
Environmental Quality Check
Liquid Waste Discharge Check
Leachate Discharge from industry or project work

Quality Check for Toilet Waste and Industrial Waste (Annexes B, Figure 5.1, 5.2, 5.3)
(Collected from ECR-2023)

Laws for Management of Produced Leachate- (Annexes B, Figure 5.4, 5.5)
(Collected from ECR-2023)

5.1.3 Project Description

The STS is situated only 5 min walking distance away from BUET campus. It covers 2700 square feet area right now. 20 vans and 2 trucks are available there. There are workers but no one is resident. We are reconstructing the main office building. The total area of the STS will be 2744 square feet. Also, office buildings will be shifted in front of the STS. Our roof will be pitched like before. The main building will be of concrete and the roof part will be a steel structure. A maximum of 10x10 columns will be provided under single footing. As we are increasing the inside area, more parking is possible. Therefore, we are also increasing the van number to 30. Moreover, we are incorporating 2 compactors to the STS, which facility is not available right now. We will compact the wet waste to reduce the volume and also segregate the dry waste for recycling purposes. As for the office building, no workers

lived there before but now one permanent worker will always be there because compactors machines are expensive and need continuous monitoring. We are building a single dormitory for the workers. Different washrooms for the dormitory and for the workers' general use will be provided. We are designing a waste management system (septic tank system) for the washrooms and a water supply system for the basin. And for the leachate of the wet wastes, we are providing drainage system around the periphery of the STS.

5.1.4 Baseline Environment

(a) Physiochemical

The physiochemical environment parameters directly influence the design, construction, and overall performance of the structure. These parameters include:

1. **Seismicity:** Dhaka city falls in seismic zone II of the seismic zoning map of Bangladesh which means the city is at moderate risk (basic seismic coefficient is 0.5 g).
2. **Topology:** Surface elevation of the planned area ranges between 15 to 20 meters.
3. **Meteorology:**
    - **Temperature:** The monthly variation of the average maximum temperature which is between 39.6°C to 30.1°C. The monthly variation of the average minimum temperature is 22.5°C to 6.5°C.
    - **Rainfall:** The average monthly rainfall during monsoon (June-September) season from 1980- 2013 is 332 mm/month. The variance in the maximum rainfall during monsoon season is 836 mm/month to 552 mm/month, whereas the variance in the minimum rainfall is 136mm/month to 59 mm/month.
    - **Humidity:** The average relative humidity in Dhaka is 76%. In the winter months of November to February, the relative humidity in Dhaka ranges from 64% to 73%.
    - **Windspeed:** 65.7 m/s
4. **Air Quality:** Around half time of the year (whole rainy season), the ambient air quality remains good and under the standard value (for PM2.5- 65 ug/m3 and for PM10- 150 ug/m3) specified by government. But it exceeds the limit at dry season. And the other criteria pollutants like SO2, CO2, NOx and O3 remains under the threshold value almost all time of the year. (Collected from the Annual Report 22-23 of DoE- https://doe.gov.bd/site/view/annual_reports/-)
   The relevant graphs, standard values and piechart for the AQI value of Dhaka are shown in **Annexes B Table 5.1, 5.2, 5.3**
5. **Noise Quality:** The major source of noise in the project area is traffic. The instruments to be used for noise measurement are sound level meter (SLM), the integrating sound level meter (ISLM), and the noise dosimeter.

(Collected from the official website of Bangladesh Meteorological Department- https://live8.bmd.gov.bd/)

(b) Ecological

Ecological environment parameters are of paramount importance in this construction project's planning and execution phases. They emphasize how the project affects the nearby ecosystem. These parameters include considerations like carefully choosing the construction site to minimize disturbances to habitats and ecosystems, along with the preservation of existing vegetation and wildlife corridors.

IUCN Bangladesh in 2002 (https://iucn.org/) classified the country into twenty-five bio-ecological zones. The project area falls under Brahmaputra-Jamuna Floodplain sub-category. Also, our project area is in Palashi, which is busy. So, there is not enough greenery or floral bio diversities in the area. Also, there is lots of dust which also keeps away birds and other animals.

(c) Socio-economical

Socioeconomic environment parameters are crucial considerations that would determine the impact on related communities and economies. The project's affordability and accessibility contribute to its inclusivity and overall societal benefit. These parameters are listed below according to survey data:

1. **Housing Pattern & Land use pattern:** The project is in a residential/commercial area as there are shops, university halls, residential buildings, and quarters around there. Also, a school and fire station are situated near the existing building. Most of the residents are middle class working people or otherwise students.
2. **Local employment opportunities during construction:** Construction can stimulate the local economy through job creation and increased business activity. However, it may also disrupt existing businesses temporarily.
3. **Transport and Communication:** The connecting road beside the station generates a light volume of traffic which can rise to medium category during peak time on weekdays. The construction work often requires road closures and diversions which can induce traffic congestion in the area and can cause inconvenience to residents and businesses by limiting access to roads, sidewalks, and public spaces.
4. **Utilities (Electricity, Gas):** In the project area there must be access to electricity and gas. Dhaka Electricity Supply Company (DESCO) supplies electricity through grid line in the project area. Titas Gas Transmission and Distribution Company supplies gas connection through pipelines.
5. **Water Supply and Sanitation:** Water supply in the project area is tap water reticulation system as like as other parts Of Dhaka city. There is also a sewerage system passing through the existing road. All households, offices, and others in these areas have hygienic latrines.

6. **Historical site:** There are no historical sites surrounding the proposed area. Butthe 'LalBag Fort' is nearby which can be a contributing factor to traffic scenario.
7. **Aesthetic:** Aesthetic beauty plays an important role in improving the environment. The existing building is in very bad condition. Our new modern station will improve it thoroughly.
8. **Respondent's perception regarding the proposed project:** The people living in that area always felt uncomfortable because of the foul odor of the station. As our modern station will reduce the problem, they are very positive about the project. But the construction phase will cause them temporary inconveniences.

Public Consultation and Stakeholder Engagement-

Public consultation and stakeholder engagement are essential parts of the socio-economic aspect. During these consultation sessions, stakeholders will be provided with detailed explanations about the project, including its benefits and potential social and environmental effects. Participants were actively encouraged to express their thoughts, concerns, and opinions openly. The presentations focused on aspects such as the project's background, goals, anticipated activities, socio-economic insights, and environmental considerations. Public consultation for this project will be:

- Government Officials (DSCC)
- Secondary Transfer Station owner
- People of the Ward- 20
- Workers at the STS
- People living near the project

5.1.5 Identification and Assessment of Potential Impacts

(a) Introduction

The identification and assessment of potential impacts are crucial steps in developing a model Secondary Transfer Station at Palashi. This process involves evaluating how the reconstruction project might affect various aspects of the surrounding area and community. Identifying and assessing potential impacts helps to understand the concerns and expectations of various stakeholders, including residents, owners, community groups, and government authorities. By assessing potential impacts, we can identify any negative effects that the construction might have on the environment, infrastructure, local businesses, traffic flow, aesthetics, and more. This allows for mitigation strategies to be developed to minimize these negative effects and maintain the overall quality of life in the area. Understanding impacts helps in designing the construction project with long-term sustainability in mind. By addressing potential environmental, social, and economic impacts, the project can contribute positively to the community over the long run.

(b) Impact During Construction

Physiochemical Environment:

(i) **Air Pollution:** The quality of the air can be negatively impacted by the discharge of emissions from machinery and the burning of fuels. The creation of dust from construction areas, storage of materials, and entry roads, dust released during digging, moving earth, loading, managing, and transporting excavated material. The air's quality might undergo changes due to emissions from vehicle exhaust and the burning of fuels

(ii) **Water Supply and Quality:** Building construction can cause water pollution through various mechanisms. During construction, excavation, grading, and earth-moving activities disturb soil and expose it to erosion. When it rains, stormwater runoff can carry sediments from the construction site into nearby water bodies, causing sediment pollution. Construction sites often use a variety of chemicals, including paints, solvents, adhesives, and concrete additives. Improper handling, storage, or disposal of these chemicals can lead to spills or leaks, allowing hazardous substances to enter waterways and contaminate them. Concrete mixing and cleaning can generate a significant amount of alkaline wastewater, which contains chemicals that can alter the pH of nearby water bodies, harming aquatic ecosystems. Poor sanitation and waste management practices at construction sites can result in bacterial contamination of nearby water sources. This can pose health risks to humans and aquatic organisms.

(iii) **Liquid/ hazardous waste pollution:** Fuel will be needed for operating construction equipment and other purposes. Other chemical and hazardous elements might be needed for construction purposes. Storage and handling of these hazardous materials are very important. Inadequate storage and management of fuels, lubricants, chemicals, and dangerous liquids on the construction site, along with the possibility of spills from these liquid substances, can pose risks to both the environment and the well-being of construction personnel.

(iv) **Noise Pollution:** Throughout the construction phase, possible noise sources arise from the operation of construction related vehicle traffic, earth-moving machinery, heavy equipment, and activities such as pile driving, which can produce elevated levels of noise and vibrations. The quality of the acoustic environment might degrade due to the upsurge in vehicular traffic.

Ecological Environment:

(i) **Topography Geology & Soils:** Excavation for the building's foundation and basement can alter the natural topography of the site. The removal of soil and earthmoving activities can create slopes or depressions, changing the site's surface contours. Construction equipment and activities can compact soil,

altering its properties. Compaction can lead to changes in soil density and permeability. The movement of soil during earthwork and backfilling operations can change the distribution of soil masses and their stress conditions. Basement construction activities can disrupt groundwater flow patterns, potentially causing changes in the water table and affecting nearby wells and aquifers. Changes in topography and soil conditions can impact the stability of slopes in the surrounding area, potentially leading to landslides or slope failures. Construction activities can expose soil to erosion, which can lead to sediment runoff into nearby water bodies, impacting water quality.

(ii) Solid Waste Pollution: Construction generates a substantial number of debris, including concrete, wood, metal, plastic, and packaging materials. If not properly managed, these materials can contribute to solid waste pollution. Construction materials often arrive with packaging that can include cardboard, plastic, and other materials and can create packaging waste. Construction workers or contractors may dispose of waste improperly, such as by littering or illegal dumping. Poorly stored construction materials and waste can be susceptible to wind, rain, and theft, leading to pollution. Failure to recycle materials like concrete, asphalt, and metal can contribute to landfill waste. Biodiversity, Forest, and Trees. Our project is in an urban area and does not have any open water body to forest near it, so it will not hamper biodiversity. There is already an existing station building in our project area so it would not cause any trees to be cut down.

Socio-economic Environment:

(i) Worker Health and Safety: Construction activities can present significant health and safety hazards to construction personnel and site visitors, potentially resulting in severe injuries or fatalities. Those living close to the construction site and the construction workforce may be exposed to various health risk factors. These factors include physical elements like noise, dust, chemicals, construction materials, solid waste, wastewater, and diseases transmitted by vectors. Additionally, there are risks associated with human behavior, such as the spread of various Contagious diseases like Diarrhea, Dengue & Malaria. Construction activities like excavation and earthmoving in urban settings always entail safety risks. Workers must remain vigilant regarding potential occupational hazards associated with working at heights and excavations. Furthermore, the construction site can also contribute to road accidents due to increased construction-related traffic. The operation of heavy machinery and equipment on the construction site poses risks, including collisions, equipment failures, and accidents. Construction sites can be noisy, and exposure to high noise levels and vibration over time can lead to hearing loss and other health issues.

(ii) Construction Camp Management: Contractors will aim to hire construction workers from the local area whenever feasible. However, it is anticipated that

a portion of the workforce, particularly those with specialized skills, will need to be recruited from areas outside the immediate vicinity. Consequently, temporary housing will be arranged in nearby areas. And construction workers might stay in that temporary house if needed. Safety personnel must stay in that temporary housing. These construction worker campsites represent critical locations that can exert notable influences, including health and safety risks, on local resources and the infrastructure of neighboring communities. Inadequate infrastructure, including housing, water supply, and sanitation facilities, will place additional demands on local services and lead to subpar living conditions and health risks. Proper waste disposal is essential to mitigate environmental impacts.

(iii) Sanitation Hazard & Drainage Congestion: Construction sites require temporary facilities for sanitation, including toilets and wastewater disposal. If not managed properly, these facilities can discharge sewage and wastewater into nearby drains or open areas, leading to sanitation hazards. The construction of the planned building can alter the current drainage pattern by obstructing the natural flow conditions if the drainage system is not planned properly. There is a risk of disease transmission, which may worsen due to insufficient health and safety measures.

(iv) Socio-Economic Impact: The construction phase typically generates employment opportunities for a range of skilled and unskilled workers, including laborers, engineers, architects, and construction management professionals. Construction activities often boost local businesses such as suppliers of construction materials, restaurants, and accommodation providers, leading to increased economic activity in the area. Increased construction-related traffic can lead to congestion and delays, impacting the accessibility of local businesses and causing frustration among residents. But we plan to load and unload construction material during nighttime or off-peak hour, so it does not cause traffic congestion.

(c) Impacts During Operation:

Physio-chemical environment:

(i) Wastewater Generation & Disposal: The operational stage can result in a continuous influx of wastewater from the office building and leachate from the waste. This can put a strain on sewage systems and can foul odors within drainage systems if not managed effectively. Proper sanitation and wastewater management are essential for maintaining hygiene and preventing the spread of diseases. If wastewater is not adequately treated or managed, it can potentially lead to water pollution and environmental degradation if discharged into local water bodies. Inadequate waste management

infrastructure can lead to overflowing trash bins and litter within and around the station area, negatively affecting its appearance and cleanliness. Improper waste disposal can attract pests, such as rodents and insects, posing health hazards to workers and vendors. Incorrect disposal practices can lead to soil and water pollution, damage to local ecosystems, and harm to biodiversity.

Socio-economic environment:

(ii) Socio-Economic and Environmental Impacts: Operational building requires maintenance, security, and support staff, creating local job opportunities (as more vans are introduced and workers are needed to manage the compactors). The presence of this model STS will attract government officials and other investors to redevelop other transfer stations of this city. Eventually, the waste will reach the landfill and the ever-concerning problem of exceeding its capacity will end. It will improve the air, water and soil quality of the surrounding area and reduce the spread of diseases. Also, as we reduce waste volume, we can cover more areas for waste collection and the required number of transferring trucks will be lessened. Moreover, as we are changing the overall waste collection system by introducing the use of two different kinds of bin bags/ garbage bags, it will help to segregate them, collect them and treat them individually.

5.1.6. Mitigation Measures

a) Pre-Construction:

i. **Community Awareness:** Announcing the demolition and construction project beforehand is crucial to inform and prepare the local community for potential disruptions.

ii. **Traffic and Access Planning:** Construction activities must be scheduled at off peak hours (when congestion is relatively less), if road closures or diversions are necessary, plant them meticulously to minimize the impact on traffic flow, ensure that pedestrian pathways and crossings remain safe and accessible.

b) During Construction:

i. **Noise Pollution and Vibration:** Optimum site activities and site layout should be applied so as not to exacerbate existing noise levels. Building area boundaries, temporary noise barriers (such as wooden screens, heavy jute screens, heavy plastic screens etc.) can be constructed to protect the nearby areas from noise pollution. If temporary noise barrier is not feasible, then regulating construction activities must be regulated during off peak hours to minimize impact intensity.

ii. **Air Pollution:** During dry seasons, regularly spraying water on dusty surfaces is crucial to minimize dust generation, thereby reducing particulate matter emissions. Conduct quarterly ambient air quality monitoring throughout the construction period to assess the impact of construction-related emissions on the surrounding

environment. This monitoring helps identify any deviations from acceptable pollution levels and allows for timely corrective actions.

iii. **Waste Pollution:** Solid wastes collection system should include separation and collection of solid waste in the dustbins throughout the work site, construction yard and labor camp. The waste such as pieces of rods and wood, newspapers, containers etc. can be sold to the venders.

iv. **Community Awareness:** Establish open lines of communication with the local community from the project's inception, hold regular meetings to inform residents and businesses about construction plans, schedules, and potential disruptions.

v. **Soil pollution:** Mitigating soil pollution during construction involves site assessment, containment measures, erosion control, proper material handling, and adherence to regulations to prevent and minimize contamination.

vi. **Health and safety:** Health and safety measures for construction workers involve providing personal protective equipment, fall protection, hazard communication, machine safety, electrical safety, and proper training. Additional measures include scaffold safety, trench safety, fire and respiratory protection, prevention of heat and cold stress, first aid and emergency response plans, safety signs, noise control, regular inspections, fostering a safety culture, worker involvement, record-keeping, and regulatory compliance. These measures aim to protect workers from workplace hazards, ensure a safe working environment, and prevent accidents and injuries.

c) Post Construction:

i. **Drainage Congestion:** The adequate sizes of drains with holes should be provided and connected with the DWASA drain and maintained regularly.

ii. **Health & Safety**: Proper acoustic system in the walls of the building should be provided for minimizing of noise and thermal pollution. Adequate power capacity of the generator, installed in a covered room, should be provided. Fire Extinguisher, smoke detectors and water sprinklers, etc. should be installed in the building. Adequate lighting facilities and proper ventilation facilities for the air should be provided.

d) Environmental Management Plan:

1. Scope of EMP

The primary objective of the environmental monitoring is to record environmental impacts resulting from the project activities and to ensure implementation of the “mitigation measures” identified earlier to reduce adverse impacts and reduce negative impacts from specific project activities. In addition, monitoring plan should also include regular reviews of the impacts that cannot be adequately assessed before the start of the works, or which

arise unexpectedly, along with appropriate measures to mitigate any negative impacts and/or enhancing beneficial impact.

2. Work Schedule (Shown in Annexes B Table 5.4)

3. Monitoring Program

a) During Construction Phase (Shown in Annexes B Table 5.5 & 5.6)

The measured noise levels should conform to the national noise level standards and guidelines for different areas (residential, silent zone etc.) as applicable. Noise level during construction activities should be within the limits of exposure prescribed in the OSHA guidelines. The measured air quality should be within the limits of the national ambient air quality standards and guidelines for particulate matters in the air. The drinking water quality parameters should be within Bangladesh drinking water quality standards.

b) During Operation Phase

Environmental monitoring during operation phase must address the concerns of air and noise pollution as well as solid/liquid waste generated from the MCC facility. This would be mainly the responsibility of EMU. Specific monitoring requirements for the environmental issues during operation phase listed in **Annexes B Table 5.7 & 5.8**

c) Cost of Environmental Monitoring

Table: Method/basis of estimation of cost of Monitoring

Monitoring Item	Basis of Cost/Estimated Cost
Noise level	Prevailing rate (~Tk. 40,000/- per measurement at various locations)
Ambient Air Quality	Prevailing rate (~ Tk. 40,000/- per measurement)
Routine Drinking water quality parameters	Prevailing rate (~Tk. 12,000/- per sample)
Soil Quality (Heavy metals Pb, Cr, Cd)	Prevailing rate (~Tk. 6,000/- per sample)
Water sprinkling on aggregate	Latest PWD/LGED rate (if available)/A fixed rate per cubic meter of aggregate per day.
Protective gear	Contractor to quote rate of different items of works considering the provision of adequate protective gear for workers, in accordance to the conditions of contract, specified in the Tender Document.

This table shows the preliminary cost estimates for monitoring activities during construction assuming the duration of construction to be 12-month. The responsibility of monitoring is by the contractor and the contractor has to bear the cost. The Contractor will appoint a dedicated environmental health and safety (EHS) officer in order to oversee the mitigation activities carried out during construction and prepare/compile quarterly monitoring reports.

Table: Preliminary cost estimates for monitoring and mitigation activities during construction phase

Parameter/Activity	Frequency of activity	Cost in BDT (per month)	Cost in BDT (12 months)
Particulate Matter (PM_{10}, $PM_{2.5}$)	Once every month	40,000/- per each set of PM_{10} and $PM_{2.5}$ measurement	6,00,000/-
Noise Level (ambient and personal exposure)	Once every month (day and night)	40,000/- (per set of measurement)	6,00,000/-
Drinking water quality testing: pH, color, turbidity, total hardness, chloride, Total and Fecal coliform, Total Dissolved Solids, Arsenic, Iron, Manganese, Electrical Conductivity (salinity), Free Chlorine	Monthly	Tk. 12,000/- per set of measurement	1,44,000/-
Soil Quality (Heavy metals Pb, Cr, Cd)	Monthly	Tk. 6,000/- per set of measurement	72,000/-
Site Cleaning and preparation including providing necessary protective fencing and safety Measures with sign boards.	Periodic	Lump sum	5,00,000/-
Vegetation & Tree plantation around the site including fencing/ conservation/ maintenance for 2 years. Trees need to be replanted around the periphery of the proposed site at an interval of 10 feet @ Tk. 1500 for each tree.	Periodic	Lump sum	2,00,000/-
Providing safety gear package like hand gloves, eye protection-glasses, helmets, rubber shoes, light reflecting dress etc. for 40 sets @ Tk. 10,000 for each set	-	Lump sum	4,00,000/-
Drinking water container for workers including necessary-ceramic filters for providing drinkable water	-	Lump sum	1,00,000/-
Temporary Sanitary Latrine/- Septic Tank/ Portable Toilet: 2 nos. (1 no of Toilet for female	-	Lump sum	1,50,000/-

Parameter/Activity	Frequency of activity	Cost in BDT (per month)	Cost in BDT (18 months)
and 1 no of Toilet for male) @Tk. 50,000			
Waste disposal charge from site by outsourced cleaners	Daily or weekly collection of solid waste	40,000/-	4,80,000/-
Dust suppression measures like water sprinkling on aggregates/ unpaved roads, in and around the work site (Lump Sum). For road construction works cost of this item has been mentioned in road section.	Daily or weekly activities	Lump sum	4,20,000/-
Health and safety warning sign	-	Lump sum	30,000/-
Appointment of an Environmental Health and Safety officer for Environmental and Social Management and Monitoring during construction (salaried position)	-	50,000/-	12,00,000/-
Total			48,94,000/-

Notes: (1) The estimated costs for particular matter (PM) and noise level measurements as well as laboratory analysis for water samples are based on current rates charged by BRTC, BUET and the rates may vary. (2) During the construction phase, some monitoring may be carried out by the PMU through its own staff and equipment, if available, or can be out- sourced to a competent Contractor. Equipment for monitoring such as digital camera, sound level meter, GPS etc. may be purchased by Administration.

Table: Preliminary cost estimates for monitoring and mitigation activities during operational phase

Parameter/Activity	Frequency of activity	Cost estimate (per month)
CO, SO_X, NO_X, PM_{10}, SPM for generator stack emission	Monthly	Tk. 40,000/-
Treated water for drinking: pH, color, turbidity, total hardness, chloride, Total and Fecal coliform, Total Dissolved Solids, Arsenic, Iron, Manganese, Electrical Conductivity (salinity), Free Chlorine	Monthly	Tk. 20,000/-

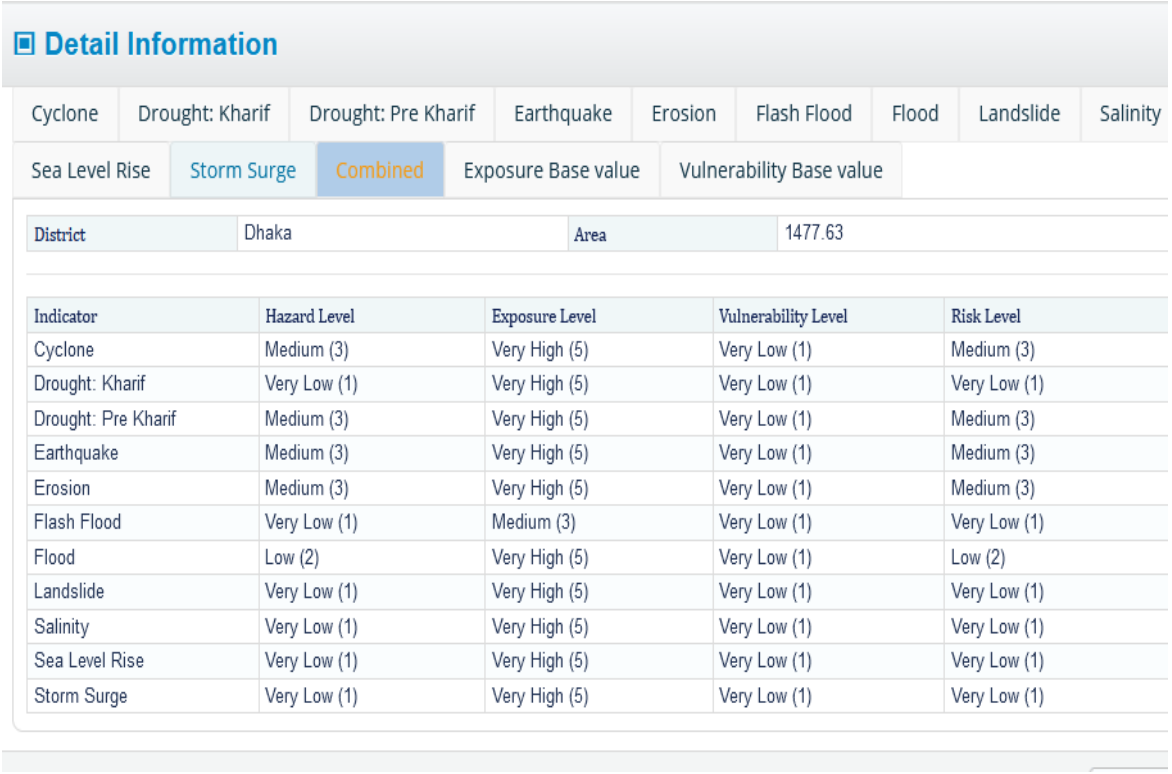
Noise level monitoring at surrounding areas (nearby residential and college Areas). Noise emissions from generator.	As and when required	Administration conducts monitoring and records positions by Cable Car Project- owned noise level meter and GPS (Cost of standard noise level meter 50,000/- and GPS is 10,000/-)
Solid waste management, recycling of wastes	Monthly	Tk. 10,000/-
Fire drills	Monthly	Contracted out to Fire Department or other competent contractors

Notes: The estimated costs for air emission and water quality analysis are based on current rates charged by BRTC, BUET for analysis of the parameters and the rates may vary. The monitoring may be out-sourced to a competent Contractor. Equipment for monitoring such as digital camera, sound level meter, GPS etc. may be purchased by administration.

5.2 Assessment of Disaster Resilience of the Project

It is seen from the **DRIP basic map** that the risk level associated with cyclones, landslide, salinity, earthquake, flood etc. within the project area are either medium or low or very low. The two most crucial natural calamities faced by Dhaka city are cyclones and earthquakes, and it Is important to have an emergency management plan to ensure the safety of the people. In the event of a cyclone or earthquake, the authorities will ensure the presence of rescue and emergency medical teams on the premises at all times. Emergency communication lines (i.e., satellite communication, landline, battery-powered radio) will be activated at selected locations to coordinate rescues within the area.

In the event of a disaster, locals and users will be guided to designated evacuation sites. These sites will be set up to accommodate large numbers of people and be fitted with basic utilities to ensure public safety and order.



Detail Information

Cyclone | Drought: Kharif | Drought: Pre Kharif | Earthquake | Erosion | Flash Flood | Flood | Landslide | Salinity

Sea Level Rise | Storm Surge | Combined | Exposure Base value | Vulnerability Base value

District	Dhaka	Area	1477.63

Indicator	Hazard Level	Exposure Level	Vulnerability Level	Risk Level
Cyclone	Medium (3)	Very High (5)	Very Low (1)	Medium (3)
Drought: Kharif	Very Low (1)	Very High (5)	Very Low (1)	Very Low (1)
Drought: Pre Kharif	Medium (3)	Very High (5)	Very Low (1)	Medium (3)
Earthquake	Medium (3)	Very High (5)	Very Low (1)	Medium (3)
Erosion	Medium (3)	Very High (5)	Very Low (1)	Medium (3)
Flash Flood	Very Low (1)	Medium (3)	Very Low (1)	Very Low (1)
Flood	Low (2)	Very High (5)	Very Low (1)	Low (2)
Landslide	Very Low (1)	Very High (5)	Very Low (1)	Very Low (1)
Salinity	Very Low (1)	Very High (5)	Very Low (1)	Very Low (1)
Sea Level Rise	Very Low (1)	Very High (5)	Very Low (1)	Very Low (1)
Storm Surge	Very Low (1)	Very High (5)	Very Low (1)	Very Low (1)

(Prepared by Bangladesh Government, this DRIP is available at http://drip.plancomm.gov.bd/BasicMap/MapViewer)

A study (Rajib Shaw et al) based on disaster assessment of Dhaka city measured the existing level of climate disaster resilience of Dhaka City Corporation by assessing the problems and potentialities in different sectors. UDRI measures urban disaster resilience by considering five dimensions: physical, social, economic, institutional and natural and shows resilience level in scores from 1-5 where 1 representing very poor and 5 the best. DCC's Overall UDRI (all ward average score of the 5 dimensions) scored 2.52, while the physical and social resilience are higher (3.37 and 2.53 respectively) than the other dimensions on average whereas natural and institutional resilience show low scores (2.37 and 2.11 respectively). As compared to an assessment done in 2010 when overall UDRI score of then Dhaka City Corporation (DCC) was 2.35, the city realized a significant improvement in physical and economic resilience, however, scores of social, institutional, and natural resilience dropped. The analysis suggests that mainstreaming of DRR, allocation of budget for DRR, environmental policy, and community

preparedness are key challenges to lead DCC towards more resilient and safer city. The Dhaka City Corporation (DCC) is prone to several natural hazards, including floods, waterlogging, earthquakes, fires, and heatwaves. The resilience of the city's natural dimension is assessed based on the intensity/severity and frequency of these hazards, as well as factors such as ecosystem services, land use, and environmental policies. The UDRI (Urban Disaster Resilience Index) scores indicate a higher intensity and lower frequency of natural hazards, suggesting that DNCC is more exposed to disaster events with low intensity but high frequency.

Due to its proximity to rivers, the city experiences annual flooding caused by elevated water levels, heavy rainfall, and tidal effects. Waterlogging is another significant issue attributed to factors like inadequate drainage systems, natural siltation, poor maintenance, and the disposal of solid waste into drains. Heatwaves during the summer season pose additional challenges. Moreover, the city faces an increasing number of fire incidents and thunder/lightning occurrences, with the government declaring lightning as a natural hazard in 2015. Additionally, DCC encounters difficulties in managing urban diversity. Even though our project area is relatively strong in terms of physical resilience, but it is lacking in terms of social and institutional resilience. Keeping these factors in mind, necessary DRR measures are suggested.

Disaster Risk Reduction (DRR) Measures:

DRR measures for cyclone:

1. Early Warning Systems:

a) Establish and maintain a robust early warning system to provide timely alerts about cyclones.
b) Ensure effective communication channels to disseminate warnings to the public.

2. Evacuation Plans:

a) Develop and regularly update evacuation plans for vulnerable areas in Dhaka City.
b) Identify safe shelters and establish evacuation routes, ensuring easy access for residents.

3. Community Awareness:

a) Conduct regular awareness campaigns to educate the public about cyclone risks and the importance of following evacuation orders.
b) Teach basic preparedness measures, such as securing loose items and having emergency kits.

4. Infrastructure Resilience:

a) Implement and enforce building codes that consider cyclone-resistant construction techniques.
b) Retrofit vulnerable structures to make them more resilient to cyclone impacts.

5. Drainage and Flood Management:

a) Improve and maintain drainage systems to reduce the risk of waterlogging during cyclones.
b) Implement flood management measures to control water levels in rivers and canals.

DRR measures for flooding:

1. Early Warning Systems:

a) Establish and maintain a reliable early warning system to provide timely and accurate flood alerts to residents.
b) Ensure that the public is well-informed about the meaning of different warning levels and knows how to respond.

2. Flood Preparedness Education:

a) Conduct regular public awareness campaigns to educate residents about flood risks, safety measures, and evacuation procedures.
b) Teach basic preparedness actions, such as storing emergency supplies and securing important documents.

3. Infrastructure Improvements:

a) Upgrade and maintain drainage systems, ensuring they can handle heavy rainfall and prevent waterlogging.
b) Invest in the construction and maintenance of flood barriers, embankments, and reservoirs to control water flow.

4. Land Use Planning:

a) Implement land use planning that considers flood risk, avoiding construction in high-risk areas and promoting sustainable urban development.
b) Ensure adherence to building codes that include measures to mitigate flood impact, such as elevated foundations.

5. Green Infrastructure:

a) Promote the development of green spaces, parks, and permeable surfaces to absorb rainwater and reduce surface runoff.
b) Plant trees and vegetation along water bodies to stabilize riverbanks and prevent erosion.

6. Stormwater Management:

a) Implement effective stormwater management systems, including the construction of retention basins and the use of permeable pavements.

b) Regularly clean and desilt drains and water channels to maintain their efficiency.

DRR measures for earthquake:

1. **Public Awareness:** Conduct regular public awareness campaigns on earthquake preparedness and response.
2. **Emergency Response Plans:** Develop and practice comprehensive emergency response plans at the city and community levels.
3. Evacuation Drills: Conduct regular evacuation drills to familiarize residents with safe evacuation routes and assembly points.
4. **Land Use Planning:** Incorporate earthquake risk considerations into urban planning to avoid construction in high-risk areas.
5. **Community Capacity Building**: Train communities in basic first aid, search and rescue techniques, and emergency response.
6. **Seismic Monitoring:** Invest in seismic monitoring systems to detect and assess earthquake risks.

Plan for business continuity-

The key response and recovery priorities are centered on the well-being of users and local businesses, with a focus on assessing functionality and post-disaster status. Structural, electrical, and mechanical components require thorough inspection to evaluate fatigue, corrosion, and excessive friction. In cases of direct impact on intersection structures, retrofitting and overhauling measures are essential to ensure strength capacity. Following events like cyclones, fires, or earthquakes, a comprehensive structural and geotechnical investigation is necessary to gauge damage and post-disaster residual capacity. Additionally, utilities such as the electrical grid, backup generator system, and emergency communication systems should be evaluated, with mock drills conducted to build confidence before reopening.

Section 6: Cost-Benefit Analysis

6.1 Financial Analysis

6.1.1 Introduction

An essential component of determining the sustainability and viability of development projects is economic and financial analysis. For the Secondary Waste Transfer Station in Lalbag, Dhaka, to be developed and improved into a model STS, it is essential to undertake a thorough economic and financial study in order to guarantee the best use of available resources and long-term success. In order to determine whether the project is financially feasible, the financial analysis focuses at a number of factors, including funding sources, cost estimates, and revenue generation. It examines operating costs and budgetary allotments to determine the project's long-term financial viability.

6.1.2 Project Duration

To make a model STS in Dhaka, not only the structural modifications is adequate but also the whole system of waste collection and treatment should be changed. So, in this project with construction a new structural outlook of the STS a well-established and practiced waste handling system at some developing countries like China, Inda etc. will be implemented. In this regard, the full construction of new STS at Lalbag required at least **12 months** and the expected operation period of this new STS will be at least **20 years**. For this reason, the full financial analysis is conducted over this period.

6.1.3 Project Fund Source

The waste handling process is a service work to the people of this metropolitan which is conducted by the local municipal, The South City Corporation, Dhaka. And this program is under the vigilance of the ministry of LGED (Local Government Engineering Development). So, this is a govt. project and the funding of any govt. project comes from the GoB (Government of Bangladesh) or any international organization’s financial support (ex. World Bank, ADB-Asian Development Bank).

6.1.4 Cost Breakdown

6.1.4.1 Land Acquisition Cost

The STS constructed on govt. land which own the city corporation. So, in this project land acquisition in not required. This project will only redevelop the station and make a model STS within that place. Although land acquisition is not required the land worth must be known to ensure no misuse of land in the project. The project land area is 4400 square ft or 6.11 katha (1 katha = 720 sq ft [1]). According to recent real estate business price of 5.5 katha land at Hazaribag near Lalbag is 40 crores [2]. So, the project land worth becomes 6.11*40/5.5 or around **44.5 crores**.

6.1.4.2 Preliminary Cost Estimate

The preliminary cost estimate of this project is conducted using PLAR method according to PWD Schedule of Rates 2022 (Revised). As the project lifetime is 20 years, to estimate the total life time cost inflation rate of these years should be take into consideration. The present

inflation rate of Bangladesh is **11.66%**[3], but it fluctuates with time. To make the overall calculation simple in this estimate, the inflation rate is assumed **12%** which will be fixed throughout this project life time.

[1] বাংলাদেশ-ভূমি-পরিমাপের-আদর্শ-এককসমূহ (minland.gov.bd)
[2] land for sale | pbazaar.com
[3] Bangladesh Bank (bb.org.bd)
[4] PART A: CIVIL WORKS, PWD SCHEDULE OF RATES 2022 (REVISED), 16th edition.

6.1.4.3 Preliminary Cost Estimate Schedule[4]

Building type : Non-Residential Building (Light industrial building)
Building Category : Special (2744 sft STS building, 477 sft office & staff room)
Type of structure : R. C. C. frame structure with a steel truss pitched roof
Soil type : Bearing capacity of soil = 3 ksf
Foundation : Shallow foundation, single storey
Plinth Area : 3362.6 sft (312.56 sqm) or (2832.2sft+530.4sft or 263.25sqm+49.3sqm)
Site : Lalbag, Dhaka (earth-quake zone-2)

1. SOIL INVESTIGATION

		Quantity/ Amount		Unit Rate (Tk.)		Total Amount (Tk.)
(i)	**Mobilization and demobilization of boring equipment**	1	site	TK. 14,702.00	/site	TK. 14,702.00
(ii)	**Soil Investigation**: LS or Actual cost (BH Nos. as primary, say)	5	nos	Tk. 33,871.00	/No	Tk. 169,355.00
				"A"	=	**Tk. 184,057.00**

2. CONSTRUCTION OF BUILDING

A. FOUNDATION COST

		Quantity/ Amount		Unit Rate (Tk.)		Total Amount (Tk.)
(i)	**Foundation cost**:From PLAR Table - 1, (For B.C.qa=3ksf) 263.25 sqm @ Tk. 12,362.00 per sqm	263.25	sqm	Tk. 12,362.00	/sqm	Tk. 3,254,296.50
(ii)	**Foundation cost:**From PLAR Table - 1, (For B.C.qa=3ksf) 49.3 sqm @ Tk. 9,915.00 per sqm	49.30	sqm	Tk. 9,915.00	/sqm	Tk. 488,809.50
				"B1"	=	Tk. **3,743,106.00**

B. SUPER STRUCTURE COST

I.	(i)	**STS building** (from PLAR Table-2) 263.25 sqm @ Tk. 33,933.00 per sqm	263.25	sqm	Tk. 33,933.00	/sqm	TK. 8,932,862.25
	(ii)	**Add extra cost for member weight** (M.W.) (from PLAR	263.25	sqm	Tk. 887.00	/sqm	TK. 233,502.75

		Table-3) 263.25 sqm @ Tk. 887.00 per sqm					
II.	(i)	**Office building and staff room** (from PLAR Table-2) 49.30 sqm @ Tk. 35,231.00 per sqm	49.30	sqm	Tk. 35,231.00	/sqm	TK. 1,736,888.30
	(ii)	**Add extra cost for member weight** (M.W.) (from PLAR Table-3) 49.30 sqm @ Tk. 591.00 per sqm	49.30	sqm	Tk. 591.00	/sqm	TK. 29,136.30
					"B2"	=	Tk. **10,932,390.00**
C. ADDITIONAL SUPER STRUCTURE COST							
III.	Add extra super structure cost 3% for wind (other than coastal area) & earth quake load resisting structure: 3% on Tk. 10,776,808.85		Tk. 10,776,808.85		3%	/sqm	Tk. 323,304.27
IV.	Extra cost for **Rooftop & LC** (from PLAR Table-2): 49.30 sqm @ Tk. 3,629.00 per sqm		49.30	sqm	Tk. 3,629.00	/sqm	Tk. 178,909.70
V.	Extra cost for Rooftop R.C.C **water tank** (from additional cost chert item-4): 220 gal. @ Tk. 196.00 per gal.		220	gallon	Tk. 196.00	/gal	Tk. 43,120.00
VI.	Supply, fabrication and installation of **Hot-rolled W & I section** (from Structural steel works, sheet roofing and safety canopy chart item-10.4): 32913.80 kg @ Tk. 131.00 per kg		32913.80	kg	Tk. 131.00	/kg	Tk. 4,311,707.80
VII.	Supply, fabrication and installation of **Hot-rolled channel & angle section** (from Structural steel works, sheet roofing and safety canopy chart item-10.6): 10249 kg @ Tk. 129.00 per kg		10249	kg	Tk. 129.00	/kg	Tk. 1,322,121.00
VIII.	Supply, fabrication and installation of **corrugated galvanized iron sheet** (from Structural steel works, sheet roofing and safety canopy chart item-10.21): 310 sqm @ Tk. 578.00 per kg		310	sqm	Tk. 578.00	/sqm	Tk. 179,180.00
IX.	Supply, fabrication and installation of **anchor bolts** (from Structural steel		4316.30	kg	Tk. 192.00	/kg	Tk. 828,729.60

	works, sheet roofing and safety canopy chart item-10.1): 10% of total kg steel or 4316.30 kg @ Tk. 192.00 per kg					
x.	Extra cost for **safety net & canopy**	150.59	sqm	Tk. 51.00	/sqm	Tk. 7,680.09
				"B3"	=	Tk. **7,194,753.00**
		Sub Total, "B" =(B1+B2+B3)			=	Tk. **21,870,249.00**
OTHER BUILDING COST						
3.	**Internal Sanitary & Water Supply** (from additional cost chart, item-6): 312.56 sqm @ Tk. 2,131.00 per sqm	312.56	sqm	Tk. 2,131.00	/sqm	Tk. 666,065.36
4.	**Internal Electrification** (from additional cost chart, item-7): 312.56 sqm @ Tk. 2,140.00 per sqm	312.56	sqm	Tk. 2,140.00	/sqm	Tk. 668,878.40
5.	**External Water Supply**: Construction of underground reservoir (from additional cost chart, item-9-i-a): 550 gal @ Tk. 117.00 per gal	550	gallon	Tk. 117.00	/gal	Tk. 64,350.00
	Supplying and installation of pumps: 1.5 HP water pump @ Tk. 10,500.00 with 15% supplying & installation cost	1	No.	Tk. 10,500.00	/No.	Tk. 12,075.00
6.	**Construction of Compound drain**: (from additional cost chart item-15-i) 64 meter @ Tk. 3,495.00 per meter	49	meter	Tk. 3,495.00	/m	Tk. 171,255.00
7.	**Boundary wall** in RCC Frame, 1.80 m in height, level difference between FGL and EGL up to 0.45m. 66 m wall @ Tk. 15,129.00 per meter.	66	meter	Tk. 15,129.00	/m	Tk. 998,541.00
8.	**Fire Fighting**: Install 6 fire extinguisher of 5kg CO2 @ Tk. 4,200.00	6	No.	Tk. 4,200.00	/No.	Tk. 25,200.00
9.	**Soil Improvement**: sand filling (from Excavation, Filling & site development and Palisading chart item-2.10.2) 124.69 cum @ Tk. 1,167.00 per cum	124.70	cum	Tk. 1,167.00	/cum	Tk. 145,525.00
				"C"	=	Tk. **2,751,890.00**
		Sub Total, "O" =(A+B+C)			=	Tk. **24,806,196.00**

As this estimate is done using PWD Schedule of Rates 2022 (Revised), the total cost should be converted into **Present Value of 2024 (Present Value @ 12% inflation rate on O)**					**"P" =**	Tk. **31,116,892.26**
9.	Quality Assurance, Material Sample Collection & Testing (1% of P)	**"Q"**			=	Tk. 311,168.92
10.	**Legal and Administrative Expense**: Design & Consultancy, supervision. (4% of P)	**"R"**			=	Tk. 1,244,675.70
11.	**Contingency** (5% of P) or Actual need	**"S"**			=	Tk. 1,555,844.61
12.	**Environmental Monitoring Cost:** During construction environmental & social management and monitoring.	**"X"**			=	Tk. 4,849,000.00
		Sub Total, "T" =(P+Q+R+S+X)			=	Tk. **39,077,583.00**
12.	Cost of **Land**	**"U"**			=	Tk. 0.00
13. Equipment Cost						
I.	**2 Waste Compactor** from Sumac Auto Recycling Equipment Co Limited (Jiangyin): (including purchasing, shipping/ transportation and installation) 2 compactor @ 18000.00 + 70.00 USD[5] or Tk. 2,300,000.00 per compactor	2	No	Tk. 2,300,000.00	/No	Tk. 4,600,000.00
II.	**Two Compartment Van**: Two compartment steel paddle driven van. 30 Van @ Tk. 40,000.00[6] per van	30	No	Tk. 40,000.00	/No	Tk. 1,200,000.00
III.	**Waste Container**: 12 ft length, 6 ft wide & 5.5 ft height. 8 container @ 600.00 USD[7] or Tk. 71,400.00 per container.	8	No	Tk. 71,400.00	/No	Tk. 1,319,040.00
IV.	Office Equipment: 2 Tables, 6 wooden fixed Chair, 2 Revolving Chair, 2 Shelf and 1 bed.	Tk. (10,000*2+3,000*6+6,000*2+24,000*2+8,000)				Tk. 106,000.00
		Sub Total, "Y" =				**Tk. 7,225,040.00**
		Grand Total, "V" =(T+U+Y)			=	**Tk. 46,302,623.00**

[5] waste tire baling machine, buy waste compactors on China Suppliers Mobile - 143542174 (goldsupplier.com)

[6] China to Bangladesh Shipping: Cost and Import Tariff (airsupplycn.com)

[7]https://yzhero88.en.made-in-china.com/product/dZNfwjqyUbhV/China-Gantry-Bin-Garbage-Skip-Bin-Heavy-Duty-Metal-Commercial-Dustbin.html?pv_id=1i78gk6uo501&faw_id=1i78gmq5refa

6.1.4.4 Maintenace Cost

Maintenance cost includes all forms of utility cost, repairing cost, environmental monitoring cost after construction and miscellaneous cost occurring throughout the year. The cost is calculated per year and estimated for the life time of this project. The monthly maintenance cost is approximately **Tk. 500,000**. So, yearly maintenance cost is approximately **Tk. 6,000,000.00**.

6.1.5 Revenue Breakdown

6.1.5.1 Direct Revenue

		Quantity/Amount		Unit Rate (Tk.)		Total Amount (Tk.)
I	**Reuse/Recycle:** Around 10% of the total waste is reusable and recyclable (paper, plastic bottle, steel can etc.). Yearly around 200 ton @ Tk. 25,000.00 per ton.	200	ton	TK. 25,000.00	/ton	TK. 5,000,000.00
II	**Waste Collection Bill**: A fixed monthly charge/ bill will be collected from every apartment, institution, shop, restaurant and so on. Tk. 200 per house & shop, Tk. 500 per institution & restaurant per month.	12	month	Tk. 60,000.00	/month	Tk. 720,000.00
				"A"	=	**Tk. 5,720,000.00**

6.1.6 Financial Analysis Summary

As, 5% increment in govt. job every year, the estimated cash flow are designed 5% increment in every 2 years. The cash flow diagram of this project up to 20 years (cashes are in Lac. BDT and time are in year) are presented below:

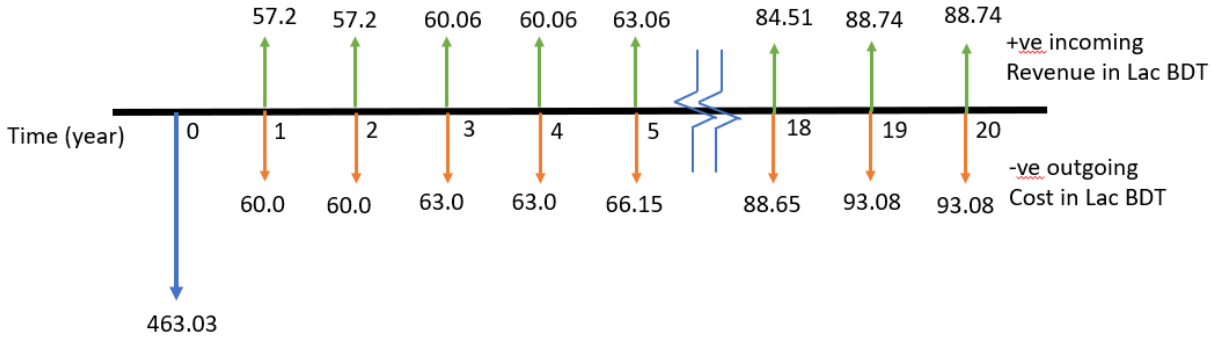


Fig-6.1: Cash-Flow Diagram of the project throughout the project life time

The Net present Value (NPV), Internal Rate of Return (IRR) and Benefit-Cost Ratio (B/C) of this project from this cash flow diagram for its life time are calculated using discount rate of 12%. Total details calculation is presented in **Annexes-C Table-6.1.**
NPV = ∑PV Revenue - ∑PV Cost = Tk. -48,716,000.00

IRR = -0.2%

B/C = 0.73

6.2 Economic Analysis

Construction & Maintenance Cost

To get economic cost from financial cost, we are using a standard conversion factor of **0.8.**
From the financial analysis the total construction cost is BDT 46,302,623.00
Total Construction Cost per year for Economic Analysis= 46,302,623.00*0.8= **37,04,2098.40 BDT**
Maintenance cost is taken 3% of the construction cost (conservatively)
So, Maintenance Cost = (370.42)*0.03= **11.112 lacs BDT**

Benefits

Benefits are quantified at the project's conclusion and on an ongoing basis afterward to Determine how well it met its main goals and how cost-effectively. After the project is Completed, reports and surveys are used to determine its advantages. However, the physical and social environment may change over a long period of time, making it challenging to discern between impacts and accomplishments. Corrective actions taken during implementation might keep accruing benefits on track. Implementation delays brought on by outside factors, changes in the global economy, and adjustments to policy on loans and systems are a few examples of Such factors that may be out of the Government of Bangladesh's control.
A secondary waste transfer station project can offer several socio-economic benefits to a community. These benefits can be categorized into environmental, economic, social, and public health impacts:

1. Economic Benefits:

A) Job Creation: Construction, operation, and maintenance of the facility create employment opportunities in the local community, ranging from skilled to unskilled labor.
Assume the salary of 6 officer and 30 worker in a year = (25*15,000+4*42,000)*12= 66 lac BDT
Assume 80% of their salary benefits the economy So benefit= 66* 0.8= **52.8 lac BDT/Year**
B) Cost Efficiency: By optimizing waste collection and transportation, the project can reduce the overall costs associated with waste management, which can translate to lower waste management fees for households and businesses. Assume transportation cost saved by 7000 BDT(Average renting cost of 5 ton truck for a day in Dhaka is 5000-10000 BDT)
Considering conversation factor 1, total benefit =7000*365*1= **25.5 lac BDT**
C) Economic Development: A well-managed waste transfer station can attract other related industries, such as recycling companies, thereby promoting local economic growth.
D) Resource Recovery: Secondary waste transfer stations often include sorting facilities that enable the recovery of recyclable materials, which can be sold, creating additional revenue streams.

2. Environmental Benefits:

A) Reduction in Illegal Dumping: Providing a designated and accessible place for waste disposal reduces the incidence of illegal dumping, which can harm local environments and

water sources.

B) Improved Waste Management: A secondary waste transfer station can facilitate better waste segregation, leading to increased recycling rates and reduced landfill use, which benefits the environment.

C) Lower Carbon Emissions: By consolidating waste before final transport, the project can reduce the number of trips needed, thereby cutting down on fuel consumption and emissions from waste collection vehicles.

Air Quality Monetization According to the article published by Food and Agriculture Organization of The UN at 2001, Average reforestation could contribute up to 10 tons of carbon per hectare per year absorption in tropical area. Carbon credits in 2024 cost about $80 per metric ton of CO2 or equivalent GHG emissions . However, carbon pricing can fluctuate greatly with demand.

So, the Carbon credit we could acquire from our project in about 2.4 credit per year which could generate an income of (2.4*80*119) BDT. 23000 per year.

3. Social Benefits:

A) Community Health and Safety: Proper waste management reduces exposure to hazardous waste, minimizing the risk of disease and other health issues in the community.

B) Enhanced Public Services: The project can improve the overall cleanliness and hygiene of the area, enhancing the quality of life for residents.

C) Community Awareness: Such projects often include educational initiatives about waste management, encouraging responsible behavior among residents.

4. Public Health Benefits:

A) Reduced Disease Transmission: Proper waste containment and handling can significantly reduce the spread of diseases that are often associated with poor waste management.

B) Cleaner Living Environments: By efficiently managing waste, the station can help maintain cleaner public spaces, reducing the breeding grounds for pests and vermin.

It will indirectly saves the medical expenses related to respiratory and skin diseases of a family in that localities. The mean healthcare expenditures for inpatient and Outpatient out-of-pocket expenditure were BDT 1874 and BDT 1120,Respectively per month in a family of 3. Interpolating the expenses only for respiratory and skin treatment costs, BDT 500/month/family, the save of medical expenses of 650 family in the locality is = (500*650)*12= **46.8 lac BDT/year c**onsidering conversation factor 1

5. Urban Development Benefits:

A) Land Use Optimization: Secondary waste transfer stations can be strategically located to serve growing urban areas, ensuring that waste management infrastructure keeps pace with population growth.

B) Aesthetic Improvement: Proper waste management infrastructure prevents waste accumulation in public areas, contributing to the overall aesthetic appeal of a community, which can enhance property values.

So the total benefit= 52.8+25.5+0.23+46.8= 125 lac BDT/year

The Economic Net present Value (NPV), Internal Rate of Return (IRR) and Benefit-Cost Ratio (B/C) of this project from this cash flow diagram for its life time are calculated using discount rate of 12%. Total details calculation is presented in **Annexes C Table 6.2.**

NPV = ∑PV Revenue - ∑PV Cost = BDT 512 lac

IRR = 32%

B/C = 3.81

Interpretation of the NPV, IRR and B/C ratio,

Net Present Value (NPV): It serves as a key financial tool in evaluating investments and Capital projects. It helps gauge the current value of future cash flows, considering the fact that Money received today holds more value than money received in the future, owing to its Potential for earning returns. This allows for a fair comparison of cash Flows occurring at different points in time, offering a clear-eyed view of an investment's Profitability. As our project's net present value is positive, it indicates that the projected earnings (in present value terms) exceed the initial costs and outflows. In other words, the investment is expected to generate more value than it costs, making it financially worthwhile. A positive NPV suggests that the project or investment will add value to the firm or investor, and it is generally considered a sign that the investment is a good decision.

Benefit-Cost Ratio (BCR): It plays a crucial role in analyzing the costs and benefits of a Project, helping determine its economic feasibility. It measures the relative worth of a project By comparing the present value of all expected benefits to the present value of all associated Costs. This ratio offers a clear, straightforward way for decision-makers to assess how Efficiently and effectively a project will deliver results. As our project's BCR is 3.82 which is above 1 indicates that the Benefits outweigh the costs, signaling that the project could be economically justified. On the Other hand, it means Benefits will be 3.81 times than the costing at the end of project life.

Economic Internal Rate of Return (EIRR): A specialized technique for assessing a project's Economic viability is the Economic Internal Rate of Return (EIRR), particularly for initiatives With large societal or economic ramifications. In Essence, it determines the maximum annual rate of return that an investment could attain if all Of its advantages were acknowledged and appreciated equally from an economic and societal Standpoint. Our project having a IRR 32% means the maximum discount rate that an investor can attain if all thing works according to the plan.

6.3 Conclusion

The NPV of this project is negative which indicates that the project is not beneficial. Furthermore, the IRR is less than the discount rate 12%, which also indicates that the project is not profitable in the financial return consideration. And the B/C ratio is less than 1, which also refers that there is less financial benefit that financial expenditure. Though this is a service program, the actual viability of this project depends on the economic and socio-economic analysis of the project rather financial analysis.

Section 7: Human Resources and Administrative Support Analysis (During Implementation and Post Implementation of the project)

(a) Project Team Structure and Outsourcing:

- The project will benefit from a team with diverse expertise, including Geotechnical, Environmental, Structural, and Transportation majors.
- Certain specialized roles may be outsourced during the operational phase, with potential integration into the revenue budget during maintenance.

(b) Institutional Analysis:

- The project team possesses the necessary skills for effective structural design. But need an Architect for architectural design and construction team for effective project implementation.

(c) Project Oversight:

- A Project Steering Committee (PSC) and a Project Implementation Unit (PIU) will be established for comprehensive supervision.

(d) Operation Phase Manpower Strategy:

- During the operation phase, maintenance services' manpower may be outsourced.
- Financial packages for the technical unit and outsourced staff will adhere to government scale and public procurement rules, respectively.

(e) Overall Project Timing and Organizational Capacity:

- The project timeline aligns with organizational capacity, ensuring a seamless and well-supported implementation.

Required manpower to be deployed for the project during implementation period:

Role	Number of Personnel	Phase of Implementation	Responsibilities
Project Manager	1	Entire Project	Overall project management, coordination, and reporting.
Architects	1	Design & Planning	Designing building plans andensuring compliance with regulations.
Civil Engineers	3	Construction	Overseeing construction activities and ensuring structural integrity.

Mechanical Engineers	2	Construction & Installation	Installing HVAC systems and ensuring mechanical systemsmeet specifications.
Electrical Engineers	1	Construction & Installation	Electrical wiring, lighting, andpower systems installation.
Plumbers	4	Construction	Installing and maintaining plumbing systems.
Site Supervisors	2	Construction	On-site management, safety enforcement, and progress monitoring.
Quantity Surveyors	2	Procurement & Monitoring	Estimating costs, managing budgets, and procurement oversight.
Health & Safety Officers	2	Entire Project	Ensuring health and safety regulations are followed on-site.
Administrative Staff	2	Entire Project	Handling documentation, scheduling, and communications.
Quality Control Inspectors	2	Construction	Inspecting work quality and adherence to project specifications.
Contractors/Subcontractors	Variable	Construction	Specialized tasks (e.g., finishing works, landscaping).

Required manpower to be outsourced for the project during operation:

Role	Number of Personnel	Responsibilities
Facility Management	1-2	Oversee operations and maintenance.
Security Personnel	2-3	Security and surveillance.
Equipment Technicians	3-4	Maintenance of compactors.
Waste Management Staff	30-32	Collection and Disposal of waste.
Administrative Support	3-4	Scheduling and administrative tasks.

Section 8: Institutional and Legal Analysis

8.1 Relevant Institutional Framework Analysis:

1. **Ministry of Local Government:** Any kind of development or system change activities at the community level is under this ministry. As we are bringing major change in the collection and transportation system, this institution will surely be involved.
2. **Public Works Department (PWD):** This government department may be involved in theconstruction and renovation work, especially if it involves public infrastructure
3. **Dhaka South City Corporation (DSCC):** Responsible for municipal services in the area,including waste management, which will be crucial during and after the renovation. For changing the system from community level, some adjustment must be made in DSCC guideline like-

- **Policy Adjustments:** Policy adjustment is needed regarding collection and transportation system changing.
- **Pre-Implementation Adjustments:** No adjustments are required before the project is implemented, ensuring a smooth transition from the existing STS to the modern STS.

4. **Environmental Regulatory Authorities (Department of Environment - DoE):** As theredevelopment work involves significant construction, waste generation, or environmental impact, approvals from DoE may be required. The approvals are-

- **Positional Clearance Report** (Utility Services not allowed without Positional Clearance Report. Also, Positional Clearance Report must be renewed every 2 years at least before 30 days of expiry)

(২) হলুদ শ্রেণির শিল্প প্রতিষ্ঠান বা প্রকল্পের অবস্থানগত ছাড়পত্র অথবা পরিবেশগত ছাড়পত্রের মেয়াদ হইবে উহা ইস্যুর তারিখ হইতে ২ (দুই) বৎসর যা ২ (দুই) বৎসর অন্তর অন্তর নবায়নযোগ্য হইবে।

২১। **অবস্থানগত ছাড়পত্র নবায়ন পদ্ধতি।**—(১) সকল শ্রেণির শিল্প প্রতিষ্ঠান বা প্রকল্পের অবস্থানগত ছাড়পত্রের মেয়াদ শেষ হইবার কমপক্ষে ৩০ (ত্রিশ) দিন পূর্বে উহা নবায়নের জন্য সংশ্লিষ্ট শিল্প প্রতিষ্ঠান বা প্রকল্পের উদ্যোক্তাকে অবস্থানগত ছাড়পত্র নবায়নের জন্য ফরম-৪ পূরণ করে তফসিল-৭ এ উল্লিখিত ফি প্রদানপূর্বক বিধি ৭ অনুযায়ী সংশ্লিষ্ট কার্যালয়ে আবেদন করিতে হইবে।

- **Environmental Assessment Report (**Experimental Production not allowed without Environmental Assessment Report)
(Collected from ECR- 2023)

5. **Governance Issues**: There are no governance issues to be addressed that may affect implementation as we are maintaining the laws for buffer distance for sensitive area (at least 50 m distance in general and 10 m distance for heat and noise pollution) **(Annexes B Fig 8.1)**
6. **Cross-Cutting Issues:** There are no mentionable challenges related to cross-cutting issues to be addressed.

8.2 Legal Analysis

1. **Public Procurement Act, 2006:** The procurement process for the STS is transparent, competitive, and adheres to legal standards.
2. **Building Construction Act:** Provides regulations and standards for building safety, design, and construction practices relevant to the renovation.
3. **Environment Conservation Act, 1995:** Regulates environmental impact assessments and waste management to ensure the renovation complies with environmental protection standards.
4. **Labor Act, 2006:** This Act sets out the minimum standards for working conditions, wages, and employee benefits in Bangladesh. The project must comply with the Act's provisions to ensure fair treatment of all workers involved in the project.
5. **Bangladesh National Building Code (BNBC):** Offers technical guidelines for building design and construction, ensuring that the redevelopment meets safety and quality standards.
6. **Fire Prevention and Fire Fighting Act, 2003**: Ensures that fire safety regulations are adhered to in the building's design and renovation to protect occupants and property.
7. **Public Health Act 1994:** The redevelopment of the STS complies with public health regulations, including standards for sanitation, health safety, and disease prevention. Guidelines must be followed for the management and disposal of waste, crucial for maintaining health and safety standards in the renovated facility.
8. **Water Supply and Sanitation Act, 1996**
9. **Noise Pollution Rules, 2006**
10. **Air Pollution Control Rules, 2022**

Section 9: Risk (Uncertainty) and Sensitivity Analysis

9.1 Risk Analysis

9.1.1 Construction Risks

a. Delay in Construction

i) **Risk:** Unforeseen delays due to weather, labor strikes, or supply chain issues.

ii) **Mitigation:** Develop a detailed project schedule with contingencies, establish Relationships with multiple suppliers and include buffer periods.

b) Quality Control Issues

i) **Risk:** Potential issues with concrete and steel quality or structural integrity.

ii) **Mitigation:** Implement rigorous quality control measures, including regular inspections and testing of materials.

c) Safety Hazards

i) **Risk:** Accidents or safety violations on the construction site.

ii) **Mitigation:** Enforce strict safety protocols, provide regular safety training, and ensure compliance with safety regulations.

9.1.2 Environmental Risks

a. Pollution and Waste Management

i) **Risk:** Potential pollution from construction activities or improper waste disposal.

ii) **Mitigation:** Develop and implement a comprehensive environmental management Plan, including waste reduction and proper disposal procedures.

b) Impact on Local Ecosystem

i) **Risk:** Disturbance to local wildlife or natural habitats.

ii) **Mitigation:** Conduct an environmental impact assessment and work with ecologists to Minimize disruption. Implement measures to protect local flora and fauna.

c) Water Pollution

i) **Risk:** Runoff from construction materials or equipment could contaminate the river.

ii) **Mitigation:** Use silt fences and other barriers to control runoff, and regularly monitor Water quality during construction.

9.1.3 Social and Economic Risks

a) Disruption to Local Communities

i) **Risk:** Construction may temporarily disrupt traffic and local businesses.

ii) **Mitigation:** Develop and communicate a traffic management plan to minimize Disruptions, and keep local businesses informed and involved in the planning process.

b) Land Use Conflicts

i) **Risk:** Potential disputes over land use or property acquisition.

ii) **Mitigation:** Engage with stakeholders early and ensure clear communication and fair Compensation for any land acquired.

c) Economic Impact

i) **Risk:** Unanticipated costs or financial constraints affecting the project budget.

ii) **Mitigation:** Establish a robust financial plan with contingency funds and regularly review and adjust the budget as needed.

9.1.4 Technical Risks

a) Design Flaws

i) **Risk:** Errors or inadequacies in the design.

ii) **Mitigation:** Ensure thorough design reviews and peer evaluations, and use Experienced engineers to oversee the design and construction process.

b) Construction Challenges

i) **Risk:** Difficulties in implementing the proposed design, especially given the local Conditions.

ii) **Mitigation:** Conduct a thorough site analysis and engage experts familiar with Steel concrete construction in similar environments.

c) Structural Integrity

i) **Risk:** Potential issues with the long-term durability of the structure.

ii) **Mitigation:** Use high-quality materials and construction techniques, and plan for regular maintenance and inspections.

9.1.5 Regulatory and Compliance Risks

a) Permitting Delays

i) **Risk:** Delays in obtaining necessary permits or approvals.

ii) **Mitigation:** Start the permitting process early and maintain regular communication with regulatory agencies to ensure all requirements are met.

b) Compliance Issues

i) **Risk:** Failure to comply with local, national, or international regulations.

ii) **Mitigation:** Stay informed of all relevant regulations and standards, and ensure all Project activities are compliant through regular audits.

9.1.6 Public Perception and Acceptance

a) Community Opposition

i) **Risk:** Public resistance or opposition to the project.

ii) **Mitigation:** Engage with the community through public consultations, address Concerns transparently and highlight the benefits of the project.

b) Aesthetic Concerns

i) **Risk:** The final appearance of the structure may not meet aesthetic expectations.

ii) **Mitigation:** Involve architects and designers in the planning phase to ensure the STS's design aligns with aesthetic goals and community preferences.

Chapter 9.2: Sensitivity Analysis

The project benefits and costs were estimated for an analysis period of 50 years although the useful life of such projects spans well over hundred years with proper maintenance. Although future forecast is made on the premises presumed most suitable at the time of estimation, the actual benefit could still be either larger or smaller than estimated. Technical progress beyond assumption, occurrence of unforeseen technical objection, and fluctuation in the cost of construction material related to foreign exchange may be expected. If these unpredicted cases happen, figures from the economic analysis will also change. For these unpredicted cases, a sensitivity study was carried out by varying the projected benefit and the project cost between -10% and +10%.

Sensitivity Check					
Case	**Sensitivity Scenario**	**NPV (lacs in BDT)**	**EIRR(%)**	**BCR**	**Comment**
1	No Change in Project Delivery	512	32%	3.81	OK
2	10% Increase of Construction Cost	501	29%	3.73	OK
3	10% Increase of Maintenance Cost	495	27%	3.71	OK
4	10% Decrease of Salary Contribution to Benefit	487	26%	3.67	OK
5	10% Decrease of Transportation contribution	503	28%	3.79	OK
(2)+(3)+(4)+(5)	10% Increase of Construction Cost, 10% Increase of Maintenance Cost, 10% Decrease of Salary Contribution to Benefit, 10% Decrease in transportation benefit	473	25%	3.51	OK

As the project is not generating any revenue it is rarely sensitive to any substantial change in any costing or income. However, if all the cost is increased the NPV is significantly changed. Similarly, the NPV of the project is also critically sensitive to the construction duration.

The economic NPV Is almost critically sensitive to all types of changes in economic benefits and costing. However, The NPV and EIRR satisfies the conditions for our project to be economically benefitted even if 10% of cost is increased or 10% of the benefits are decreased. Even in the worst case scenario, the EIIR value reduces from 32% from 25%, which is not that amount of significant. So our project is not critically sensitive to the worst cases possible.

Section 10: Alternative/Options Analysis

Alternative Analysis is conducted based on the following matrix:

1. Cost
2. Technology Required
3. Aesthetic and Social Acceptability
4. 4. Material availability

Criteria	RCC frame structure	Steel structure
Cost	The construction cost of this structure is less than steel structure	The cost of construction of steel structure is 38.19% higher when compared to RCC structure.
Time of construction	The construction time of this structure is greater than steel structure due to labor-intensive construction	Steel structure saves 18.66% in construction time compared to RCC structure
Technology	RCC structure is mainly a concrete structure that contains steel bars. Due to the high compressive strength of concrete and the ease of steel placement onsite, it can perform well. Flexible size and shape of heavy member is used which is normally cast in place. Concrete batching plant, concrete pump, concrete mixer, and concrete vibrator are used which is easily available. Maintenance is required rarely due to high durability in extreme weather conditions.	Steel structure is a metal structure with high tensile strength contained components are connected to each other to carry load. Predefined size and shape of light members are used which are fabricated in factory and assembled in place. Delivery trucks, truck cranes, hoist slings, and scaffolds are used to construct this structure which is not easily available also needs skilled labour to handle the equipment. Frequent Maintenance is required to prevent corrosion.
Aesthetic & Social Acceptance	Reinforced concrete structures are socially accepted for their traditional aesthetic appeal and perceived stability. They	Steel structures offer a modern aesthetic with sleek lines and contemporary designs. They are socially accepted

	blend well with various architectural styles and are favoured for their durability	in urban environments and often preferred for their bold and innovative architectural statements.
Material Availability	Significant constituents of RCC Materials are readily available in the market. However, some constituents are imported.	Materials are mostly imported from other countries; the steel industry is still growing.

Criteria	**In Front office room**	**Back side office room**
Improved Accessibility	Placing the office at the front ensures easier access for staff, visitors, and supervisors, reducing unnecessary movement through the station. This improves efficiency and workflow.	A back-located office requires staff, visitors, and supervisors to traverse through the operational work areas, which can cause disruptions and delays, especially during peak operational hours. This added movement can waste time and reduce workflow efficiency
Better Visibility and Control	A front-positioned office allows managers and staff to have a direct line of sight to the station's entrance and the work area. This helps in monitoring operations more effectively and addressing issues promptly.	With the office in the back, it is difficult for supervisors to have a clear view of the entry point and the overall station. This limits their ability to monitor incoming and outgoing activities and respond to issues quickly.
Enhanced Security	By placing the office at the front, security can be better managed since access control points like the gate can be monitored directly, reducing the risk of unauthorized entry.	When the office is at the back, controlling access to the station becomes more challenging, as staff will not have immediate visibility of the entry points. This could lead to unauthorized access or safety concerns.
Emergency	In the event of an	In emergencies, navigating

Responsiveness	emergency, a front-located office provides quicker access to exits or emergency vehicles, ensuring faster response times compared to a back-located office.	through the station or operational areas to reach the front can be hindered by obstacles, debris, or congestion, making it harder for staff to exit or for emergency personnel to reach the office quickly.

In conclusion, Reinforced Concrete (RCC) frames offer several advantages over steel frames, particularly in terms of durability, fire resistance, and maintenance. RCC is more robust in resisting extreme environmental conditions and requires less frequent maintenance, making it cost-effective in the long run. Additionally, RCC frames are ideal for projects requiring significant structural strength, especially in areas with seismic activity, as they absorb and dissipate energy more efficiently than steel.

Similarly, having an office positioned at the front of the structure ensures better accessibility, operational oversight, and safety. A front-located office improves workflow efficiency by reducing unnecessary movement through the station, enhances supervision by providing direct visibility of operations, and allows for quicker emergency responses. Compared to a back-side office, it eliminates the delays and inefficiencies that come from obstructed views and restricted access, making it the superior choice for station design.

Section 11: Recommendation and Conclusion

Based on data analysis and conceptual calculations, the fundamental design considerations and other determining factors have been identified. A thorough analysis and discussion of these considerations have already been carried out. Below is a summary of the recommended findings:

1. Worst Case consideration: Due to political unrest in Dhaka, there is a possibility for a temporary delay of the STS redevelopment project. To overcome this issue, the project timeline is to be Maintained properly. There is a chance of an increase of project cost due to natural calamities and other Unforeseen conditions. So, the budget should be flexible so that some deviation of the Project budget can be overcome. Rigorous budget management practices and Contingency planning should be done. Extreme calamities like earthquakes and unusual amounts of rainfall have to be considered because they can affect the soil to a degree that the design might fail.

2. Financial Viability: The financial analysis of the project reflects unfavorable results. As the project mostly provides service to the people, it is recommended the project to be more engaging with the relevant stakeholders i.e., the mass people. As a result, it has a great economic viability though not a financial viability.

3. Technical Feasibility and Structural Design: It is to be ensured that the STS design meets all technical and structural requirements. This includes load capacity, durability, and compliance with safety standards. Consider innovative design solutions to enhance functionality and aesthetics. More innovative approaches should be taken in the development of waste management system. Sophisticated standards of design of Secondary Waste transfer station of other nations should be investigated and creative solutions should be implemented.

4. Environmental Impact: Measures to be taken to mitigate any negative effects on the local ecosystem, including adjacent vegetation, and water bodies. The habit of recycling should be implemented.

5. Risk Assessment and Mitigation: Identify potential risks associated with the project, such as construction delays, cost overruns, and safety hazards & develop a comprehensive risk management plan to mitigate these risks. This includes contingency planning and regular monitoring throughout the project lifecycle.

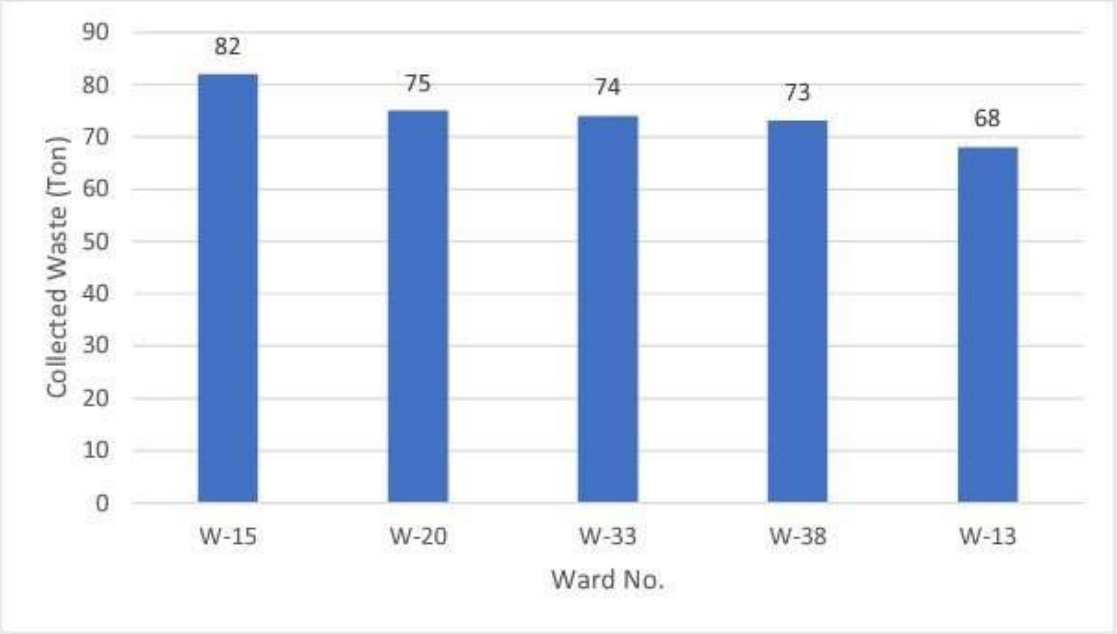
By addressing these recommendations, the project can achieve its goals of providing a safe, efficient, and sustainable waste transfer station, along with improved waste management technologies that meets the local community's needs now and in the future.

In conclusion, the analysis has highlighted several critical factors that must be addressed to ensure the success of the redevelopment of Secondary waste transfer station project. The current infrastructure is insufficient to meet the growing demand, necessitating immediate attention locality needs and future land use patterns. Financial viability remains a challenge, emphasizing the importance of stakeholder engagement to garner support and resources. This model of waste management system can be implemented in other areas of Dhaka city considering the demands.

Section 12: Annexes

A. Stakeholder Consultations and Survey

1. Fig 3.2 WASTE MANAGEMENT REPORT, 2019-2020 Dhaka South City Corporation, Waste Management Department (WMD)



B. Calculations of Technical Analysis

1. Table-4.3: Determination of Roadway Capacity (PCU/hour)

1. Roadway pattern	2 Lane, 2 Way
2. Lane width	8 ft
3. Shoulder condition	4 ft on both side of roadway
4. Operating speed	40 mph
5. % of passing sight distance	40%
6. Level of service (LOS)	C

Traffic Count Survey Data Sheet

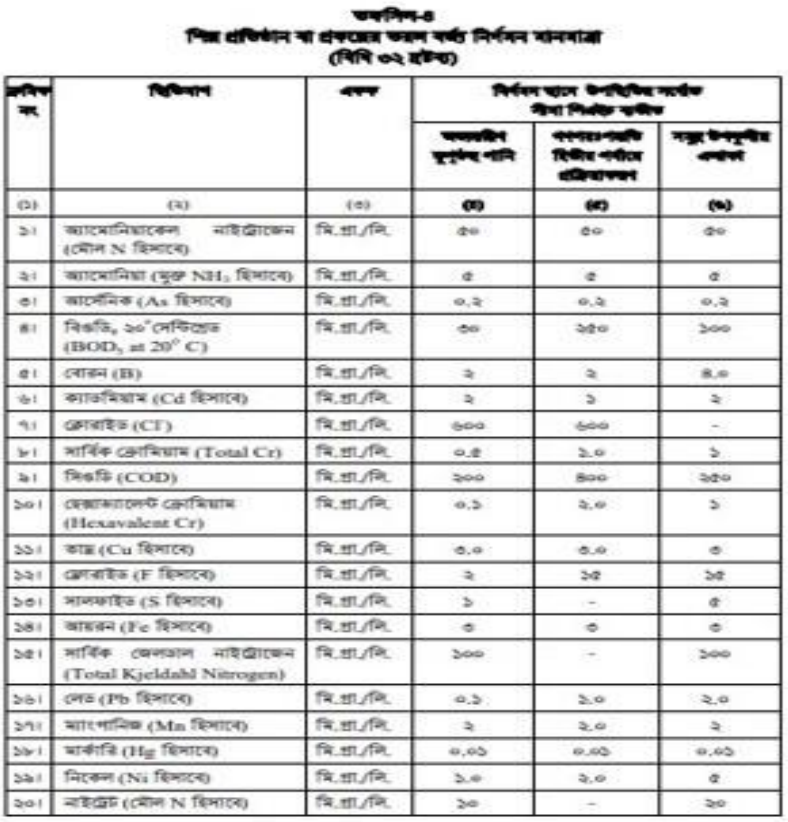
Date	15/2/2024	Weather	25°C, Sunny
Counting Hours	4:30 PM - 4:45 PM		
Approach Name	Dhakeshwari Rd, Dhaka-1000		
Station Name	Polashi Waste Transfer Station		

Vehicle Type	Interval, minutes			PCE	Total No of Vehicles	PCU	Total No of Vehicles (opposite direction)	PCU
	0-5	5-10	10-15					
Car	2	8	5	1.00	15	15.00	55	55
CNG	4	6	4	1.50	14	21.00	21	31.5
Motorcycle	5	11	9	0.75	25	18.75	55	41.25
Rickshaw	13	10	14	2.00	37	74.00	110	220
Leguna	5	3	7	1.25	15	18.75	12	15
	Total					147.50		362.75
	Total (bothDirection)/15 minutes				510.25			
	Total (bothDirection)/hour				2041.00			

2. Table 4.4: Determination of Operation Speed (mph)

Vehicle Type	No of Vehicles	Distance (ft)	Time (sec.)	Velocity (fps)	Average Velocity (fps)	Operating Speed (mph)
Car	1	88	4.23	20.80	22.23	17.33
	2	88	3.43	25.66		
	3	88	4.35	20.23		
CNG	1	88	3.58	24.58	25.64	
	2	88	2.85	30.88		
	3	88	4.1	21.46		
Motorcycle	1	88	3.36	26.19	26.18	
	2	88	2.85	30.88		
	3	88	4.1	21.46		
Rickshaw	1	88	6.3	13.97	13.14	
	2	88	6.74	13.06		
	3	88	7.1	12.39		
Leguna	1	88	3.43	25.66	24.15	
	2	88	4.52	19.47		
	3	88	3.22	27.33		

3. Figure 5.1



ক্রমিক নং	বিবরণ	একক	নির্গমন স্থানে উপাত্তভিত্তিক সর্বোচ্চ সীমা নির্ধারিত থাকিবে		
			অন্যান্য ভূ-উপরিস্থ পানি	পানযোগ্য পানি হিসাবে প্রক্রিয়াকরণ	সমুদ্র উপকূলীয় এলাকা
(১)	(২)	(৩)	(৪)	(৫)	(৬)
১।	অ্যামোনিয়াকেল নাইট্রোজেন (মৌল N হিসাবে)	মি.গ্রা./লি.	৫০	৫০	৫০
২।	অ্যামোনিয়া (মুক্ত NH_3 হিসাবে)	মি.গ্রা./লি.	৫	৫	৫
৩।	আর্সেনিক (As হিসাবে)	মি.গ্রা./লি.	০.২	০.২	০.২
৪।	বিওডি, ২০° সেন্টিগ্রেড (BOD_5 at 20° C)	মি.গ্রা./লি.	৩০	২৫০	১০০
৫।	বোরন (B)	মি.গ্রা./লি.	২	২	৪.০
৬।	ক্যাডমিয়াম (Cd হিসাবে)	মি.গ্রা./লি.	২	১	২
৭।	ক্লোরাইড (Cl)	মি.গ্রা./লি.	৬০০	৬০০	-
৮।	সার্বিক ক্রোমিয়াম (Total Cr)	মি.গ্রা./লি.	০.৫	২.০	১
৯।	সিওডি (COD)	মি.গ্রা./লি.	১০০	৪০০	১৫০
১০।	হেক্সাক্যালেন্ট ক্রোমিয়াম (Hexavalent Cr)	মি.গ্রা./লি.	০.১	২.০	১
১১।	তাম্র (Cu হিসাবে)	মি.গ্রা./লি.	৩.০	৩.০	৩
১২।	ফ্লোরাইড (F হিসাবে)	মি.গ্রা./লি.	২	১৫	১৫
১৩।	সালফাইড (S হিসাবে)	মি.গ্রা./লি.	১	-	৫
১৪।	আয়রন (Fe হিসাবে)	মি.গ্রা./লি.	৩	৩	৩
১৫।	সার্বিক জেলভাল নাইট্রোজেন (Total Kjeldahl Nitrogen)	মি.গ্রা./লি.	১০০	-	১০০
১৬।	লেড (Pb হিসাবে)	মি.গ্রা./লি.	০.১	১.০	২.০
১৭।	ম্যাংগানিজ (Mn হিসাবে)	মি.গ্রা./লি.	২	২.০	২
১৮।	মার্কারি (Hg হিসাবে)	মি.গ্রা./লি.	০.০১	০.০১	০.০১
১৯।	নিকেল (Ni হিসাবে)	মি.গ্রা./লি.	১.০	২.০	৫
২০।	নাইট্রেট (মৌল N হিসাবে)	মি.গ্রা./লি.	১০	-	১০

4. Figure 5.2

তফসিল-৩
পয়ঃনির্গমন মানমাত্রা
(বিধি ৩২ দ্রষ্টব্য)

ক্রমিক নং	বিষয়মান	একক	উপরিস্থিত সর্বোচ্চ সীমা শিরোনাম বর্জীত
(১)	(২)	(৩)	(৪)
১।	উষ্ণতা (Temp)	ডিগ্রি সেন্টিগ্রেড	৩০
২।	পিএইচ (pH)	-	৬-৯
৩।	বিওডি, ২০° সেন্টিগ্রেড (BOD_5 at 20°C)	মি.গ্রা./লি.	৩০
৪।	সিওডি (COD)	মি.গ্রা./লি.	১৩৫
৫।	প্রলম্বিত কঠিন বস্তু (SS)	মি.গ্রা./লি.	১০০
৬।	তৈল ও গ্রিজ (Oil & Grease)	মি.গ্রা./লি.	১০
৭।	নাইট্রেট (NO_3)	মি.গ্রা./লি.	৫০
৮।	ফসফেট (PO_4)	মি.গ্রা./লি.	১৫
৯।	সার্বিক কলিফর্ম (Total Coliform)	সিএফইউ/১০০ মি. লি.	১০০০

শর্তাবলি :

(১) এই মানমাত্রা ভূপৃষ্ঠস্থ পানি প্রবাহে নির্গমনের ক্ষেত্রে প্রযোজ্য।

(২) চূড়ান্ত নির্গমনের পূর্বে পয়ঃনির্গমনকে ক্লোরিন দ্বারা পরিশোধিত করিতে হইবে। Residual Chlorine (ক্লোরিন) ০.২ মি.গ্রা./লি. বেশি হওয়া যাইবে না।

5. Figure 5.3

ক্রমিক নং	বিষয়মান	একক	নির্গমন স্থানে উপরিস্থিত সর্বোচ্চ সীমা শিরোনাম বর্জীত		
			অন্যান্য ভূপৃষ্ঠস্থ পানি	পরপরঃপথটি মিশ্রিত পর্যায়ে প্রক্রিয়াকরণ	সমুদ্র উপকূলীয় এলাকা
(১)	(২)	(৩)	(৪)	(৫)	(৬)
২১।	তৈল এবং গ্রিজ (Oil & grease)	মি.গ্রা./লি.	১০	২০	২০
২২।	ফেনল যৌগাদি (C_6H_5OH হিসাবে)	মি.গ্রা./লি.	১.০	৫	৫
২৩।	দ্রবীভূত ফসফরাস (P হিসাবে)	মি.গ্রা./লি.	৫.০	-	-
২৪।	তেজস্ক্রিয় দ্রব্য (ক) আলফা কণা বিস্তুরণ (খ) বিটা কণা বিস্তুরণ	মাইক্রো কুরি/লি.	বাংলাদেশ পরমাণু শক্তি কমিশন কর্তৃক স্থিরীকৃত	-	-
২৫।	পিএইচ (pH)		৬-৯	৬-৯	৬-৯
২৬।	সিলেনিয়াম (Se হিসাবে)	মি.গ্রা./লি.	০.০৫	০.০৫	০.০৫
২৭।	জিংক (Zn হিসাবে)	মি.গ্রা./লি.	৫	১৫	১৫
২৮।	তাপমাত্রা	ডিগ্রি সেন্টিগ্রেড	জলাধারের তাপমাত্রার চাইতে ৫° সেলসিয়াসের বেশি হইবে না।	-	জলাধারের তাপমাত্রার চাইতে ৫° সেলসিয়াসের বেশি হইবে না।
২৯।	প্রলম্বিত কঠিন বস্তুকণা (SS)	মি.গ্রা./লি.	১০০	৫০০	১০০
৩০।	সায়ানাইড (CN হিসাবে)	মি.গ্রা./লি.	০.১	২.০	০.২
৩১।	টোটাল রেসিডিওয়াল ক্লোরিন (Total Residual Chlorine)	মি.গ্রা./লি.	১.০	-	১.২
৩২।	Bio assay test (কেবল বায়োইন্ডিকেটর ও ঔষধ কারখানার ক্ষেত্রে প্রযোজ্য)		৯০% মাছ ৯৬ ঘণ্টা পরেও পরিশোধিত তরলবর্জ্যে জীবিত থাকে।	৯০% মাছ ৯৬ ঘণ্টা পরেও পরিশোধিত তরলবর্জ্যে জীবিত থাকে।	৯০% মাছ ৯৬ ঘণ্টা পরেও পরিশোধিত তরলবর্জ্যে জীবিত থাকে।

শর্তাবলি:

১। তফসিল-৫ এর অধীন বর্ণিত শিল্প শ্রেণি ব্যতীত অন্যান্য শিল্পপ্রতিষ্ঠান বা প্রকল্পসমূহের ক্ষেত্রে এই মানমাত্রা প্রযোজ্য হইবে।

6. Figure 5.4

তফসিল-১৪
শিল্প প্রতিষ্ঠান বা প্রকল্পের শ্রেণিবিভাগের নির্ণায়ক
[বিধি ৫ এর উপ-বিধি (২) এর শর্তাংশ দ্রষ্টব্য]

ক্রমিক নং	শিল্প প্রতিষ্ঠান বা প্রকল্পের কার্যক্রমের ফলে সৃষ্ট দূষণের প্রকৃতি			শিল্প প্রতিষ্ঠান বা প্রকল্পের শ্রেণিবিভাগ	মন্তব্য
	তরল বর্জ্য	বায়বীয় নিঃসরণ	কঠিন বর্জ্য		
(১)	(২)	(৩)	(৪)	(৫)	(৬)
১।	(ক) তরল বর্জ্যের সিওডি > ১৫০০ মি.গ্রা./লি. এবং (খ) টক্সিক	(ক) উৎপাদন প্রক্রিয়ায় বস্তুকণা সৃষ্টি হয় যাহা নিয়ন্ত্রণের জন্য ইএসপি, ব্যাগ ফিল্টার, স্ক্রাবার, ইত্যাদি প্রযুক্তির প্রয়োজন হয়; এবং (খ) বায়বীয় নিঃসরণে বিপজ্জনক পদার্থের উপস্থিতি	(ক) বিপজ্জনক কঠিন বর্জ্য যাহা পরিত্যাজনের জন্য প্রক্রিয়াকরণ (Treatment) বা ইনসিনারেশনের প্রয়োজন।	লাল	(ক) শিল্প প্রতিষ্ঠান বা প্রকল্পের তরল বর্জ্য কিংবা বায়বীয় নিঃসরণ কিংবা কঠিন বর্জ্যের প্রকৃতি ক্রমিক নং ১ এ উল্লিখিত ধরণের হইলে তাহা লাল শ্রেণিভুক্ত হইবে; এবং (খ) নির্ণায়ক অনুসারে কমলা শ্রেণিভুক্ত শিল্প প্রতিষ্ঠান বা প্রকল্পের শিল্প ও গৃহস্থালীর তরল বর্জ্যের মোট পরিমাণ দৈনিক ১০০ ঘন মিটারের বেশী হইলে তাহা লাল শ্রেণিভুক্ত হইবে।
২।	(ক) তরলবর্জ্যের সিওডি >৭০০ - <১৫০০ মি.গ্রা./লি. এবং (খ) নন-টক্সিক	(ক) উৎপাদন প্রক্রিয়ায় বস্তুকণা সৃষ্টি হয় যা উপযুক্ত প্রযুক্তির সাহায্যে নিয়ন্ত্রণযোগ্য; এবং (খ) বায়বীয় নিঃসরণে নাইট্রোজেনের অক্সাইডসমূহ, কার্বন মনোঅক্সাইড, কার্বন ডাইঅক্সাইডের উপস্থিতি।	(খ) বিপজ্জনক কঠিন বর্জ্য যাহা পরিত্যাজনের জন্য প্রক্রিয়াকরণ বা ইনসিনারেশনের প্রয়োজন হয় না, যেমন: স্ল্যাগ, ফ্লাই এ্যাশ, খনির পরিত্যক্ত বস্তু।	কমলা	(ক) শিল্প প্রতিষ্ঠান বা প্রকল্পের তরল বর্জ্য কিংবা বায়বীয় নিঃসরণ কিংবা কঠিন বর্জ্যের প্রকৃতি ক্রমিক নং ২ এ উল্লিখিত ধরণের হইলে তাহা কমলা শ্রেণিভুক্ত হইবে; এবং (খ) নির্ণায়ক অনুসারে হলুদ শ্রেণিভুক্ত শিল্প প্রতিষ্ঠান বা প্রকল্পের শিল্প ও গৃহস্থালীর তরল বর্জ্যের মোট পরিমাণ দৈনিক ১০০ ঘন মিটারের বেশী হইলে তাহা কমলা শ্রেণিভুক্ত হইবে।

7. Figure 5.5

ক্রমিক নং	শিল্প প্রতিষ্ঠান বা প্রকল্পের কার্যক্রমের ফলে সৃষ্ট দূষণের প্রকৃতি			শিল্প প্রতিষ্ঠান বা প্রকল্পের শ্রেণিবিভাগ	মন্তব্য
	তরল বর্জ্য	বায়বীয় নিঃসরণ	কঠিন বর্জ্য		
(১)	(২)	(৩)	(৪)	(৫)	(৬)
৩।	(ক) তরল বর্জ্যের সিওডি ≥২০০ মি.গ্রা./লি. এবং (খ) নন-টক্সিক	(ক) উৎপাদন প্রক্রিয়ায় বস্তুকণা সৃষ্টি হয়; এবং (খ) সহজ উপায়ে সৃষ্ট বস্তুকণা দূরীকরণ সম্ভব।	(ক) অবিপজ্জনক কঠিন বর্জ্য; (খ) পচনশীল জৈব বর্জ্য; এবং (গ) সহজে পুনঃব্যবহারযোগ্য কঠিন বর্জ্য	হলুদ	(ক) শিল্প প্রতিষ্ঠান বা প্রকল্পের তরল বর্জ্য কিংবা বায়বীয় নিঃসরণ কিংবা কঠিন বর্জ্যের প্রকৃতি ক্রমিক নং ৩ এ উল্লিখিত ধরণের হইলে তাহা হলুদ শ্রেণিভুক্ত হইবে; এবং (খ) নির্ণায়ক অনুসারে সবুজ শ্রেণিভুক্ত শিল্প প্রতিষ্ঠান বা প্রকল্পের শিল্প ও গৃহস্থালীর তরল বর্জ্যের মোট পরিমাণ দৈনিক ১০ ঘন মিটারের বেশী হইলে তাহা হলুদ শ্রেণিভুক্ত হইবে।
৪।	(ক) তরল বর্জ্যের সিওডি <২০০ মি.গ্রা./লি.	(ক) ফিউজিটিভ ডাস্ট সৃষ্টি হয়; (খ) জ্বালানি দহনের কারণে বা রাসায়নিক দ্রব্য প্রক্রিয়াকরণের কারণে বস্তুকণা সৃষ্টি হয় না; এবং (গ) সহজ উপায়ে সৃষ্ট বস্তুকণা দূরীকরণ সম্ভব।	(ক) পচনশীল কঠিন বর্জ্য; এবং (খ) মোড়কজাতীয় কঠিন বর্জ্য।	সবুজ	শিল্প প্রতিষ্ঠান বা প্রকল্পের তরল বর্জ্য কিংবা বায়বীয় নিঃসরণ কিংবা কঠিন বর্জ্যের প্রকৃতি ক্রমিক নং ৪ এ উল্লিখিত ধরণের হইলে তাহা সবুজ শ্রেণিভুক্ত হইবে।

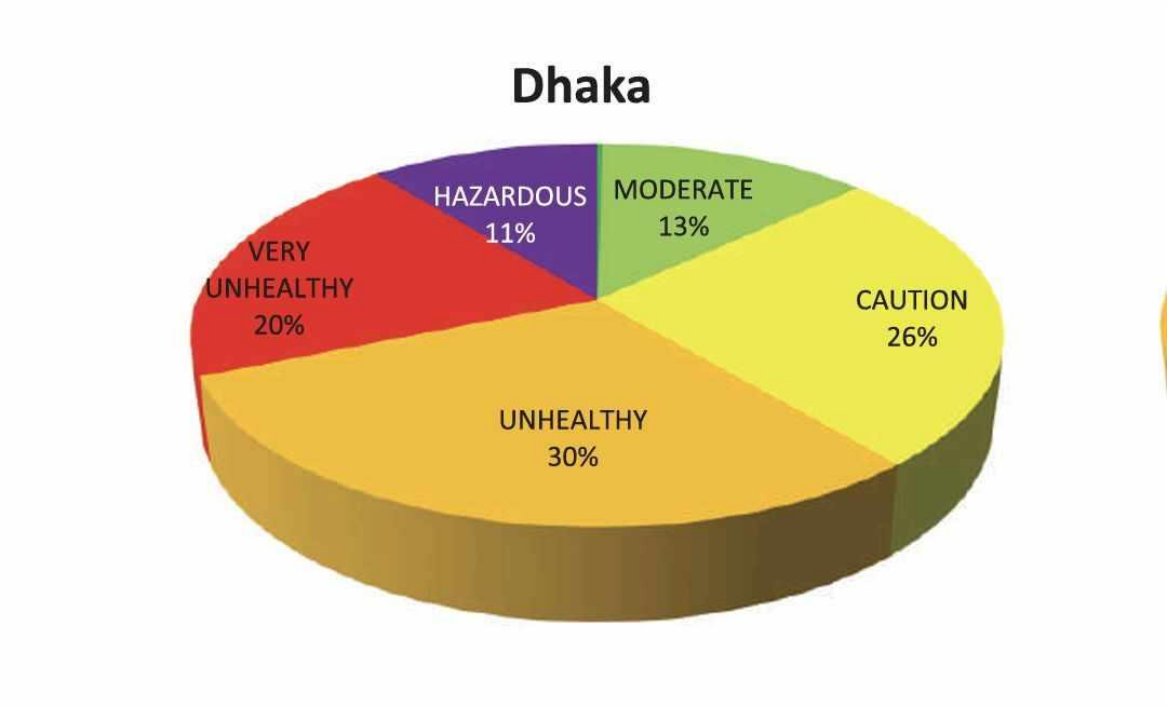
8. Table 5.1:

০৩। পরিবেষ্টক বায়ুর মানমাত্রা (Ambient Air Quality Standards):

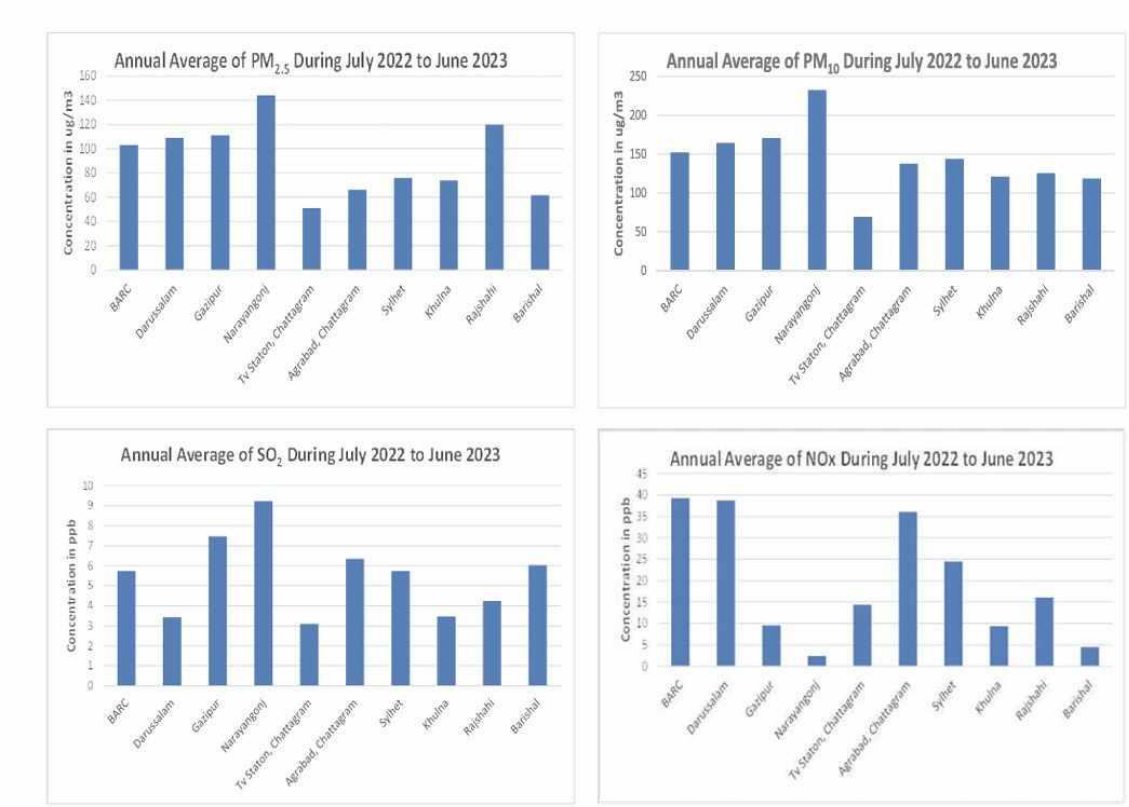
বায়ুদূষণ (নিয়ন্ত্রণ) বিধিমালা, ২০২২ অনুযায়ী পরিবেষ্টক বায়ুর মানমাত্রা (Ambient Air Quality Standards) নিম্নরূপঃ

বায়ুদূষক	মানমাত্রা	গড় সময়
কার্বন মনোক্সাইড (CO)	০৫ মিলিগ্রাম/ঘনমিটার(ক)	৮ ঘন্টা
	২০ মিলি গ্রাম/ঘনমিটার(ক)	১ ঘন্টা
লেড (Pb)	০.২৫ মাইক্রোগ্রাম/ঘনমিটার(খ)	বার্ষিক
	০.৫০ মাইক্রোগ্রাম/ঘনমিটার(ক)	২৪ ঘন্টা
নাইট্রোজেন ডাইঅক্সাইড (NO_2)	৪০ মাইক্রোগ্রাম/ঘনমিটার(খ)	বার্ষিক
	৮০ মাইক্রোগ্রাম/ঘনমিটার(ক)	২৪ ঘন্টা
বস্তুকণা$_{১০}$(PM_{10})	৫০ মাইক্রোগ্রাম/ঘনমিটার(খ)	বার্ষিক
	১৫০ মাইক্রোগ্রাম/ঘনমিটার(ক)	২৪ ঘন্টা
বস্তুকণা$_{২.৫}$ ($PM_{2.5}$)	৩৫ মাইক্রোগ্রাম/ঘনমিটার(খ)	বার্ষিক
	৬৫ মাইক্রোগ্রাম/ঘনমিটার(ক)	২৪ ঘন্টা
ওজোন (O_3)	১৮০ মাইক্রোগ্রাম/ঘনমিটার(ক)	১ ঘন্টা
	১০০ মাইক্রোগ্রাম/ঘনমিটার(ক)	৮ ঘন্টা
সালফার ডাইঅক্সাইড (SO_2)	২৫০ মাইক্রোগ্রাম/ঘনমিটার(ক)	১ ঘন্টা
	৮০ মাইক্রোগ্রাম/ঘনমিটার(ক)	২৪ ঘন্টা
অ্যামোনিয়া (NH_3)	১০০ মাইক্রোগ্রাম/ঘনমিটার(খ)	বার্ষিক
	৪০০ মাইক্রোগ্রাম/ঘনমিটার(ক)	২৪ ঘন্টা

9. Table 5.2



10. Table 5.3



চিত্রঃ সার্বক্ষণিক বায়ুমান পরিবীক্ষণ কেন্দ্রের সাহায্যে প্রাপ্ত $PM_{2.5}$, PM_{10}, SO_2 & NOx এর মান।

11. Table 5.4: Environmental Monitoring Reporting Schedule

Stage/Topic	Frequency/Stage	Contributors
Initial review	Before start of work	EMU, Consultant
Routine Progress Report	Quarterly	Environmentalist and Social Sector Expert
Specific Problems and Solutions	As required	Environmentalist and Social Sector Expert
Mid-term Review: review of activities possible modification to procedure and/or overall plan	Approximate mid-way through the project	Consultant
Final Review	Toward the end of the project	EMU, Consultant, Contractor
Quarterly Environmental Management Report for DoE	Every Year	EMU

12. Table 5.5: Monitoring issues/ requirements during Construction phase of the project

Environmental Issue	Monitoring requirements/issues
Air pollution	Construction materials should be properly covered while hauled and stored, roads properly cleaned and water sprayed in order to minimize concentration of dust in air. Use of equipment like stone crushers (for concreting work), which produce excessive noise as well as generate particulate matter, must not be used close to human settlement. During trench construction activities, the topsoil removed should be placed in a location that ensures little or no fugitive dust formation from stockpile. Concentration of particulate matter within and around the project site should be measured, at least once every three months, and air quality management plan should be revised, if needed.
Noise pollution	Use of equipment like stone crushers (for concreting work), which produce excessive noise as well as particulate matter, must not be used at the site. Vehicle movement to and from the site should be properly managed in order to ensure that this causes minimum disturbance to the people living in the surrounding areas. Noise levels along the perimeters of the project area should be monitored during the construction period and any defective equipment or vehicle removed from activities immediately.
Traffic congestion	Hauling of materials and equipment to and from project sites should preferably be done after the regular working hours, so that it causes minimum disturbances to the regular traffic in and around the project site. Contractor should take responsibility of proper traffic flow and management within the immediate vicinity of the project site.
Drainage congestion	Appropriate measures should be taken to avoid temporary drainage congestion during construction activities.
Impacts to Water Resources	During excavation activities, the topsoil removed should be placed in a location that ensures no turbidity impacts to nearby water resources. Should the contractor vacate the area leaving stockpiled material a suitable penalty (fine and removal cost) should be levied to remedy the situation. Wastewater from workers' camp should be well managed.

13. Table 5.6: Monitoring parameters and frequency during construction phase

Monitoring	Period/Location	Parameters to be monitored	Monitoring Frequency and responsibilities	Resources Required
Noise Level	Baseline One set of measurements at property boundaries of selected critical locations (the nearby residential plot, other residential areas, highways etc.) prior to commencing activities. One set of measurements at the same locations during construction activities.	Equivalent Noise level (Leq) with GPS location, wind speed and direction	Spot checking in a monthly basis; Contractor's Responsibility	Noise level meter, GPS;
Air Quality (dust particles/ particulate matter)	Baseline Only at selected critical locations downwind of site activities (prior to commencement of work) and in close proximity to human receptors (specially the nearby residential plot). Only at selected critical locations downwind of site activities (during construction activities) and in close proximity to human receptors	PM10, PM2.5 with GPS location, wind speed and direction	Once in three months or as deemed by the Project Coordinator; Contractor's Responsibility	PM sampling device, GPS Wind speed/direction data to be collected from local BMD station
Ground water quality	Chemical Analysis of Tube-well water used as drinking water source for the workers	Routine drinking water parameters	Once in six months; Contractor's Responsibility	Laboratory facilities for water/ wastewater analysis

Soil Quality	Sample randomly selected at one or two locations within the project site	Selected heavy metals (Pb, Cr, Cd)	Once in six months; Contractor's Responsibility	Laboratory facilities for soil sample analysis
General site condition	Baseline: Visual survey (once) of proposed site before commencement of work. Visual survey of the project site during the entire period of construction	General site condition, traffic condition, pedestrian movement, vegetation clearance etc. by visual survey (photographs)	Weekly and as directed by the Project team leader; Contractor's Responsibility	Digital camera
House- keeping activities, Safety measures during construction	Visual survey of the project site during the entire period of construction	Construction debris management, road traffic/ river traffic management, management of flammable materials (if any), use of Personal Protective Equipment by workers etc.	Weekly and as directed by the Project team leader; Contractor's Responsibility	Digital camera

14. **Table 5.7: Monitoring issues/requirements during Operation phase of the project**

Environmental Issue	Monitoring requirements/issues
Air pollution	Ambient air quality should be monitored at near the generator locations of the MCC site.
Noise pollution	Indoor noise environment should also be assessed as a part of the occupational health and safety plan.
Traffic congestion	Hauling of materials and equipment to and from project sites should preferably be done after the regular working hours, so that it causes minimum disturbances to the regular traffic in and around the project site. Contractor should take responsibility of proper traffic flow and management within the immediate vicinity of the project site.
Impacts to Water Resources	Waterfall water quality i.e. Dissolved Oxygen, oil and grease etc. should be monitored.
Management of Solid Waste	Amount of solid waste generated from the facility should be documented The hazardous nature of the waste should be assessed before final disposal at a landfill

15. Table 5.8: Monitoring parameters and frequency during Operation Phase

Monitoring	Period/Location	Parameters to be monitored	Monitoring Frequency and responsibilities	Resources Required
Noise Level	Baseline One set of measurements at the lower locations and the nearby residential plot, other residential areas, highways etc.) prior to commencing activities.	Equivalent Noise level (Leq) with GPS location, wind speed and direction	Spot checking in a monthly basis; EMU's Responsibility	Noise level meter, GPS;

Ambient Air Quality (Particulate matter)	Baseline Near the standby generator room.	SPM, PM10, PM2.5, SOx, NOx, CO, VOC with GPS location, wind speed and direction.	Once in three months or as deemed by the ESMU; EMU's Responsibility	PM sampling device, GPS Wind speed/direction data to be collected from local BMD station.
Soil Quality	Sample randomly selected at one location within the MCC site.	Selected heavy metals (Pb, Cr, Cd)	Once in a year; as directed by the ESMU; EMU's Responsibility	Laboratory facilities for soil sample analysis
Management of Solid Waste	Visual survey of the MCC project site during operation.	Solid Waste Management of the EMU	Weekly and as directed by the ESMU; EMU's Responsibility in collaboration with Union Parishad	Digital camera
Safety measures during Operation	Visual survey of the MCC Complex during operation.	Road traffic management, management of flammable materials (if any), use of Personal Protective Equipment by EMU officials etc.	Weekly and as directed by the ESMU; EMU's Responsibility	Digital camera

16. Fig 8.1

শিল্পের শ্রেণি	শিল্পের ধরন	বাফার দূরত্ব
(১)	(২)	(৩)
সবুজ বা হলুদ	হালকা শিল্প বা কার্যক্রম যাহা নিম্নরূপ বৈশিষ্ট্য সম্পন্ন : • বায়ুদূষণ, শব্দ, কম্পন, গন্ধ, অগ্নি বা বিস্ফোরণের সম্ভাবনা খুব কম বা নাই; • বিপজ্জনক পদার্থ কাঁচামাল হিসাবে ব্যবহৃত হয় না বা উৎপাদন প্রক্রিয়ায় তৈরি হয় না; • কোনো বিপজ্জনক কঠিন বর্জ্য সৃষ্টি হয় না।	• ন্যূনতম ৫০ মিটার; • প্রযোজ্য ক্ষেত্রে মডেলিং-এর মাধ্যমে প্রকৃত বাফার দূরত্ব নির্ধারণ করা যাইতে পারে।
সবুজ বা হলুদ শ্রেণি	ক্ষুদ্র শিল্প যাহা নিম্নরূপ বৈশিষ্ট্য সম্পন্ন : • বায়ুদূষণ, শব্দ, কম্পন, গন্ধ, অগ্নি বা বিস্ফোরণের সম্ভাবনা খুবই কম বা নাই; • ভূমি ব্যতীত বিনিয়োগকৃত মূলধন বৎসরের যে-কোনো সময় ৪০ লক্ষ টাকার অধিক নহে এবং বার্ষিক টার্নওভার ৬০ লক্ষ টাকার অধিক নহে; • শুষ্ক প্রকৃতির উৎপাদন প্রক্রিয়া। ধোয়া, মোছা ও পরিষ্কার-পরিচ্ছন্নতার মাধ্যমে তরল বর্জ্য সৃষ্টি হইতে পারে, তবে তাহা নির্গমনের ফলে পানি দূষণের সম্ভাবনা কম; • কোনো বিপজ্জনক কঠিন বর্জ্য সৃষ্টি হয় না।	• তাপ ও শব্দদূষণ সৃষ্টি হইলে ন্যূনতম ১০ মিটার বাফার দূরত্ব রাখা যাইতে পারে।

C. Calculations of Project Lifetime and Cost-Benefit Analysis

1. Table 6.1: Financial Cost-Benefit Analysis for the Project Life Time.

Financial Analysis							
		Undiscounted Cost	**Undiscounted Revenue**	**Net Cash Flow**	**Net Present Value (in lakhs BDT.)**	**Internal Rate of return (IRR)**	**Benefit/Cost Ratio (B/C)**
Sl No	**Year**	**Total Cost (in lakhs BDT.)**	**Total Revenue (in lakhs BDT.)**	**Revenue -Cost (in lakhs BDT.)**	**Discounted Rate 12%**		
1	2024	463.03	0.00	-463.03	-487.16	-0.2	0.73
2	**2025**	60.00	57.20	-2.80			
3	**2026**	60.00	57.20	-2.80			
4	**2027**	63.00	60.06	-2.94			
5	**2028**	63.00	60.06	-2.94			
6	**2029**	66.15	63.06	-3.09			
7	**2030**	66.15	63.06	-3.09			
8	**2031**	69.46	66.22	-3.24			
9	**2032**	69.46	66.22	-3.24			
10	**2033**	72.93	69.53	-3.40			
11	**2034**	72.93	69.53	-3.40			
12	**2035**	76.58	73.00	-3.57			
13	**2036**	76.58	73.00	-3.57			
14	**2037**	80.41	76.65	-3.75			
15	**2038**	80.41	76.65	-3.75			
16	**2039**	84.43	80.49	-3.94			
17	**2040**	84.43	80.49	-3.94			
18	**2041**	88.65	84.51	-4.14			
19	**2042**	88.65	84.51	-4.14			
20	**2043**	93.08	88.74	-4.34			
21	**2044**	93.08	88.74	-4.34			

2. Table 6.2 Economic Analysis

Economic Analysis Results (BDT in lacs)								
Year	**Undiscounted Cost (Lacs)**			**Undiscounted benefits (Lacs)**	**Net Cash flow (undiscounted) (lacs)**	**Net Present Value(lacs)**	**Internal Rate of Return (EIRR)**	**BCR**
	Construction Cost	**Maintenance Cost**	**Total Cost**	**Total Benefit**	**(Total Benefit-Total Cost)**	**Discount rate=12 %**	**(At this, NPV=0)**	
2024	370.42		370.42	0	-370.42	**BDT 512.00**	**32%**	**3.81**
2025	0	11.112	11.112	125	113.888			
2026		11.67	11.67	125	113.33			
2027		13	13	131.2	118.2			
2028		14	14	131.2	117.2			
2029		15	15	137.8	122.8			
2030		16	16	137.8	121.8			
2031		17	17	144.7	127.7			
2032		18	18	144.7	126.7			
2033		19	19	151.9	132.9			
2034		20	20	151.9	131.9			
2035		21	21	159.5	138.5			
2036		23	23	159.5	136.5			
2037		25	25	167.5	142.5			
2038		27	27	167.5	140.5			
2039		29	29	175.8	146.8			
2040		31	31	175.8	144.8			
2041		33	33	184.6	151.6			
2042		35	35	184.6	149.6			
2043		37	37	193.9	156.9			
2044		39	39	193.9	154.9			
			net cost=	**net benefit=**	**Net Cash flow (undiscounted) (lacs)**			
			825.202	**3143.8**	**2318.598**			