KCC Solid Waste Management Master Plan 2040

Khulna City Corporation

The People's Republic of Bangladesh

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Message from the Administrator

As Administrator of Khulna City Corporation (KCC), I want to address the critical issue of solid waste management and outline our comprehensive plan for a cleaner, healthier, and more sustainable future.

Our city, like many others in rapidly developing regions, faces significant challenges due to increasing population and urbanization. The current situation, with a large portion of our waste being deposited at the Rajbandh open landfill, is unsustainable and poses serious environmental and health risks.

To address these challenges, KCC has developed the "KCC Solid Waste Management Master Plan 2040," a strategic framework designed to achieve "zero-unmanaged waste." This plan is not just a document; it's a commitment to transforming our city's waste management practices.

Key initiatives include:

Transition to Sanitary Landfills: We are actively developing and operationalizing sanitary landfills at Soula and Mathavanga, alongside the existing 3R project, to ensure decentralized and efficient waste disposal.

Emphasis on the 4R Approach: We are prioritizing Reduce, Reuse, Recycle, and Recover principles to minimize waste generation and maximize resource recovery.

Community Engagement: We recognize that public participation is crucial. We are establishing ward-based Community Based Organization (CBO) committees, implementing "Fixed-time and Fixed-place" collection systems, and creating online feedback mechanisms to ensure transparency and accountability.

Performance-Based Incentives: We will incentivize wards to excel in waste management through a performance-based system, fostering healthy competition and driving positive outcomes.

Strengthening Institutional Capacity: We are committed to ensuring that the Waste Management Department has the necessary human, infrastructure, and financial resources to effectively implement the master plan.

Focus on Plastic Reduction: As our master plan is part of the "SCIP Plastics Project", we are very focused on reducing the amount of plastic waste that is generated within the city.

We understand that this transformation requires a collective effort. We urge all residents to actively participate in waste segregation, recycling, and composting initiatives. Your cooperation is essential for the success of this plan.

We are also committed to transparency and accountability. We will regularly monitor progress, evaluate the effectiveness of our initiatives, and make necessary adjustments to ensure we achieve our goals.

We are confident that by working together, we can create a cleaner, healthier, and more sustainable Khulna City for generations to come.

Md. Firoz Sarkar
Administrator, Khulna City Corporation
&
Divisional Commissioner, Khulna.

Message from the Chief Executive Officer

As Chief Executive Officer of Khulna City Corporation (KCC), I want to address you directly regarding our unwavering commitment to transforming the city's solid waste management system. The KCC Solid Waste Management Master Plan 2040 is not merely a document; it is a roadmap for a cleaner, healthier, and more sustainable Khulna. We recognize the urgent need to move away from unsustainable practices, particularly the reliance on the Rajbandh open landfill, and to embrace modern, efficient, and environmentally sound waste management solutions. This plan represents a significant step towards achieving our vision of "zero-unmanaged waste," a vision that will benefit all residents of our beloved city.

The implementation of this master plan will involve significant changes and improvements. We are prioritizing the development and operationalization of sanitary landfills at Soula and Mathavanga, alongside the expansion of the 3R project. These initiatives are crucial for establishing a decentralized and efficient waste management system. Simultaneously, we are deeply committed to the 4R principles-Reduce, Reuse, Recycle, and Recover-to minimize waste generation and maximize resource recovery. We understand that the success of this plan hinges on the active participation of our community. Therefore, we are placing a strong emphasis on public engagement through ward-based Community Based Organizations (CBOs), the implementation of efficient collection systems, and the establishment of robust feedback mechanisms.

We are also focused on strengthening the capacity of the KCC Waste Management Department, ensuring they have the necessary resources and expertise to implement this plan effectively. Furthermore, we are establishing rigorous monitoring and evaluation systems to track progress and ensure accountability. We are determined to achieve our goals and create a lasting positive impact on our city. This is a collaborative effort, and we urge all residents to join us in this endeavor. Your cooperation in waste segregation, recycling, and composting is vital. We are committed to transparency and open communication, and we will keep you informed of our progress every step of the way. Together, we can build a cleaner, healthier, and more sustainable Khulna for generations to come.

Lasker Tazul Islam
Chief Executive Officer (CEO)
Khulna City Corporation

Message from the Focal Point

As the Author and Focal Point for the Khulna City Corporation (KCC) Solid Waste Management Master Plan 2040, I am privileged to address you regarding the transformative journey we are undertaking to reshape our city's waste management practices. This master plan is a testament to our commitment to creating a cleaner, healthier, and more sustainable Khulna for all its residents. We are striving towards the ambitious, yet achievable, goal of "zero-unmanaged waste," a vision that will significantly enhance our city's environmental and public health standards.

This comprehensive master plan is the result of collaborative efforts, and I extend my sincere gratitude to the "Sustainable Capacity building to reduce Irreversible Pollution by Plastics" (SCIP Plastics) project. Their support and funding have been instrumental in enabling us to develop and implement this crucial initiative. I also express my deepest appreciation to Khulna City Corporation (KCC) for their unwavering commitment and leadership in driving this project forward. The dedication of KCC's leadership and personnel is vital for the successful execution of this plan.

The master plan's implementation will necessitate significant changes, including the development of sanitary landfills, the promotion of the 4R principles (Reduce, Reuse, Recycle, Recover), and the active engagement of our community. We are determined to build a robust and efficient waste management system that benefits everyone. Community participation is paramount, and we encourage all residents to actively contribute to this endeavor. We are committed to transparency and accountability, ensuring that progress is continuously monitored and communicated. I am confident that, through our collective efforts, we can achieve our vision and create a legacy of sustainable waste management for Khulna.

Dr. Md. Manjur Morshed
Focal Point, KCC Waste Management Master Plan 2040
&
Professor
Department of Urban and Regional Planning
Khulna University of Engineering & Technology (KUET)
Khulna-9203.

Bauhaus-Universität Weimar

Message from the Project Lead

As Project Lead for SCIP Plastics, I'm thrilled by Khulna City Corporation's (KCC) commitment to achieving a "zero-unmanaged waste" city by 2040, as outlined in their new Solid Waste Management Master Plan. This plan recognizes that global goals require local action, especially for complex municipal solid waste management. This involves diverse technologies, disciplines, and stakeholders-from government to private enterprise-all working within legal and social guidelines.

Effective waste management demands cross-disciplinary collaboration: administrative, financial, legal, architectural, planning, and engineering skills must converge for a successful and sustainable integrated plan.

Recognizing these challenges, SCIP Plastics focuses on three key elements:

- An Awareness Centre for Wastes Management downtown.
- Bangladesh's first Waste Management Laboratory at KUET.
- A Waste Management Knowledge Transfer HUB at KUET campus.

Our project also addresses improving secondary transfer stations, integrating private recycling shops to reduce plastic waste, ensuring safe and sanitary landfilling, and promoting the substitution of plastics with natural materials.

It's inspiring to see the KCC's collaboration with universities and citizens, which has forged a roadmap for the city's waste management well-being. This partnership is built on a shared commitment to reliable data, professional best practices, technical feasibility, financial viability, and social balance.

I'm grateful for the opportunity to contribute to this process. Khulna's Solid Waste Management Master Plan is a milestone-a transparent blueprint inviting all citizens to participate in making progress measurable. I believe this approach will become a model for many Bangladeshi cities within the next decade.

Prof. Dr.-Ing. Eckhard Kraft
Project Lead, SCIP Plastics Project
&
Head of Professorship Resource Management
Bauhaus-Universitat Weimar, Germany, 99423 Weimar

Message from the Project Lead (KUET)

Dear Residents of Khulna City, as Project Lead (KUET) of the "Sustainable Capacity building to reduce Irreversible Pollution by Plastics" (SCIP Plastics) project, I am writing to you regarding the critical work we are undertaking to transform Khulna's waste management system, specifically through the KCC Solid Waste Management Master Plan 2040. This master plan, a core component of the SCIP Plastics project, represents a significant step towards achieving a cleaner and more sustainable Khulna. It is built on a foundation of collaboration between Khulna City Corporation (KCC), Khulna University of Engineering & Technology (KUET), and Bauhaus-Universitat Weimar (BUW), bringing together expertise and resources to address the urgent challenges we face.

Our primary goals involve transitioning away from the unsustainable Rajbandh open landfill. We are diligently establishing functional sanitary landfills at Soula and Mathavanga, and expanding the existing 3R project. This shift is crucial for mitigating environmental hazards and safeguarding public health. We are also embracing the 4R principles (Reduce, Reuse, Recycle, Recover) to minimize waste generation and maximize resource recovery, significantly reducing the burden on our landfills and promoting a circular economy.

Recognizing the essential role of community involvement, we are actively engaging with residents through ward-based Community Based Organizations (CBOs), implementing efficient collection systems, and establishing feedback mechanisms. Given the SCIP Plastics project's focus, we are particularly dedicated to reducing plastic waste, researching and implementing innovative solutions to promote sustainable alternatives.

Furthermore, we are committed to ensuring the KCC Waste Management Department has the necessary resources and capacity to effectively implement the master plan. We are also establishing robust monitoring and evaluation systems to track progress and ensure accountability. This complex undertaking requires the cooperation of all stakeholders, and we are confident that by working together, we can achieve our vision of "zero-unmanaged waste" and create a cleaner, healthier, and more sustainable Khulna for future generations. We are committed to transparent communication, keeping you informed of our progress, and encourage your participation in our initiatives and feedback. Thank you for your support.

Prof. Mohammad Mashud, Ph.D.
Project Lead (KUET)
SCIP Plastics Project
Khulna University of Engineering & Technology (KUET), Khulna-9203.

Acknowledgement

We want to extend our deepest gratitude for the invaluable support we have received for the "KCC Solid Waste Management Master Plan, 2040". This crucial initiative was significantly bolstered by the "Sustainable Capacity building to reduce Irreversible Pollution by Plastics - SCIP Plastics Project funded by the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV)"

This project is a testament to the power of international collaboration, being a joint research endeavor among Khulna University of Engineering & Technology (KUET); Khulna City Corporation (KCC); Chittagong University of Engineering and Technology (CUET), Bangladesh; and Bauhaus-Universitat Weimar (BUW), Germany.

Our sincere thanks go to Swadhin Das, whose expertise as a GIS expert was instrumental. We are also profoundly grateful to Prof. Dr.-Ing. Eckhard Kraft, the dedicated Project Leader from Bauhaus-Universitat Weimar (BUW), Germany, for his leadership. Additionally, we acknowledge the vital contributions of Prof. Dr. Muhammed Alamgir (Scientific Expert), Gregor Biastoch (Project Coordinator, BUW), Dipl.-Ing. Senta Berner (Scientific Coordinator, BUW), Philipp Lorber (Scientific Coordinator, BUW) and Michaela Rohrbach (Research Scientist, ISOE), for their support and coordination during the master plan preparation. We would also like to express our appreciation to Mr. Abir Ul Jabbar, Chief Planning Officer of Khulna City Corporation (KCC) and Focal Point for his meaningful advice and contribution. In addition, we would like to thank Engr. Md. Abdul Aziz, Chief Waste Management Officer of KCC, as well as the KCC Authority, for their essential guidance and support.

Finally, we thank all team members of the SCIP Plastics Project, especially Sheikh Enjamamul Haque, Head of the Awareness Centre of KCC; Sourav Saha, Lead of the Assessment of Secondary Transfer Stations; Pangkaj Kumar Mahanta, Lead of the Assessment of Landfill; Jobaer Ahmed Saju, Lead of the Assessment of Recycling Shops; and Md. Noor Alam, Expert of Waste Lab for their invaluable data and information support provided for the Masterplan.

Dr. Md. Manjur Morshed
Focal Point, KCC Waste Management Master Plan 2040
&
Professor
Department of Urban and Regional Planning
Khulna University of Engineering & Technology (KUET)
Khulna-9203.

Executive Summary

Solid Waste Management Rules, 2021 stipulates additional 28 Responsibilities to local governments for Solid Waste Management (SWM). Among those responsibilities, the foremost are: (i) SWM Master Plan preparation; (ii) treatment, Recycling, Re-use, Recover, Reduction, Processing and Segregation of SW; and (iii) construction of sanitary landfills. This SWM masterplan is an endeavor to plan to manage an estimated 1000 tons/day of solid waste generated at Khulna city in 2023 and to plan for the year 2040. The masterplan is financially supported by the Sustainable Capacity builidng to reduce Irreversible Pollution by Plastics (SCIP Plastics Project), Khulna University of Engineering & Technology (KUET). Subsequently, the SWM masterplan is a collaborative effort by the SCIP plastics project and Khulna City Corporation (KCC).

The masterplan in question is subdivided into seven chapters:

Chapter 1: Introduction
Chapter 2: Regulatory Framework & Previous Projects for SWM
Chapter 3: Overview of SWM in Khulna City
Chapter 4: Framework of Master Plan
Chapter 5: Master Plan for SWM in Khulna City
Chapter 6: Budget and Priority Project
Chapter 7: Conclusion and Recommendation

The scope of the masterplan covers the KCC area, approximately 45.65 km^2 divided into 31 wards. The solid wastes comprise of MSW, business waste, medical waste, drainage waste, industrial waste, building waste, hazardous waste and marine waste. The target year of the masterplan is the year 2040. The layout of the masterplan is as follows. First, a population forecast is done up to the year of 2040 along with estimated waste generation in the KCC area. Secondly, the waste generation is projected for the same year along with targets for waste collection and disposal. Thirdly, all open dumpsites are considered closed by the year 2030 and engineering landfill sites are proposed. Fourthly, several SWM scenarios are generated, facility requirements are predicted and timeframe is set. Fifthly, the working process of the master plan is laid out considering the roles and responsibilities of different stakeholders. Finally, some specific proposals are suggested and a few recommendations are made to ensure sustainable SWM system.

In the present area of KCC, 1800 tons/day MSW is estimated for the year 2040. With a collection target set at 95% of the MSW, three landfill sites are proposed Mathavanga, Rajbandh and Shoula. These landfill sites are already in the planning phase of the KCC as land has already been acquired. One of the major policies of the masterplan is to align with the existing system and future plan of KCC to manage MSW. Secondary transfer stations (STS) are proposed in suitable locations which will be in line with the minimum transport requirements. Moreover, landfills are decentralized in such a location that the transportation of MSW for the STS will be minimized. It is understood that no additional sanitary landfills will be required by the year 2040 given that the landfills are constructed as per the proposed timeframe.

One of the major limitations of this masterplan is that it does not provide a financial feasibility plan. However, the masterplan sets specific recommendation for improving MSW collection, transportation, recycling and safe disposal of solid wastes in Khulna city.

List of Abbreviation

AAP - Approach Action Plan
AWC - Awareness Centre
BUW - Bauhaus-Universitat Weimar (BUW)
CAP - Community Action Plan
CBO - Community Based Organization
CC - City Corporation
CD - Conservancy Department
CHD - Centre for Human Department
CO - Community Organization
CI - Community Institution
CRDP - Community Resilience and Development Programme
CUWG - Community Unit Working Group
DSK - Dustha Shasthya Kendra
DFID - Department for International Development, UK
DGHS - Directorate General of Health Services, Ministry of Health and Family Welfare
DoE - Department of Environment, Ministry of Environment and Forests
EIA - Environmental Impact Assessment
FY - Financial Year
FTFP - Fixed-Time Fixed-Place
GAP - Grant Aid Project
GIZ - Deutsche Gesellschaft fur Internationale Zusammenarbeit
GoB - The Government of Bangladesh
HCEs - Health Care Establishments
JICA - Japan International Cooperation Agency
KCC - Khulna City Corporation (KCC)
KFW - Kreditanstalt fur Wiederaufbau ("Credit Institute for Reconstruction")
KUET - Khulna University of Engineering & Technology
LFS - Landfill Site
LGD - LGD Local Government Division, Ministry of Local Government, Rural Development and Co-operatives
LGED - Local Government Engineering Department
MD - Mechanical Department
MLGRD&C - Ministry of Local Government, Rural Development and Cooperatives
MoEF - Ministry of Environment and Forests
MSW - Municipal solid waste (MSW)
NGO - Non-Government Organization
O&M - Operation and Maintenance
PAPS - Public Awareness Planning Section
PCSPs - Primary Waste Collection Service Providers
SCPs - Secondary Collection Points (SCPs),
PRD - Public Relations Department
PCG - Public Consultative Group
PSCP - Public Sanitary and Cleanliness Promoters
SEIAM - Social & Environmental Increasing Analysis Movement
STS - Secondary Transfer Station
SWMSC - Solid Waste Management Standing Committee
SWs - Solid Wastes (SWs)
UNDP - United Nations Development Program
WBA - Ward-based Approach
3-R - Reduce, Recycle and Reus

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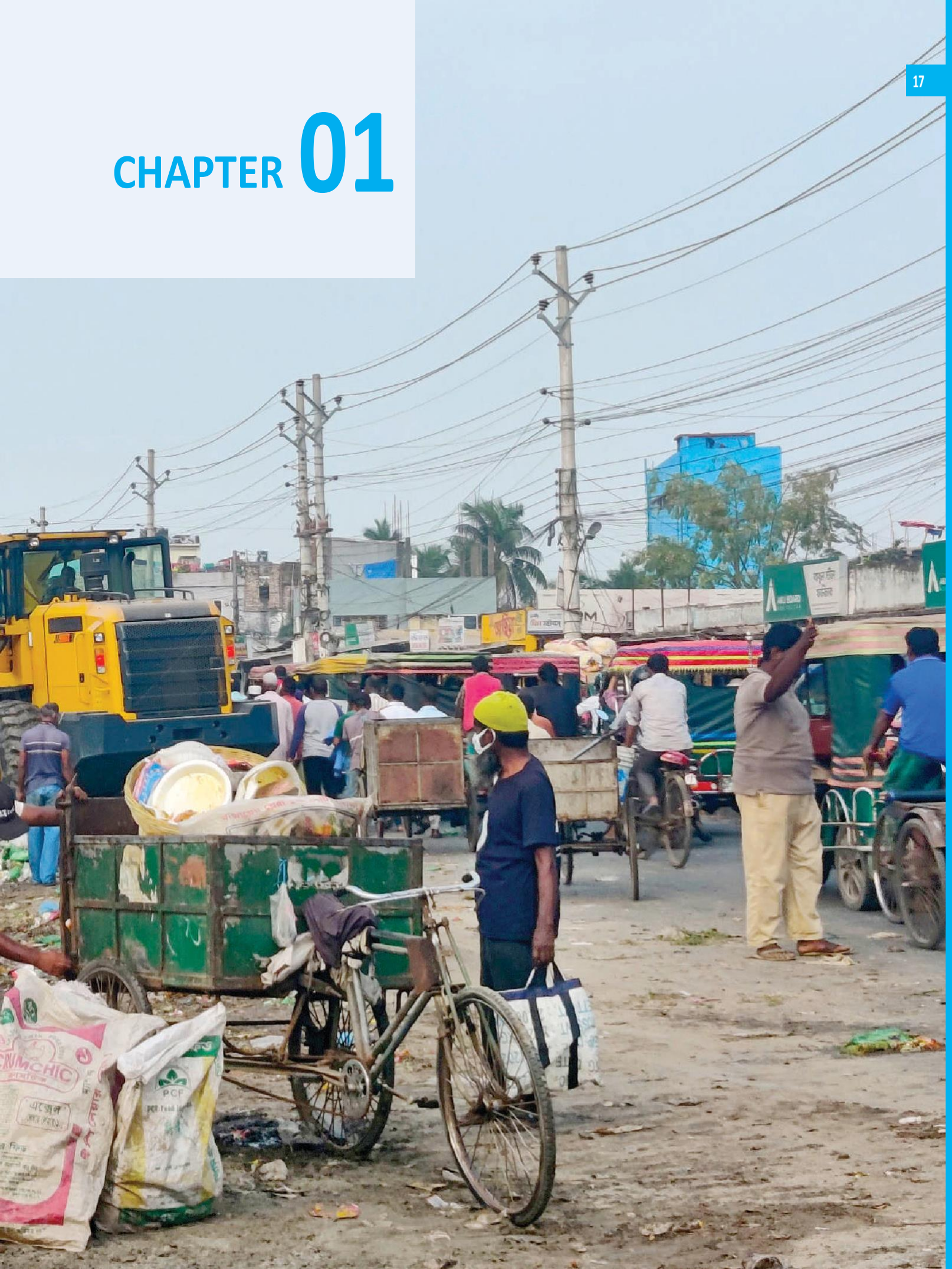
CHAPTER 01



CHAPTER 01

INTRODUCTION

1.1 Background

Managing Solid Wastes (SWs) of cities of developing countries is a priority, and also a challenge. The concern for SWs overlaps health and population (SDGs Goal 3), water and sanitation (SDGs Goal 6), sustainable cities and human settlement (SDGs Goal 11), and sustainable consumption and production (SDGs Goal 12). By 2050, more than two-thirds of the world population is expected to reside in urban areas, and cities below five million population have the biggest prospect for urbanizing economies globally (Cities Alliance, 2023). Thus, managing urban growth, as well as coping with the changing consumption and SWs management (European Environmental Agency, 2023), is a key concern for secondary cities.

Khulna is the third largest metropolitan city in Bangladesh, which falls into the secondary city category. The area of the Khulna City Corporation is 45.65 km2. The city consists of 31 wards with a total population of 1.26 million in 2023, which is projected to be 1.73 million in 2040 (KCC, 2023). The study contains eleven upazilas along with the city area. The city is situated at the junction of the Rupsha and Bhairab rivers and is laid out along the Bhairab. Khulna City Corporation (KCC) is responsible for managing municipal solid waste (MSW) in Khulna City. The city generates approximately 1000 tons of MSW per day (KCC, 2023), which is expected to increase in the coming years due to population growth and urbanization. Around 80% of the daily generated MSW (800 tons/day) is collected and dumped (100%) at the Rajbandh open landfill site (AA News Desk 2023).

The Bangladesh Solid Waste Management Rules 2021 opts for the National 3R (Reduce, Reuse, and Recycle) strategy for MSW. Hence, all municipalities and city corporations are bound to follow the national strategy of managing MSW through sanitary landfills. As a result, three additional MSW processing units are underway: Soula sanitary landfill, Mathavanga sanitary landfill and the 3R project. The principal approach is to distribute MSW into these three projects. Soula sanitary landfill is due to be operational in 2024, Mathavanga is yet to be materialized and the 3R is a completed pilot project that processes 20 tons/day MSW. The current MSW management system in Khulna City is inadequate, leading to environmental hazards and health problems. For this reason, KCC aims to develop a comprehensive Solid Waste Master Plan to address these issues and ensure a sustainable solid waste management system.

The current MSW management system in Khulna City is inadequate, leading to environmental hazards and health problems. For this reason, KCC aims to develop a comprehensive Solid Waste Master Plan to address these issues and ensure a sustainable solid waste management system. The title of the study is "KCC Solid Waste Management Masterplan, 2040". The study is a subcomponent, and thereby funded, the project entitled "Sustainable Capacity Building to reduce Irreversible Pollution by Plastics-shortly SCIP Plastics Project", which is collaborative research between Khulna University of Engineering & Technology (KUET), Khulna, Bangladesh, and Bauhaus-Universitat Weimar (BUW), Germany.

1.2 Review of the Previous Master Plan

There is no master plan for solid waste management for Khulna. This is the first waste management master plan for Khulna City Corporation (KCC).

1.3 Preparation Process of the Master Plan

For the preparation of the Master Plan, basic information, and data on SWM in KCC were collected. This was then analyzed after reviewing the literature, as shown in Figure 1-1. After the preparation of the Master Plan draft, KCC will establish a committee to review the draft and finalize the Master Plan.

This master plan is a dynamic document and thus, will have to be revised every three to five years or at any suitable time as per the requirement of the authority (City Corporation or concerned authority) with updated data and information to meet the current conditions of the city's situation and needs of the society.

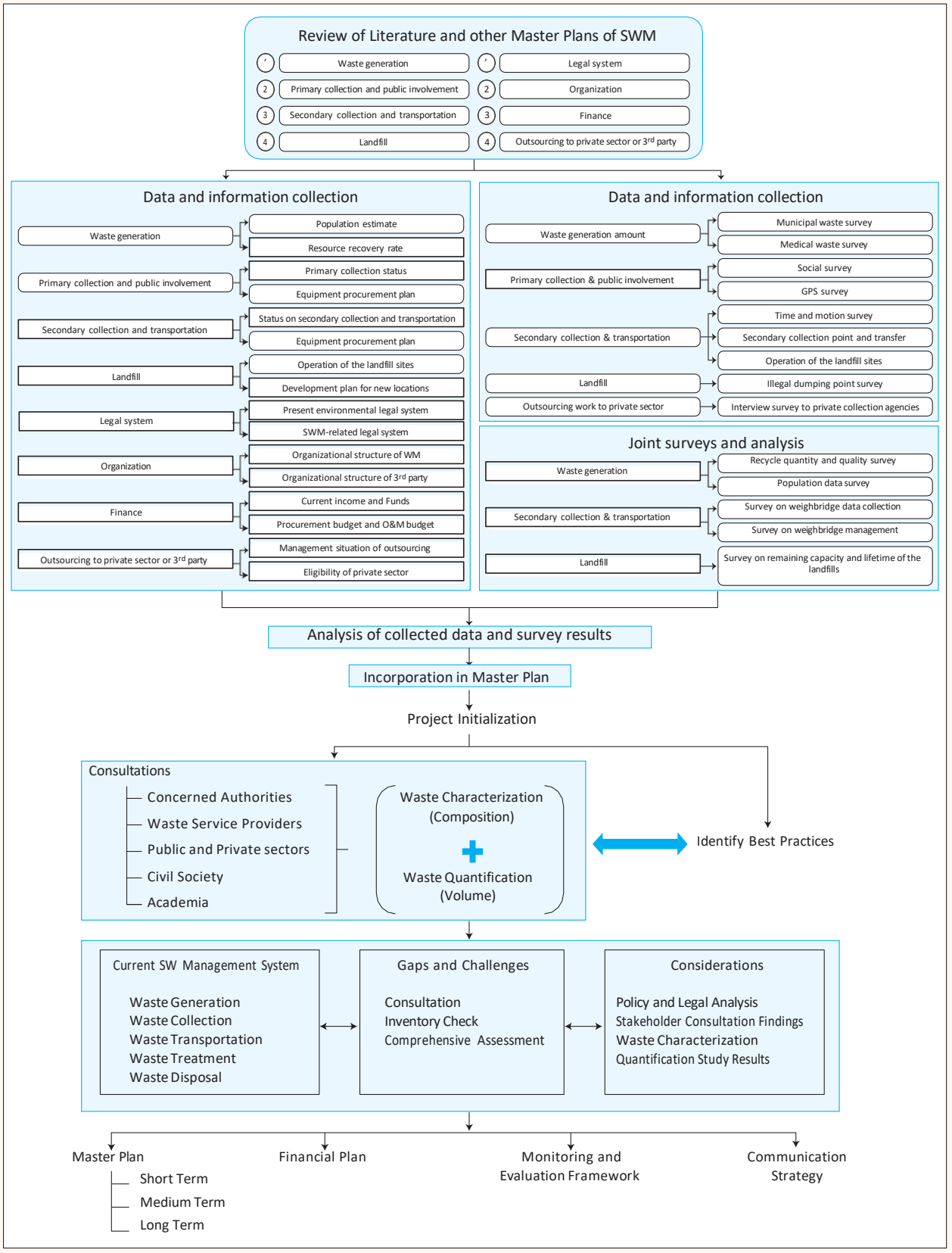


Figure 1-1. Waste Management Master Plan Preparation Process

1.4 Target Area and Waste

1.4.1 *Target Area*

The Master Plan covers the entire jurisdiction of KCC as of 2023 which is comprised of 31 wards, as shown in Figure 1-2. The total area is approximately 45.65 km2.

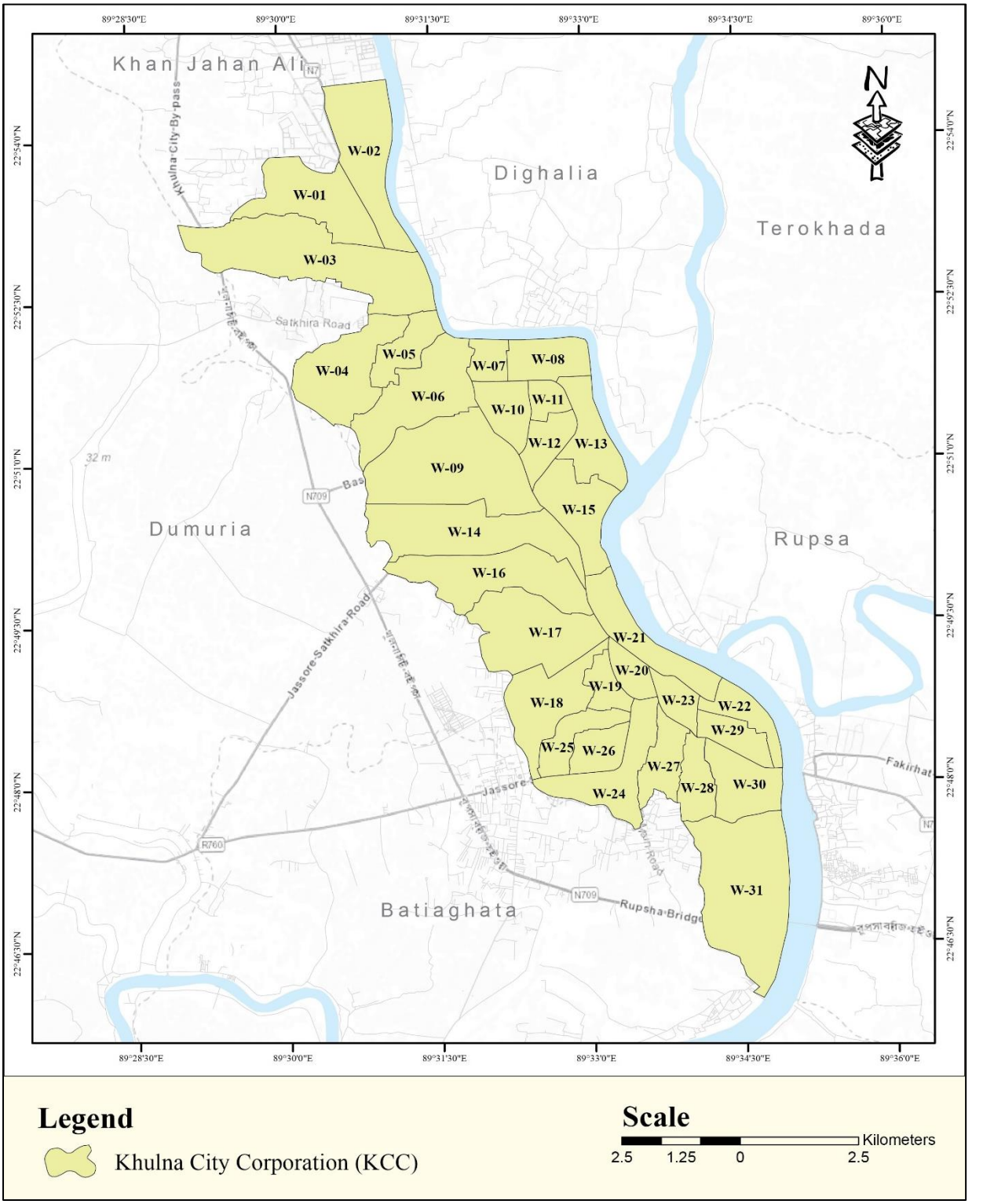


Figure 1-2. KCC Jurisdiction of Khulna

1.4.2 *Target Year*

The reference year of the Master Plan is calendar year 2025 (FY2024-2025), and the target year is set as 2040 (2039-2040).

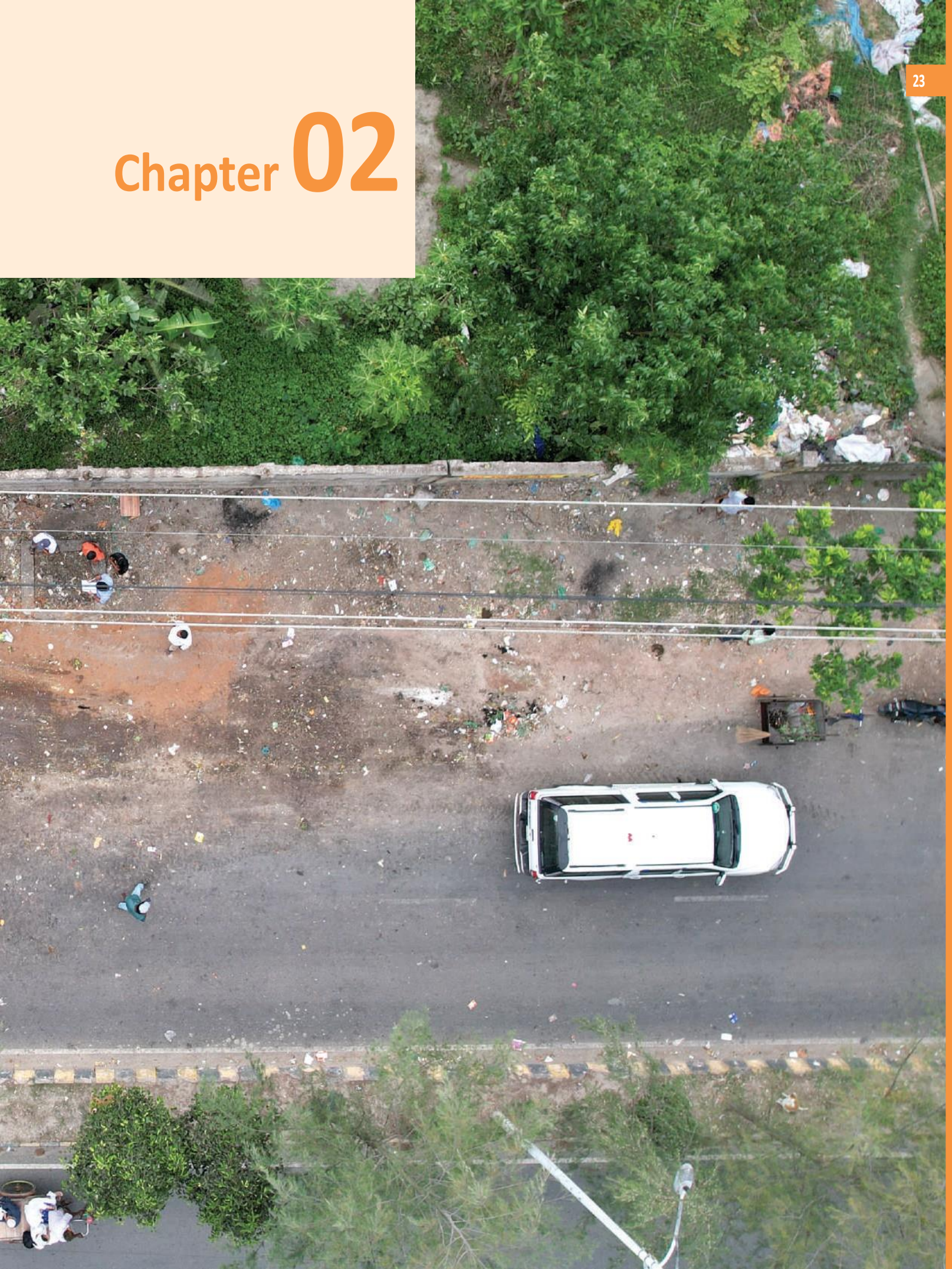
1.4.3 *Target Waste*

The targeted waste in this Master Plan comprises three types of waste: municipal solid waste, business waste, and medical waste, as shown in Table 1-1. KCC recognizes that some waste is received, whereas some other portion is likely to be dumped illegally. For hazardous waste and other industrial waste, some private companies have already established their disposal systems without the involvement of KCC, but the detail is unknown until now. Thus, the KCC will further investigate the detail of these wastes including generation, collection and transport, and final disposal to incorporate them into the future Master Plan for appropriate solutions.

Table 1-1. Target Waste in This Master Plan

Waste Category	Contents
Waste	"Waste" refers to any solid, liquid, gaseous, or radioactive substance, the discharge, disposal, and dumping of which may cause harmful changes to the environment
Solid Waste	Non-hazardous and non-poisonous waste (solid or partially solid) may have value or no value.
Municipal Solid Waste	Waste generated from residences and collected by the KCC
Household Waste (By Income)	Solid waste collected from households.
Low Lower Middle Middle Higher Middle High	(Biodegradable Waste) (Plastics) (Glass) (Textiles and wood) (Electric goods) (Dust & others)
Street Waste	Solid waste collected from streets.
Industrial Waste	General term of waste from business properties, which sometimes includes chemical components, generated from the business, commerce, agriculture, building construction, and other activities
Business Waste	Industrial waste collected from restaurants, hotels, markets, and offices
Construction Waste	Industrial waste collected from building construction
Other	Industrial waste collected from other businesses
Hazardous Waste	Waste having physical and chemical properties or that mixed with other waste and materials to cause poisonous effects, viral transmission, flaming, explosive effects, radioactivity, corrosiveness, and other destructive effect on the environment
Drainage Waste	Sludge and drainage waste were collected during various periods. And data on that.
Marine Waste	Plastic pollution running into directly into marine.
Medical Waste	Waste emitted, generated, or accumulated from the treatment, vaccination, or diagnosis of diseases.
Non-hazardous waste	Non-hazardous waste generated
Hazardous waste	All other wastes apart from non-hazardous waste such as infectious, sharp, radioactive waste

Chapter 02



CHAPTER 02

REGULATORY FRAMEWORK AND PREVIOUS PROJECTS FOR SOLID WASTE MANAGEMENT

2.1 Regulatory Framework

2.1.1 *Central Government Policies, Acts, Rules, and Regulations*

The Government of Bangladesh (GoB) has developed several regulatory documents, including waste management policies, acts, rules, and strategies. The Solid Waste Management Rules 2018 have been drafted as a fundamental waste management law and are currently awaiting approval. Furthermore, the GoB recently announced plans to implement intermediate treatment as a powerful waste-reduction tool.

Table 2-1. Regulatory Documents related to Solid Waste Management

Title	Year	Organization
Bangladesh Environment Conservation Act, 1995, amended in 2000, 2002, and 2010	1995	DoE
National Environmental Management Action Plan	1995	DoE
Environmental Conservation Rules, 1997	1997	DoE
Lead Acid Battery Recycling Related Circular	2006	DoE
Medical Waste (Management and Handling) Rules, 2008	2008	DoE
National 3R Strategy for Waste Management, 2010	2010	DoE
Local Government (City Corporation) (Amended) Act 2011	2011	LGD
Hazardous Waste and Ship Breaking Waste Management Rules, 2011	2011	DoE
Ship Breaking and Recycling Rules, 2011	2011	Ministry of Industries
National Environmental Policy, 2013	2013	DoE
Seventh Five Years Plan (FY2016-FY2020)	2015	Ministry of Planning
Electrical and Electronic Product Induced Waste (E-waste) Management Rules, 2017	2017	DoE
Solid Waste Management Rules, 2018	2018	DoE

2.1.2 *Responsibility Defined in the Regulatory Documents*

The waste management-related laws define the responsibility of SWM regarding waste collection and transport in addition to waste treatment and disposal, as shown in Table 2-2. Despite the case that the regulation appoints the central government agencies as supervision authorities. CCs and municipalities are often involved in its own supervision.

Table 2-2. Responsibilities of agencies regarding solid waste management

Types of Waste	Responsibility		Supervision
	Collection and Transport	Treatment and Disposal	
Municipal solid waste	Licensed contractor, society, association, community or private company (primary collection) and local government: CC and municipalities (secondary collection and transport)	Local government: CC and municipalities	Local government: CC and municipalities
Commercial Waste	Discharger and licensed entities	Discharger and licensed entities	DoE, CC
Construction Waste	Discharger and licensed entities	Discharger and licensed entities	Local government: CC and municipalities
Hazardous Waste	Discharger and licensed entities	Discharger and licensed entities	DoE, CC
Medical Waste	Discharger or licensed entities of skilled personal/company/ contractor	Discharger or licensed entities of skilled personnel/company/ contractor	DGHS, DoE, and Local government: CC
E-waste	Discharger and licensed entities (producer, collection center, collector or transporter)	Discharger and licensed entities (dealer/dismantler/recycler/ refurbished)	DoE, CC
Leachate	Discharger and licensed entities	Discharger and licensed entities	DoE, CC
Flammable Waste	Discharger and licensed entities	Discharger and licensed entities	DoE, CC

Source: SCIP, 2023

2.1.3 *Structure of Central and Local Government in Solid Waste Management*

In general, the supreme authority of local government management lies in the central government, which is essentially responsible for policy and decision making, planning, finance, and human resources management. Local government is a delivery organization for executing or implementing a service. KCC is responsible for SWM service delivery through SWM planning. From the perspective of the country-level governance structure, the LGD is responsible for managing all city corporations (CCs) and municipalities in administrative aspects and provides budgetary support. Local government is responsible for SWM in CCs and municipalities in formulating a project and obtaining approval from the Planning Commission or ECNEC. For SWM, the role of Department of Environment (DoE) under the Ministry of Environment and Forests (MoEF) is vital in a legal aspect. The DoE has been formulating various environmental laws in close association with the LGD and other related departments and ministries.

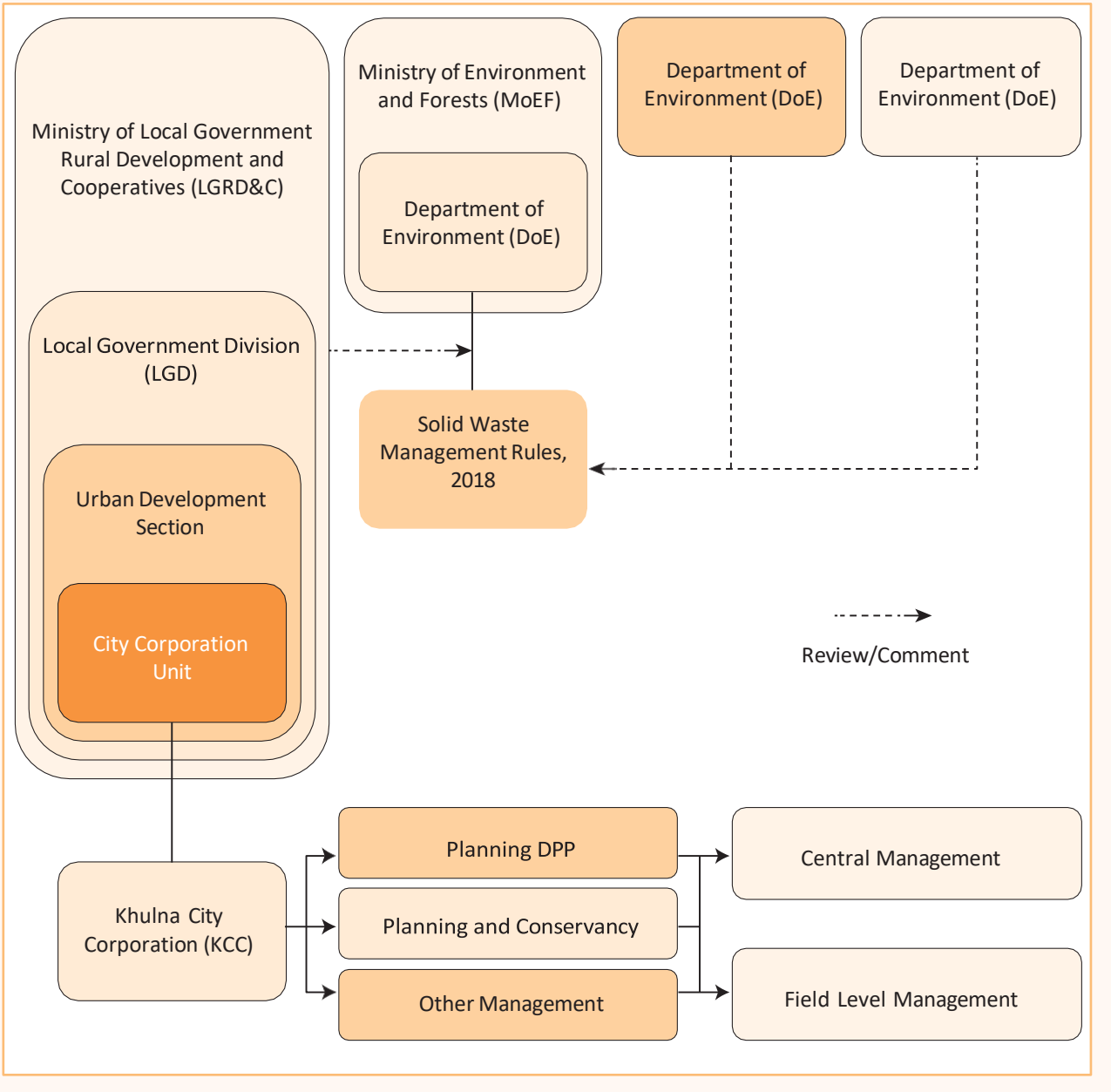


Figure 2-1. Structure of Central and Local Government in Solid Waste Management in KCC

2.2 Projects Related to Solid Waste Management

2.2.1 *Self-funded Projects of KCC*

KCC has four self-funded projects to improve the solid waste collection and management system within the KCC administrative area. The details of the projects are presented in Table 2-3 (2019-2027).

Table 2-3 SWM related GoB and Donor-funded projects

Sl. No	Name of the project	Amount in BDT	Major Activities
1.	Development of Damaged Roads in Khulna City Corporation	6.52 billion GoB	a. Construction of road and roadside drains b. Construction of footpaths c. Intersection area improvement
2.	Improvement of Drainage Network to Mitigate Water Logging Problem in Khulna City Corporation	8.23 billion GoB	a. Construction of drains b. Construction of Sluice gates c. Canal Excavation d. Lining of canals e. Construction of pump house f. Construction of bridges
3.	Improvement of Solid Waste Management in KCC	4.03 billion GoB	a. Construction of landfill b. Procurement of equipment c. Construction of secondary Transfer Station
4.	Climate Change Adaptation and Urban Development Project	3.91 billion GoB, KFW, KCC	a. City protection dam and embankment b. Excavation canals and embankment c. Renovation and embankment of 17 ponds d. Development of Sonadanga bypass road and drainage

Source: KCC, 2023

2.2.2 *Donor Supported Projects*

Seven projects are in progress for SWM in KCC supported by foreign donors. The details of these projects are shown in Table 2-4.

Table 2-4 SWM related donor-funded projects

Sl. No	Name of the project	Amount in BDT	Major Activities
1.	City Region Development Project II Funded By: Asian Development Bank	650 million	a. Improvement of waste management
2.	Bangladesh Municipal Development Fund Funded By: World Bank	450 million	a. Construction of roads and roadside drain b. Kitchen Market
3.	City Wise Inclusive Sanitation Engagement in Khulna City Funded By: Bill and Melinda Gates Foundation Supported By: SNV (2018-2022)	50 million	a. Feacal Sludge Management b. Awareness program c. Construction of Feacal sludge treatment plant

Sl. No	Name of the project	Amount in BDT	Name of the project
4.	Urban Management of Internal Migration Due to Climate Change Funded by: German Development Cooperation (GIZ)	2 million	a. Livelihood Training program in slum area specially for climate migrants b. COVID 19 Support
5.	Livelihood Improvement of Poor Communities (Slum Improvement) Funded by: UNDP DFID	150 million	a. Construction of small roads, footpaths, drains, Toilets, b. Cash money for education, business, housing etc. c. COVID 19 Support
6.	Transitioning to Sustainable Urban Water Cycles in Bangladesh Funded By: EKN Supported By: SNV (2023-2027)	50 million	a. Capacity Building b. Drainage Master Plan Review & Operation (Software) c. Waste Management (Soft Component)
7.	Sustainable Capacity building to reduce Irreversible Pollution by Plastics-SCIP Plastics (2023-2025)	50 million	a. Establishment of Awareness Centre b. Renovation of STS c. Establishment of Occupational Health Safety Training Centre d. Construction of Embankment at Rajbandh Landfill e. Development of Recycling Business Model f. Preparing KCC Solid Waste Management Master Plan 2040

Source: KCC, 2023

2.2.3 *Completed Projects Financed by German Cooperation*

KCC completed several projects financed by German Cooperation for SWM in KCC area. The outlines of these projects are presented in Table 2-5 (2013-2018).

Table 2-5 Climate Change Improvement subprojects supported by German Cooperation

1.	CRDP/LGED/KCC/KfW/ ICB/W-03	Access Road Improvement in poor areas connected to other component (Laban Chara Areas, M. A. Bari Road Areas, Mujgunny Maha Sarak Areas)	Km	9.850
2.	CRDP/LGED/KCC/ KfW/ NCB/W-02	Rehabilitation of Embankment/ River Front Road (Ch. 00-3000m)	Km	3.000
3.	CRDP/LGED/KCC/KfW/ NCB/2014/W-04	Enhancement of Infrastructure for Public Transport on the Outer Bypass Road (Gollamari to Sonadanga Ch. 0 - 1725m)	Km	1.725
4.	CRDP/LGED/KCC/KfW/ NCB/2014/ W-05	(i) Improvement of Link Road-7 (Ch. 2072-3014m) (ii) Improvement of Drain of Link Road-7 (Ch. 00-2450m) (iii) Streetscaping of Link Road -7 (Ch. 00-2500m)	Km	3.014
5.	CRDP/LGED/KCC/KfW/ NCB/2014/W-01	Jessore Road, Boro Bazar to Joragate Area Improvement (Ch. 0-2225m)	Km	2.225
6.	CRDP/LGED/ KCC/KfW/ NCB/2015/W-06	Improvement of Rupsha Bus Terminal	-	-

7.	CRDP/LGED/KCC/KfW/NCB/2015/W-07	Road Safety Measures in KCC	No.	-
8.	CRDP/LGED/ KCC/KfW/ NCB/15/ W-08	Rupsha River Crossing Area Improvement	-	-
9.	CRDP/LGED/ KCC/ KfW/ NCB/2015/W-09	Rehabilitation of Embankment/ River Front Road (Ch.3000-4008m) - Part-II	Km	1.008
10.	CRDP/LGED/ KCC/ KfW/ NCB/2015/W-10	Rupsha River Crossing Area Improvement- Part-II	-	-
11.	CRDP/LGED/ KCC/KfW/ NCB/2016/W-11	i) Access road -Part II; ii) ii) Construction of 115 m RCC Retaining Wall at Jessore Road, Borobazaar to Joragate Area; iii) iii) Construction of Box Culvert (3mx2m) on Mujgunni Road at Ch. 2+150.	Km	1.500

Source: KCC, 2023

2.2.4 *SWM Related Projects in KCC*

KCC has completed several SWM projects, which highlights the importance of sustainable SWM in the city region. Some of the major projects are in the following:

1. 3-R initiative pilot project phase-I at Mathavanga
2. City Region Development Project-II
3. Improvement of Waste Management in Khulna

At the same time different development partners and international organizations have supported KCC for different SWM approaches, such as Community Based Pilot Project on Solid Waste Management in Khulna City (in collaboration with Swiss Agency for Development and Co-operation) and Proposed Integrated Landfill & Resource Recovery Facility in the Khulna City Corporation, Bangladesh (in Collaboration with ADB).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CHAPTER 03

CHAPTER 03

OVERVIEW OF SWM IN KHULNA CITY

3.1 Profile of Khulna City Corporation

Khulna City Corporation (KCC) is situated in the southwestern region of Bangladesh, near the confluence of the Rupsha and Bhairab rivers. KCC serves as the administrative and economic hub of the Khulna Division. It is the administrative headquarters of the Khulna Division, one of the country's eight administrative regions. The city plays a vital role in regional trade and commerce, with a major seaport, the Port of Mongla, and the Khulna Export Processing Zone contributing to the city's economic significance. Moreover, Khulna is known for its industrial presence, with various factories and manufacturing units, particularly in the textile and jute industries. Figure 3-1 represents the land use map of Khulna City.

Table 3-1 Profile of Khulna City Corporation

Item	Description
Established as Municipality	12th December, 1884
Established as City Corporation	6th August 1990
Area	45.65 sq.km
Total Population	1.26 million (2023)
Number of Wards	31
Number of Ward Councilor	31
Facilities	Urban Primary Health care center- 35 Nos.
	Length of roads- 640.68 km
	Number of parks - 5
	Number of modern children park - 1
	Length of Drains- 1205.75 km
	Total streetlights - 25,612
	Number of Households - 76,628
	Number of supermarkets and small market - 22
	Number of slaughterhouses - 22
	Number of public toilets - 10
KCC own land	246.2962 acres/ 99.676 hectors

Source: KCC, 2023

KCC has experienced steady urbanization and population growth over the years. The total area of the city is 45.65 sq km, and about 1.26 million people live in 31 wards in the KCC area. Figure 3-2 presents the ward-wise population distribution in the KCC area. The population is distributed in a total of 31 wards within the city, with the urban core being more densely populated, while the outskirts and suburban areas are home to a significant portion of the population as well. Projections for the future suggest that Khulna's population will continue to grow due to urbanization, industrialization, and its role as an economic center. Figure 3-3 illustrates the projected population in the KCC area up to 2040. The city's strategic location, along with its expanding economic activities, is likely to attract more residents, contributing to further urban development and infrastructure challenges as the city seeks to accommodate its growing population.

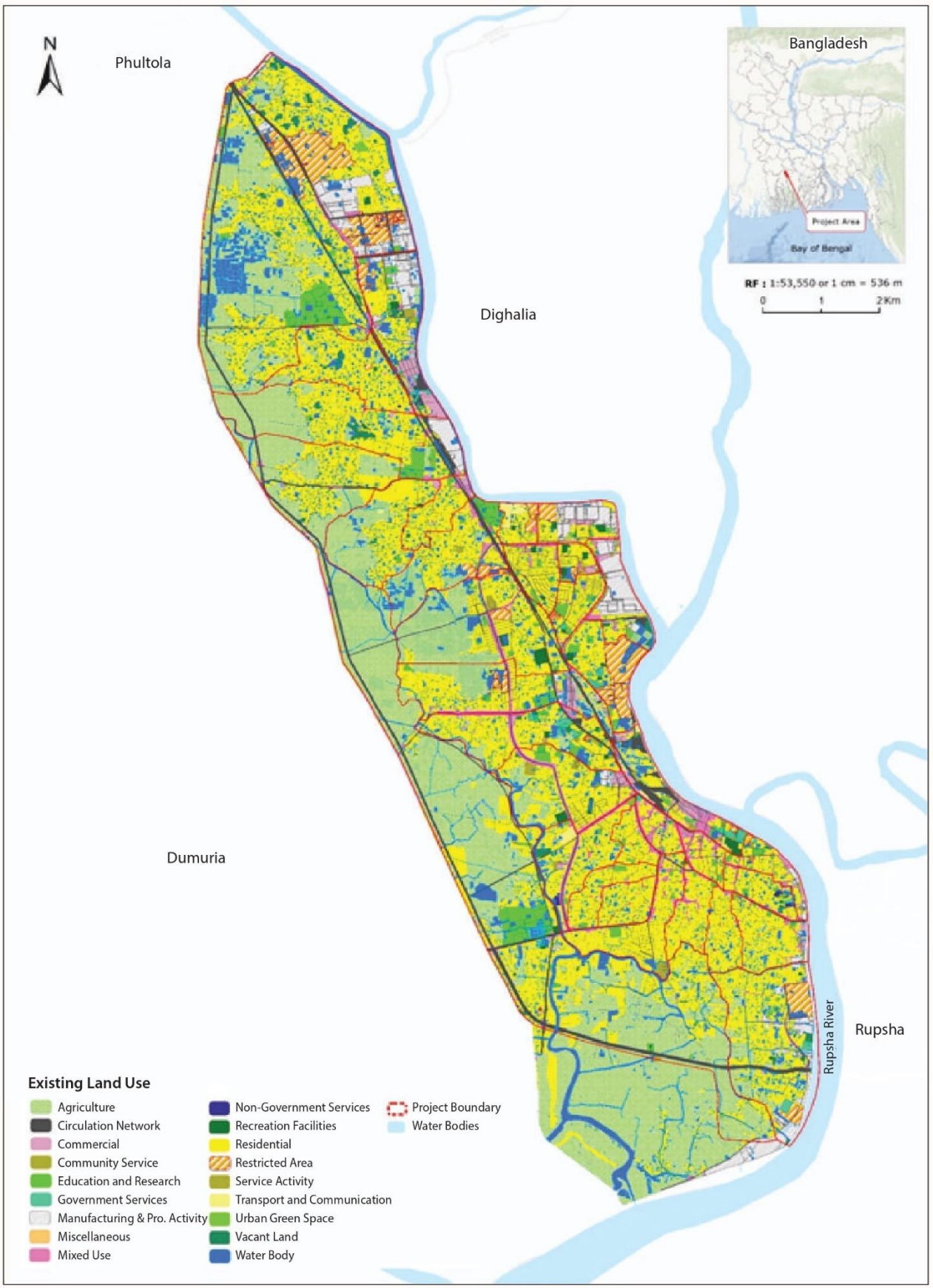


Figure 3-1. Generalized Land Use Map of Khulna City

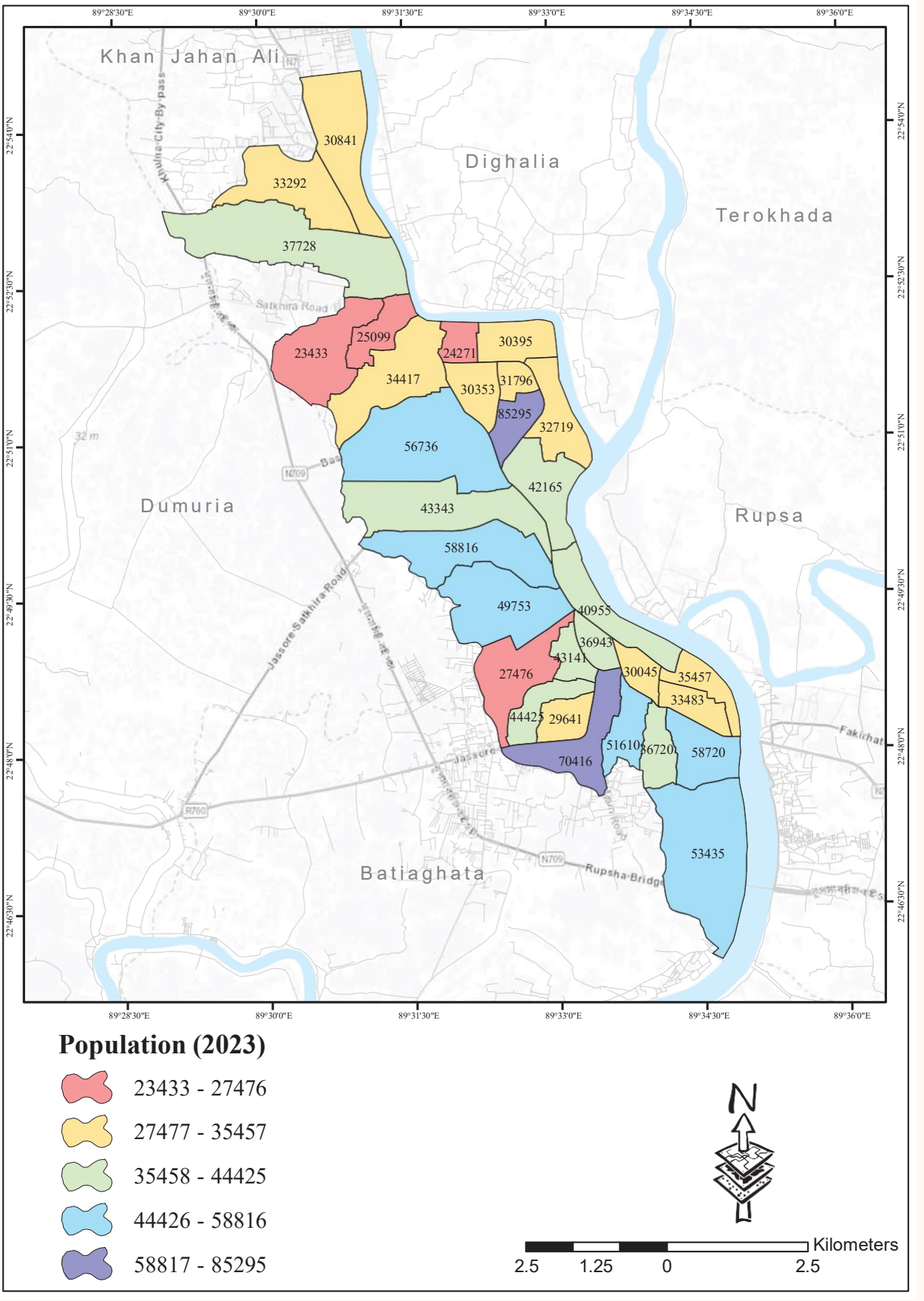
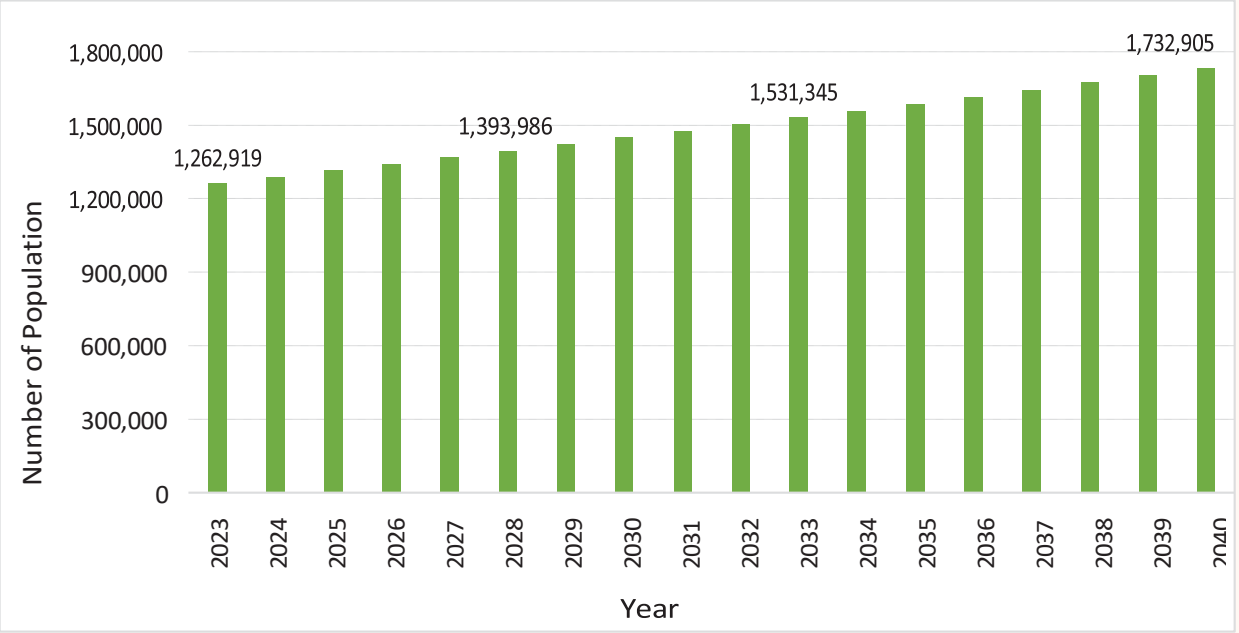


Figure 3-2. Ward Wise Population Distribution in KCC Area



Source: KCC, 2023

Figure 3-3. Projected Population in KCC Area Up To 2040

3.2 Organizational Structure in Solid Waste Management

3.2.1 *CBOs, NGOs and Private Sector in Waste Management*

NGOs and CBOs use a door-to-door collecting method, and their collected waste is then disposed of at the closest secondary transfer station (STS). Organizations like NGOs and CBOs run about 120 non-motorized vans. To move trash from community bins to STS, KCC has 400 vans available. In Khulna City, only about 14% of households are covered by KCC-enlisted NGOs and CBOs. NGOs and CBOs are obliged to report KCC every month. Some informal individuals contribute in the primary collection. There is no separation of waste at the home level. In most cases, waste is gathered in a single bucket, and the pickup vehicle has just one compartment, which causes the waste to mix. In Khulna City, 1000 tons of waste are generated daily, and 80% of the waste is collected. 20% of garbage is never dumped in landfills for various reasons. There are 81 STS in Khulna: 7 are in-house, 18 are open, and 56 are containers. Around 1,200 community bins are placed on roadways at random intervals. The MSW from community bins is usually moved to STSs by KCC vans. KCC operates 31 motorized trucks that collect garbage from STS and transport it to the landfill.

Table 3-2 NGOs/ CBOs Waste Collection Capacity

Sl. No	Name of the NGOs/ CBOs	Collection capacity per van trip per day (kg)	Total number of van trip completed per day	Total generated waste per day (kg)	Waste generated per household per day(kg/HH)
1	Bonchaya Mohila Kolyan Somiti	300	14	4200	2.92
2	Bonchaya Mohila Kolyan Somiti	300	11	3300	2.98
3	CHD (Centre for Human Department)	280	41	11480	3.31
4	Clanship Association	290	34	9860	0.89
5	DSK (Dustha Shasthya Kendra)	150	34	5100	1.66
6	SEIAM (Social & Environmental Increasing Analysis Movement)	288.1	32	9219.2	7.68
7	Nirala Janalolyan Somiti	234.89	--	--	--
8	CARITAS	480.53	8	3844.24	8.09
	Muktir Alo				

Source: SCIP, 2023

Table 3-3 Number Trips of Vehicles in KCC

Sl. No	Vehicle Type	Capacity (ton)	Trips (Monthly)	Distance (km/day)	Avg Speed (km/hour)
1	Small Truck	3	1400 to 1700	65.06	24.01
2	Medium Truck	7	300 to 400	48.7	24.38
3	Large Truck	13	450 to 650	88.97	21.49
4	Small Container Truck	2.5	300 to 350	108.11	26.65
5	Medium Container Truck	4.5	250 to 350	188.025	24.25
6	Large Container Truck	5	200 to 300	81.31	22.13

Source: KCC, 2023

3.3 Financial Information

3.3.1 *KCC Budget and Revenue*

Annual budget of KCC was BDT 675.20 lakhs in the FY2021-2022, and BDT 1488 lakhs in the FY2022-2023. The main source of the revenue is holding tax. Conservancy tax, which is the exclusive revenue of SWM, is collected as part of holding tax.

3.3.2 *Expenditures Related to Solid Waste Management*

The expenditure of the KCC for solid waste management during the FY2022-2023 is detailed in Table 3-4. Despite having a budget of 1488 lakhs for FY2022-2023, the total expenditure incurred by the KCC amounted to 1233 lakhs. Of this total expenditure, 608 lakhs were allocated for waste collection and transportation, 495 lakhs for cleaning drainage and roads maintenance, 70 lakhs for landfill operation expenses, and 60 lakhs were utilized for repair work.

Table 3-4 Breakdown of KCC Budget For Operation (FY2022-2023)

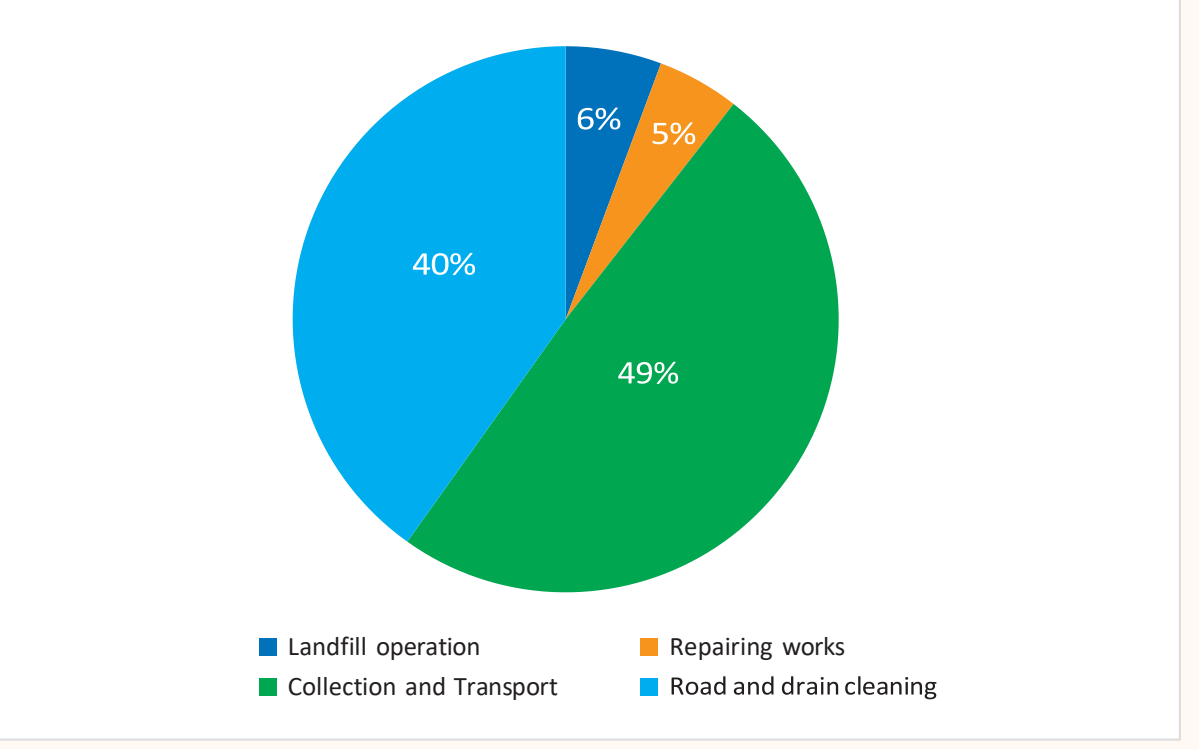
Unit: in Lakhs BDT

Criteria	Landfill Operation	Repair Works	Collection and Transport	Road/ Drain Cleaning
Conservancy Product Buy	–	–	30.00	–
Worker's apron Buy	–	–	3.00	–
Gam boot, Raincoat, Hand-gloves, Mask buy for officers, labors & cleaners	–	–	5.00	–
Wheel Baro car Buy & Maintenance	–	10.00	–	–
Van Buy	–		30.00	–
Van Maintenance & Parts Buy	–	15.00	–	–
De-Mountable Container Buy	–	–	30.00	–
Mud containing Car Buy	–	–	25.00	–
Conservancy Transport Maintenance	–	–	25.00	–
Garbage Truck with Compactor buy	–	–	55.00	–
Small/Large Excavator Buy	–	–	40.00	–
Road Sweeping Machine, Speed & back Wheel Loader Maintenance	–	–	–	5.00
Power Trailer with small trolly Buy	–	–	50.00	–
Shed Build for Garbage Truck	–	35.00	–	–
Three-Wheeler Buy	–	–	25.00	–
Wins Machine Buy	–	–	45.00	–
Pick up Car Buy	–	–	15.00	–
Motor Cycle Buy	–	–	8.00	–
Boundary Wall Construction for Sanitary Landfill	20.00	–	–	–
Cleaning Operation & Mud lifting for reducing Waterlogging	–	–	–	60.00
Rajbandh, Sholua, & Mathavanga Trenching ground Reformation	10.00	–	–	–
STS Construction	40.00	–	–	–
Solid Waste management through Tender	–	–	–	80.00
Mini truck Buy	–	–	10.00	–
Appointing Cleaners through Outsourcing	–	–	–	50.00
Appointing External Cleaners on Daily Wages	–	–	–	250.00
Only for Emergency Labor or Transport Appointment	–	–	–	50.00
Fuel Consumption for Solid Waste Removal	–	–	142.00	–
Fuel Consumption for Removal of Mud & Floating waste of Drain	–	–	70.00	–
Total	70.00	60.00	608.00	495.00

Source: KCC, 2023

3.3.3 *Operation-wise Solid Waste Management Expenditure*

The operation wise expenditure of KCC for solid waste management during FY2022-2023 is summarized in Figure 3-4. SWM activities in KCC are divided into four categories: cleaning roads and drains, waste collection and transportation, landfill operation, and repair of infrastructure. Figure 3-4 shows that 49% of KCC's waste management budget used for waste collection. Cleaning roads and drains receive around 40% of the total budget. Landfill operations account for just 6% of the budget, with the remaining 5% allocated to repair work.



Source: KCC, 2023

Figure 3-4. Operation Wise Solid Waste Management Expenditures in KCC

3.4 Municipal Solid Waste

3.4.1 *Solid Waste Generation*

I. Household Waste

For household-based waste generation profiling, households were categorized into five types based on income levels: higher income, higher middle income, middle income, lower middle income, and low income. Household-based waste generation statistics in KCC are summarized in Tables 3-5. Total household waste in FY2022-2023 was 641049 kg, associated with 1.26 million people. The dominant share of waste is biodegradable waste. Ward wise per capita waste generation data is summarized in Table 3-6.

Table 3-5 Estimated Household Waste Generation by Income Level in FY2022-2023

Criteria	Low Income	Lower middle Income	Middle Income	Higher Middle Income	Higher Income	Average
Composition	%	%	%	%	%	%
Biodegradable Waste	85.45	83.23	81.52	79.56	78.32	81.62
Plastics	2.94	3.67	4.21	5.64	6.01	4.49
Paper & cardboard	4.18	5.56	6.80	7.45	7.88	6.37
Glass	0.59	0.64	0.65	0.67	0.76	0.66
Textiles &wood	1.92	1.79	1.56	1.32	1.14	1.55
Electric goods	0.11	0.25	0.35	0.39	0.48	0.32
Ceramic	0.31	0.33	0.46	0.97	1.52	0.72
Metals	0.12	0.21	0.44	0.52	0.66	0.39
Medical waste	0.12	0.16	0.23	0.28	0.28	0.21
Dust & others	4.26	4.16	3.78	3.20	2.95	3.67
Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: SCIP, 2023

Table 3-6 Estimated Waste Generation by Ward in FY2022-2023

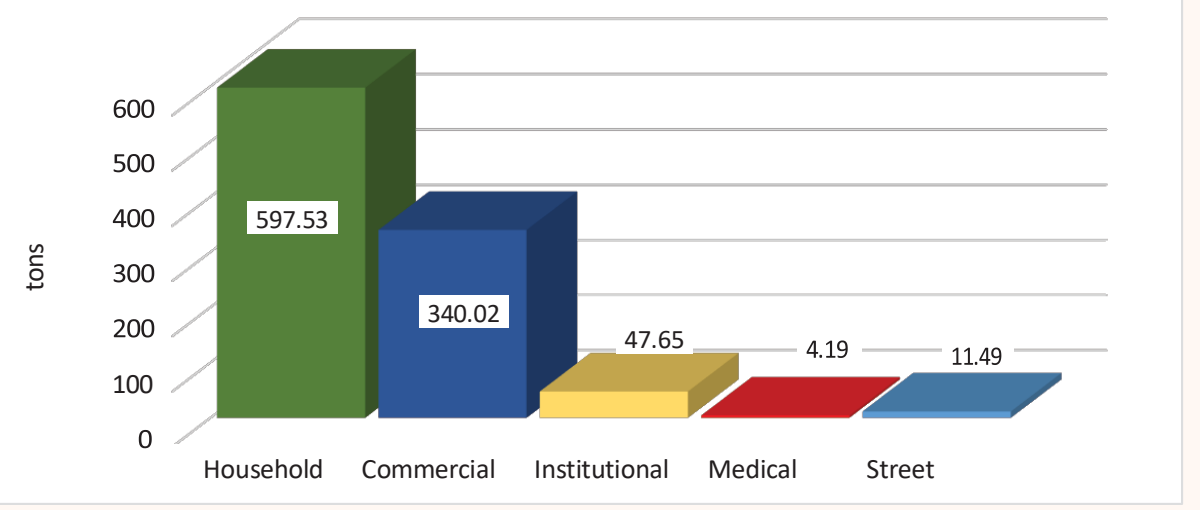
Ward No.	Population	Waste generation (ton)	Average Waste Generation Rate (kg/cap/day)
1	33292	12.45	0.33
2	30841	13.11	0.36
3	37728	14.98	0.30
4	23433	8.79	0.28
5	25099	9.96	0.20
6	34417	16.59	0.42
7	24271	12.40	0.27
8	30395	14.65	0.39
9	56736	30.64	0.67
10	30353	17.54	0.47
11	31796	16.25	0.59
12	85295	39.58	0.71
13	32719	17.67	0.43
14	43343	17.21	0.40
15	42165	21.55	0.44
16	58816	27.06	0.44

Ward No.	Population	Waste generation (ton)	Average Waste Generation Rate (kg/cap/day)
17	49753	28.76	0.44
18	27476	13.24	0.52
19	43141	20.02	0.56
20	36943	14.67	0.44
21	40955	19.74	0.54
22	35457	20.49	0.59
23	30045	13.82	0.37
24	70416	32.67	0.57
25	44425	20.44	0.58
26	29641	17.25	0.46
27	51610	23.74	0.36
28	36720	14.58	0.34
29	33483	19.35	0.52
30	58720	28.30	0.43
31	53435	20.04	0.34
Total	1262919	597.53	0.44

Source: SCIP, 2023

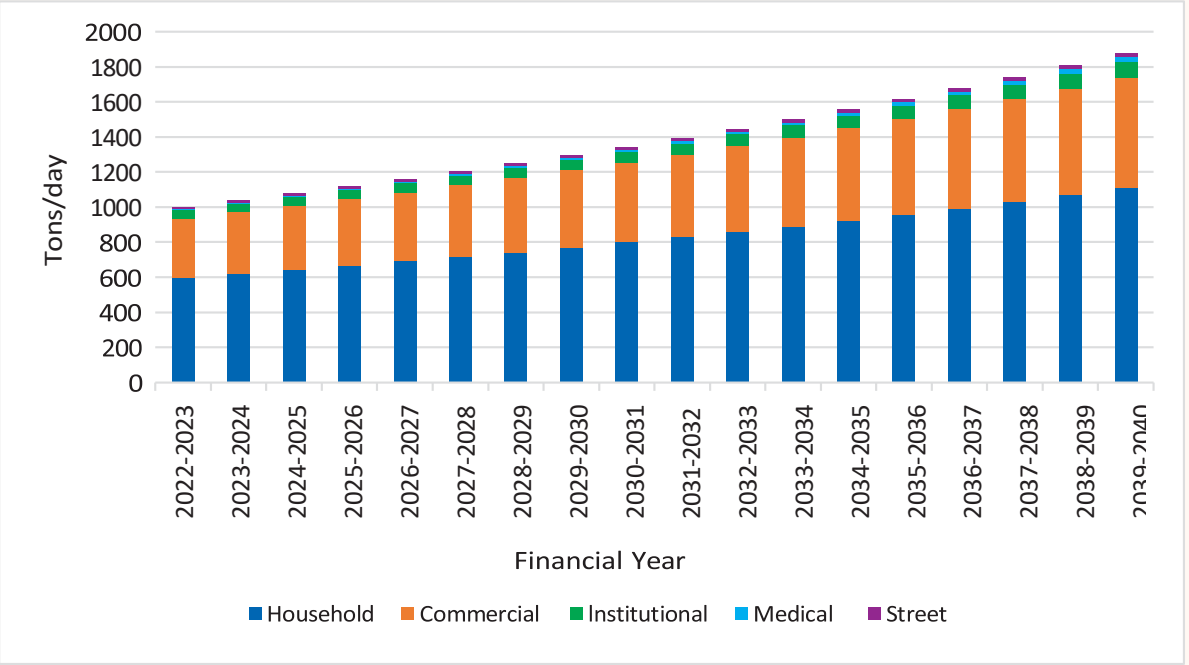
ll. Other Wastes

Total waste generation in FY2022-2023 was approximately 1000880 kg/day. Notably, households were the largest contributors to this waste stream, generating 5,97,530 kg per day. Household and commercial wastes accounted for 93.60% of the total waste. Medical waste generation was estimated at 4,910 kg/day (0.42%), institutional waste at 47,652 kg/day (4.76%), and street waste at 11,485 kg/day (1.15%) of the total waste volume. Projected waste generation during the project years presented in Figure 3-6.



Source: SCIP, 2023

Figure 3-5. Estimated Waste Generation by Waste Types in FY2022-2023



Source: SCIP, 2023

Figure 3-6. Estimated Waste Generation in KCC During Project Years

3.4.2 *Solid Waste Composition*

During FY2022-2023, about 5,97,530 kg of soil waste were generated in the KCC area. The composition of soil waste generated in the KCC area during FY2022-2023 is presented in Tables 3-7. About 81.62% of waste was biodegradable, and only 0.21% was medical waste.

Table 3-7 Composition of Solid Waste in KCC Area

Waste types	Amount of waste (kg)	Composition (%)
Biodegradable Waste	487680.08	81.62
Plastics	26853.00	4.49
Paper & cardboard	38086.56	6.37
Glass	3955.65	0.66
Textiles &wood	9237.81	1.55
Electric goods	1888.19	0.32
Ceramic	4290.27	0.72
Metals	2330.37	0.39
Medical waste	1278.71	0.21
Dust & others	21929.35	3.67
Total	597530.00	100.00

Source: SCIP, 2023

3.4.3 *Waste Flow/ Recycling/ Landfill*

Figure 3-7 represents the waste collection and transportation process in KCC area. The waste flow diagram shown in Figure 3-8 provides a detail overview of the waste management process within the KCC area, tracking the journey of waste from its generation to its ultimate disposal. The diagram takes into account waste originating from various sources, including streets, households, and commercial areas. Notably, street waste and construction waste follow a direct path to landfill sites. Additionally, non-recyclable waste originating from households and medical sources is collected by primary waste collectors and transported to landfill sites. However, a notable challenge is the presence of a considerable volume of waste originating from households and businesses that finds its way into illegal dumping sites. Recyclables wastes are collected by recyclable buyers from households, commercial spaces, and medicals.

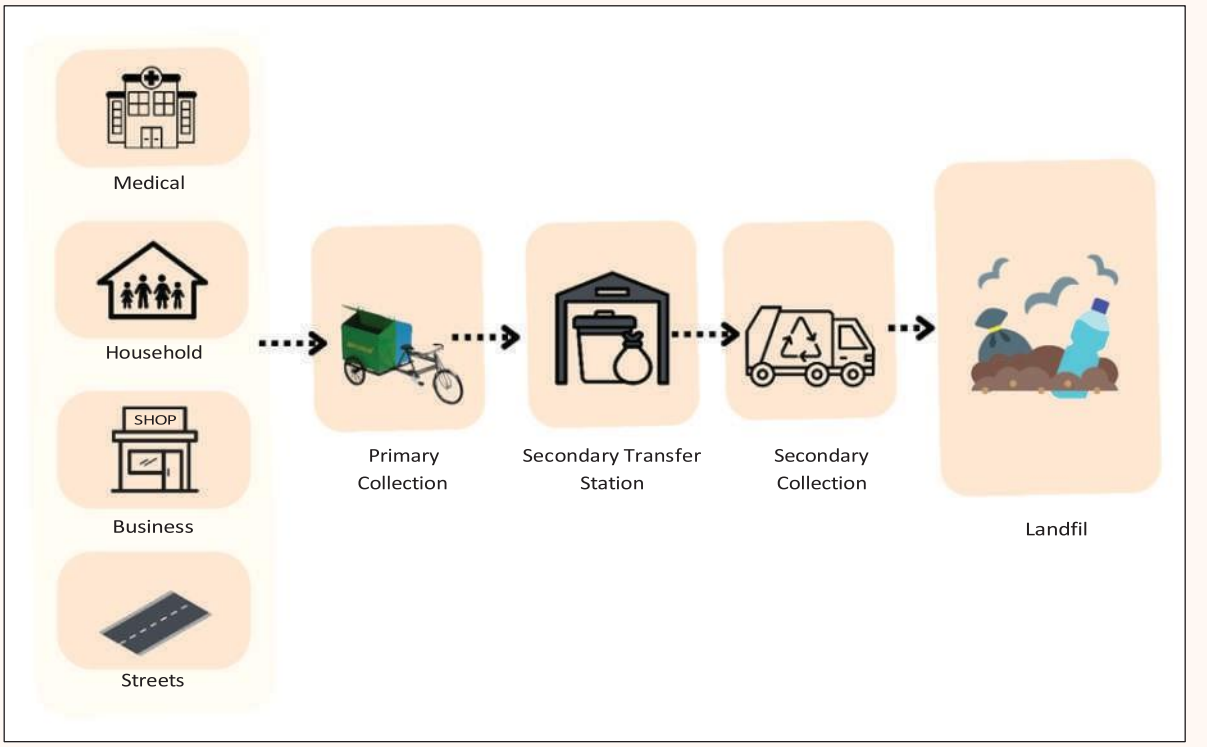
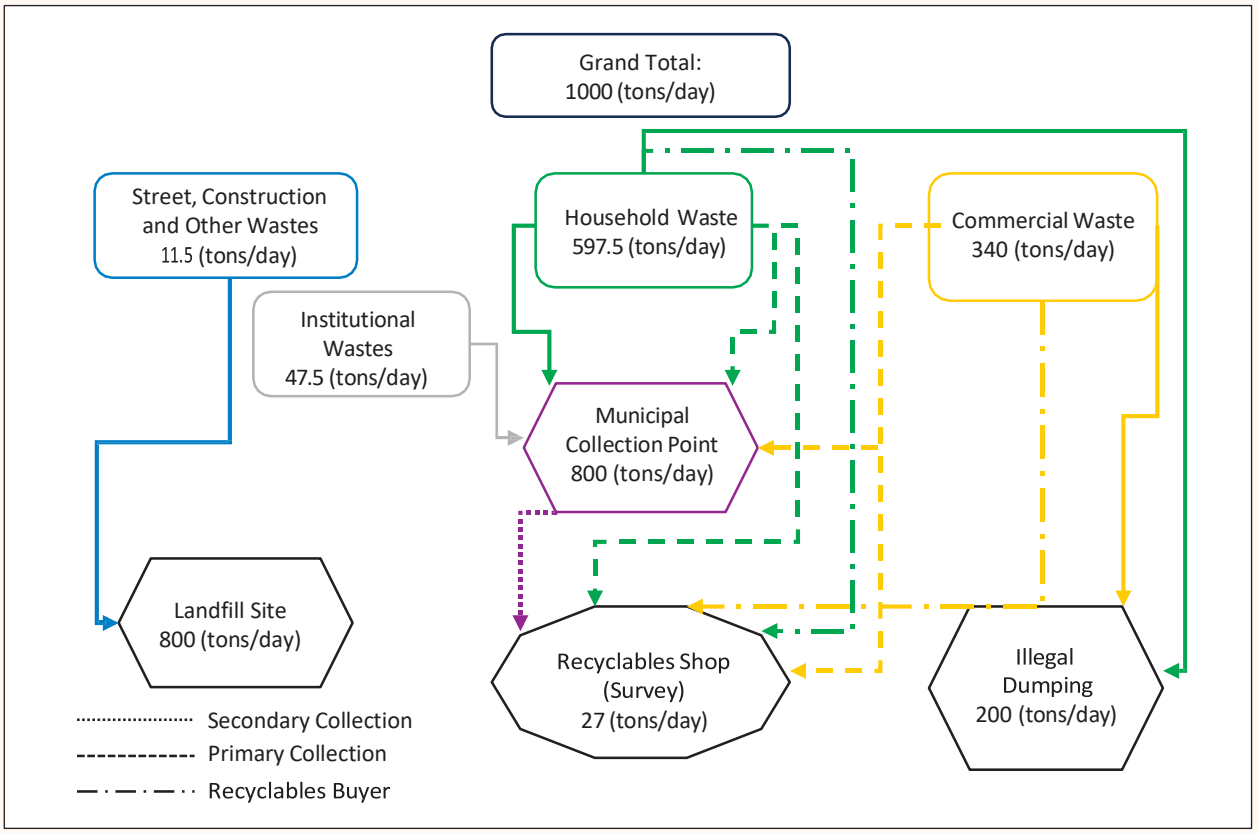


Figure 3-7. Waste Transportation Flow in KCC



Source: SCIP, 2023

Figure 3-8. Waste Flow Diagram in FY2022-2023

3.5 Public Relations and Awareness

3.5.1 *Public Relations Department of Khulna City Corporation*

The Public Relations Department (PRD) of KCC is generally responsible for public relations and awareness activities and sometimes represents the city corporation. The PRD's main activities are listed below.

(i) Clips all information about various KCC departmental activities.
(ii) Relays the clippings to the mayor and concerned departments for necessary steps.
(iii) Publish notices and advertisements in daily newspapers and other media.
(iv) Develop all kinds of awareness programs for citizens.

The PRD works actively and sincerely to provide any information related to KCC activity. When the mass media request an interview of the PRD regarding a specific topic, the PRD forwards the request to the appropriate department. In the case of waste management, when the WMD issues tender notices, press releases, or press invitations to waste management events, journalists sometimes contact WMD personnel directly for interviews.

3.5.2 *Waste Management Department Public Relations Strategies and Activities*

Public relations and awareness campaigns are typically handled by the KCC Public Relations Department (PRD), which also occasionally speaks on behalf of the CC. These are the primary tasks carried out by the PRD.

(i) Gathers all data regarding different KCC departmental operations.
(ii) Forwards the data to the relevant departments and the mayor so they can take the appropriate action.
(iii) Post all kinds of announcements and commercials in periodicals and other media.
(iv) Create various citizen awareness programs

The PRD works diligently and energetically to give any information pertaining to KCC action. When the media requests an interview with the PRD on a particular subject, the PRD transmits the request to the relevant department. When the conservancy department publishes procurement notices in the context of waste management, press releases or invites to waste management events are sent to journalists, who may then get in touch with conservancy staff directly to arrange interviews.

The Conservancy Department promotes public awareness initiatives through WBA as well as at the CC level, despite the absence of a thorough PR and awareness plan. To carry out its responsibilities, the Conservancy Department gathers complaints or recommendations from city residents using the methods listed below.

(i) Letters, calls, or in-person discussions from locals about various situations in different places
(ii) The community occasionally files concerns with ward councilors;
(iv) Various agencies and departments, including LGED and the Public Works Department (PWD)
(v) A range of print and digital media sources
(vi) The Facebook page of KCC

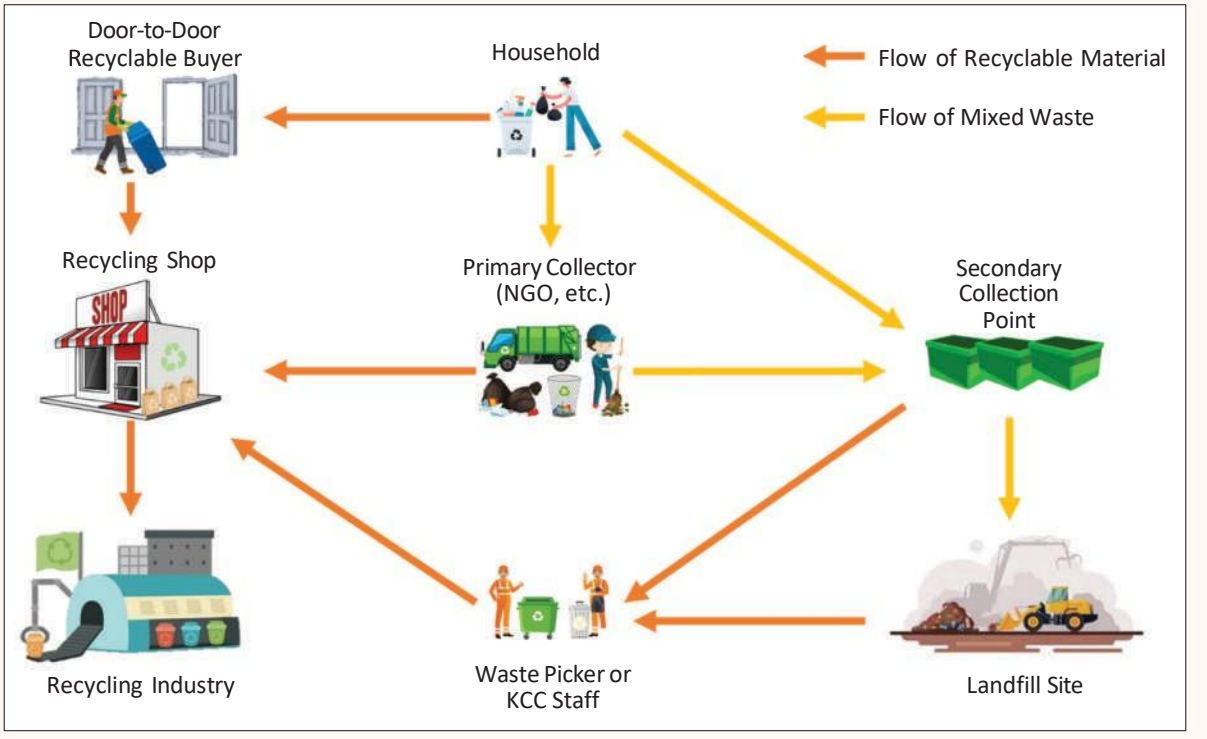
Table 3-8 Employee Status of Conservancy Division

Type	Nos.
Permanent	203
Master Role	605
Outsourcing	162

Source: KCC, 2023

3.6 Waste Recycling/ Waste Reduction

Figure 3-9 presents a flow diagram delineating the pathways of recyclable and mixed waste generated by households within KCC.



Source: SCIP, 2023

Figure 3-9. Flow Diagram for Household Waste in KCC

3.6.1 *Stakeholder Overview*

Recycling shops in Khulna serve as important hubs for the collection, sorting, and processing of recyclable materials, helping to reduce environmental pollution and conserve resources. They provide an avenue for individuals and businesses to dispose of their recyclable waste materials and earn income from their discarded items.

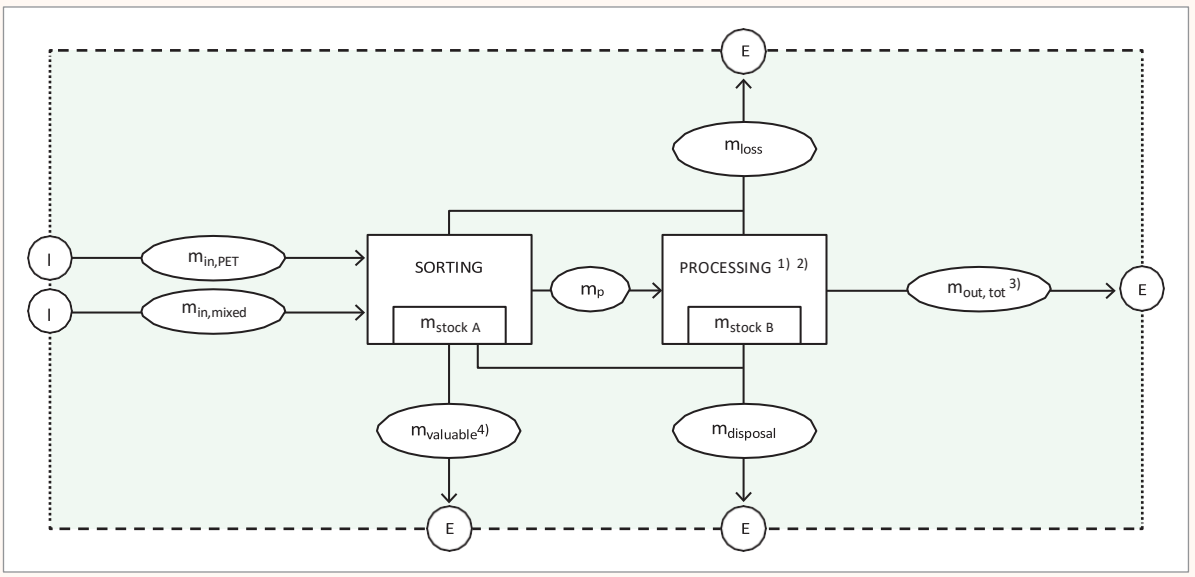
Recycling industries or recycling shops are workshops where valuable separated plastics are further processed. Activities that have been reported and observed are sorting, cutting, washing, drying, colouring, moulding and finishing. Final products or recycled grains and flakes are sold locally or exported to industries in Dhaka area.

3.6.2 *Status Analysis of the Recycling Shops*

As a starting point the analysis relies on data from the literature and on contact details provided by the Khulna Plastic Recycling Business Association. To differentiate from other stakeholders, recycling shops are defined as follows:

Any workshop or business carrying out a process by which plastic waste materials are transformed into new products in such a manner that the original products may lose their identity, is considered as recycling shop.

Material Flow Analysis



Source: Kraft et al., 2024

Figure 3-10. Framework of the MFA with 1) includes shredding, washing, drying, packing. 2) may include granules production and manufacturing. 3) includes PET, PE, PP, PA, PS, PVC, others. 4) valuable: non-plastic valuables.

3.6.3 *Recycling Shops Location*

During the course of 2022 and 2023 a widespread field survey on RS was conducted (Saju et al., 2024). The results show that the areal distribution of RS is clustered across Khulna City area. The total number of 35 shops has been identified. Five clusters have been registered representing 89% of the detected RS. The clusters are named after the local designation of the areas: Lobonchora (a), Khalishpur (b), Zero Point (c), Sonadanga (d) and Doulotpur (e). The location of recycling shops identified in Khulna city area including the deducted clusters are shown in Figure 3-11. It remains undisputed that the local market of recycling businesses regardless of business size is very vivid and dynamic.

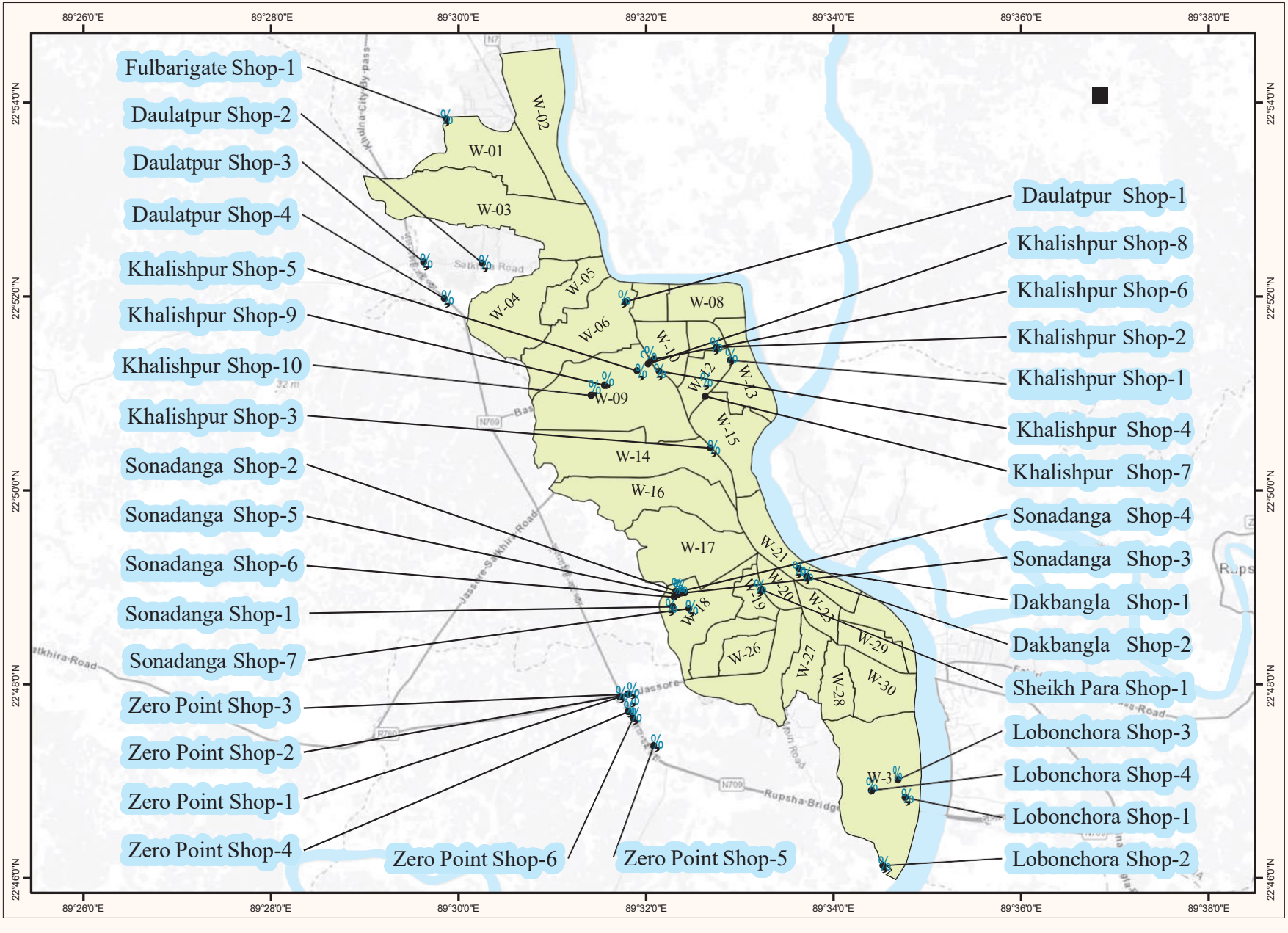


Figure 3-11. Location of study area and position of identified recycling shops

3.6.4 *Recycling Shops Activities*

Market activities associated with recycling shops in Khulna city are illustrated in Figure 3-12. The process starts with the collection of plastic wastes from different sources e.g. households, disposal sites, businesses, markets and streets by dedicated stakeholders described further down. The conducted activities at a recycling shop are depend of the recycling shop owner's business model. Basic activities that cover the whole plastic recycling process as discovered through the field survey are basically divided into two modes. The first production path solely handles disposed PET-bottles. The second main production path covers the handling of all other mixed plastic wastes. The number of activities and their sequence can differ depending on the availability of machinery at the workshop, input materials and desired end products.

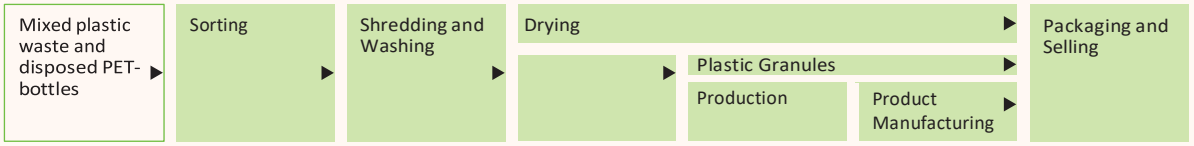


Figure 3-12. Scheme of activities connected to the process of plastic recycling

The conducted and recorded activities at recycling workshops require a considerable amount of manpower as well as machinery. The process design is rather poor. Used machines are of simple nature. The applied technologies often lack efficiency. These circumstances combined result in a respectable amount of production loss and scrap also referred to as unused and unmanaged plastic waste fraction.

PET-bottles for flake production are firstly sorted into different colours. Before shredding labels and locks are detached. The flakes are washed and dried, then packed and stored for selling. Mixed plastic wastes are also sorted by colour before shredded. After washing and drying the flakes are put into an extrusion machine producing recycled plastic granules. Various shops sell these granules to manufactories or other shops for further processing. Some shops produce their own marketable end products.

The following figures present the necessary working steps for the production of marketable PET-flakes (Figure 3-13) and recycled plastic grains respectively manufactured products from mixed plastic wastes (Figure 3-14).

Source: SCIP, 2023

Figure 3-13. Example pictures of single activities for PET-bottle recycling.

Source: SCIP, 2023

Figure 3-14. Example pictures of single activities for mixed plastic waste recycling.

The evaluation of the survey among identified recycling shop owners is giving interesting and valuable results. The total number of 33 individuals took part in the survey. Among these, 100 % of them see themselves as a contributor to the solid waste management of Khulna City. The shops receive their materials mainly from local waste collectors or waste traders (n=33 multiple naming permitted). Second often they receive materials from outside the city area (n=22), followed by other recycling shops (n=14) and others (n=5), see Figure 9. Technically all of the recycling shop owners measure their input materials by weight and the materials are all to some extend either sorted, shredded, dried or manufactured, says the survey evaluation.

3.6.5 *Environmental Challenges*

For the case of PET-bottle recycling the PET-bottle labels are clearly identified as scrap or unused waste stream within the production chain (Saju et al., 2024). Shop owners use to store the labels until they might get collected by municipal waste collectors. Alternatively, the unwanted material is taken to a nearby municipal disposal site. There are also cases recorded where PET-bottle labels have been used as cooking fuel by the shop employees or simply dumped into the area around the shop. Sometimes brick kiln operators buy PET-bottle labels as cheap fuel substitution. Apart from single observations and stories the survey results show a similar picture to what happens to unwanted materials as impurities, production losses, wastes and non-plastic materials, see Figure 13. For 23 out of 33 recycling shop owners it is common practice to at least sometimes burn or inappropriately dispose their unwanted materials such as production loss or wastes.

3.7 Collection and Transport

3.7.1 *Waste Collection System*

The household waste is collected through door-to-door services and from community collection points. NGOs and CBOs use a door-to-door collecting method, and their collected waste is then disposed of at the closest secondary transfer station (STS). Approximately 120 non-motorized vans are operated by NGOs and CBOs for waste collection, while KCC manages 400 vans to transport waste from community bins to STS. Notably, only about 14% of households in Khulna City are covered by the collection system utilized by NGOs and CBOs, leaving a significant portion without any collection service. Waste separation at the household level is virtually nonexistent, with waste typically accumulated in single buckets, leading to mixing during pickup. In Khulna City, daily waste generation amounts to 1000 tons, with 80% being collected, while the remaining 20% is left uncollected due to various reasons. There is a total of 106 STS in KCC area, comprising 4 in-house, 21 open, and 81 container stations. Additionally, approximately 1,200 community bins are distributed along roadways at random intervals, with waste from these bins typically transported to STSs by KCC vans. KCC also operates 31 motorized trucks responsible for collecting garbage from STS and transporting it to the landfill. Figure 3-15 represents the waste collection and transportation system in KCC area.

Source: SCIP, 2023

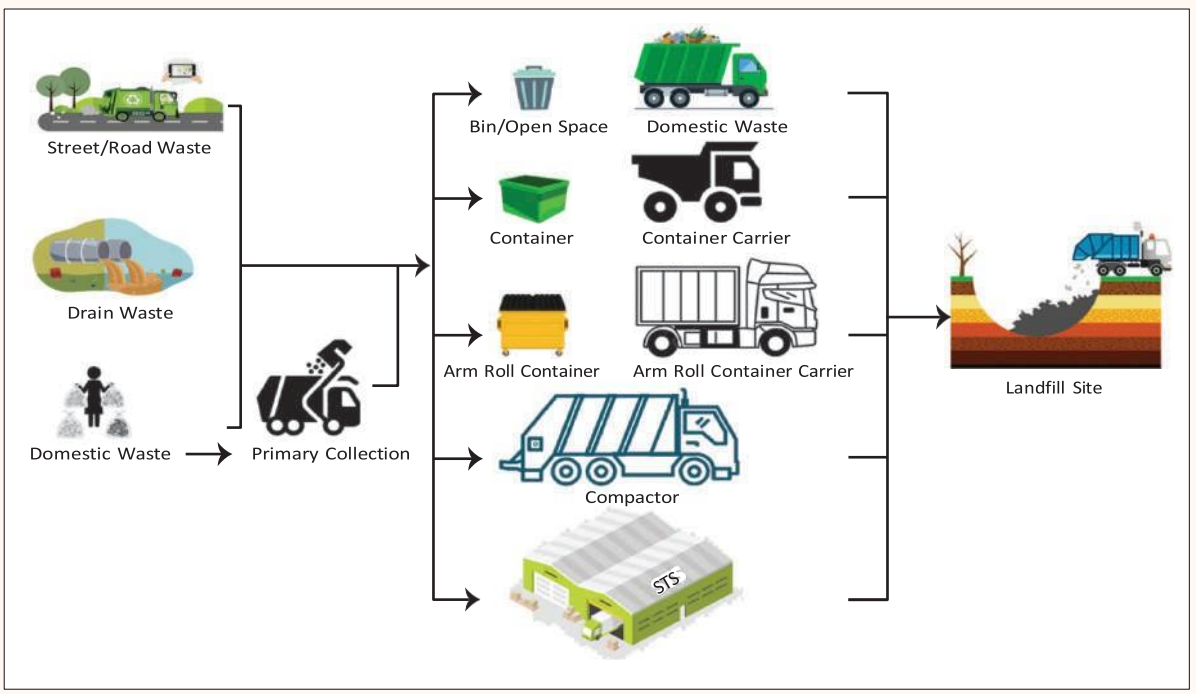
Figure 3-15. Waste Collection and Transportation Scenario in KCC Area

3.7.2 *Primary Waste Collection*

For primary waste collection, NGOs and CBOs use a door-to-door collection method. They are registered or unregistered individuals, organizations, or associations operating one or more rickshaw vans with or without hand trolleys. The forms of primary waste collection service providers (PCSPs) vary among the wards and according to the characteristics of the community. In general, CBOs, NGOs, private companies, housing societies, and individuals are common PCSPs.

3.7.3 *Secondary Waste Collection*

Waste accumulated in Secondary Collection Points (SCPs), Secondary Transfer Stations (STSs), and dustbins is categorized into three main types based on its source: household waste, street waste (including sludge from drainage system), and business waste. KCC cleaners are responsible for the daily collection of street waste and drain waste after road sweeping and drain cleaning activities. This waste is transported by trolley or vans to nearby SCPs, such as STSs, compactors, or dustbins. Household waste generated in residences, as well as commercial and office spaces, is collected directly at the source by Primary Collector,



Source: SCIP, 2023

Figure 3-16. Waste Collection and Transport Flow from Sources to Final Disposal

Secondary Point (PCSP) personnel and then transported to SCPs. SCPs include various receptacles such as concrete bins, containers, arm roll containers, and compactors, facilitating direct transport without the need for waste storage. In areas where container placement is not feasible, open curbside waste accumulation points may be designated. Waste accumulated at STSs is subsequently transported to final disposal sites or landfill sites by open trucks and compactors.

The waste collection staff normally works under considerably unsafe conditions. A limited number of collection staff members wear typical safety gear such as masks, hand gloves, and sometimes boots. Nonetheless, violations of traffic rules occur. All staff members work on roads day and night, mostly aside traffic in many areas without special traffic signs, signals, or markings.

3.7.4 *Privatization/CBOs/NGOs*

Table 3-9. List of NGOs in Khulna City Corporation Area and Their Probable Working Area

Sl. No.	Name	Activities (Type)	Working Area (Ward No.)	Contact No. Office Address	Phone/ mobile
1.	Nobolok	a) Safe drinking water b) Sanitary toilet c) Behavior change d) Advocacy and networking with different service providing agencies and the formation of a forum.	Ward No.- 01, 03, 21, 22, 24, 25 and 31	Chief Executive, 73, South Central Road, Khulna.	041-720155, 041-810855
2.	SEIAM	a. Waste Management b. Primary Health Service c. Publicity against social taboo and disease d. Public education	Ward No.- 19, 20, 25 and 26	General Secretary, 38, Hazi Tomiz Uddin Lane, Banargati, Khulna	01712809529 01914835520 01199206672
3.	BRAC	a. Safe Drinking Water b. Sanitary toilet c. Health behavior	Ward No.- 01-31	Regional Manager Brack Regional Office Khalishpur, Khulna	01716954430
4.	Dushtho Sasthya Kendra	a. Primary Health Care b. Load management c. Water and Sanitation d. DSK hospital e. Training Cell f. Informal education	Ward No.- 3,4, 5, 6, 14, 15, 17, 18, 19, 20 and 21	Regional Manager 16, Golam Rahman Road, Daulatpur, Khulna	041-860769 01713-147359

Source: SCIP, 2023

3.8 Waste Collection Vehicle Maintenance

3.8.1 *Waste Collection Vehicle Information*

Table 3-10 presents the number of waste collection vehicles, their capacities, and the associated staff numbers. Unfortunately, all vehicles owned by KCC are currently considered obsolete and in disrepair. Typically, these vehicles are acquired using KCC's budget allocation.

Table 3-10 Status of Existing Vehicles for SWM in KCC

Vehicle List	Status	Multi-purpose or reserved for SWM	Number plate	Vehicle List	Make / brand	Manufact-ured in (year) /Model	Odometer [km] or [mile]
Eicher-6	In-use	MP	On-Test	Eicher-6	Eicher	1075	Broken
Eicher-18/20	In-use	MP	On-Test	Eicher-18/20	Eicher	1075	Broken
Eicher-9	In-use	MP	On-Test	Eicher-9	Eicher	1075	Broken
Eicher-3/20	In-use	MP	On-Test	Eicher-3/20	Eicher	1075	Broken
Eicher-4/20	In-use	MP	On-Test	Eicher-4/20	Eicher	1075	Broken
Eicher-6/20	In-use	MP	On-Test	Eicher-6/20	Eicher	1075	Broken
Eicher-10/20	In-use	MP	On-Test	Eicher-10/20	Eicher	1075	Broken
Eicher-12/20	In-use	MP	On-Test	Eicher-12/20	Eicher	1075	Broken
Eicher-14/20	In-use	MP	On-Test	Eicher-14/20	Eicher	1075	Broken
Eicher-15/20	In-use	MP	On-Test	Eicher-15/20	Eicher	1075	Broken
Eicher-16/20	In-use	MP	On-Test	Eicher-16/20	Eicher	1075	Broken
Eicher-17/20	In-use	MP	On-Test	Eicher-17/20	Eicher	1075	Broken
Eicher-8	In-use	MP	On-Test	Eicher-8	Eicher	1075	Broken
Eicher-19/20	In-use	MP	On-Test	Eicher-19/20	Eicher	1075	Broken
Eicher 20/20	In-use	MP	On-Test	Eicher 20/20	Eicher	1075	Broken
DT-1/5	In-use	MP (Mainly SWM)	On-Test	DT-1/5	Volvo-Eicher	Terra 25	Broken
DT-2/5	In-use	MP (Mainly SWM)	On-Test	DT-2/5	Volvo-Eicher	Terra 25	Broken
DT-3/5	In-use	MP (Mainly SWM)	On-Test	DT-3/5	Volvo-Eicher	Terra 25	Broken
DT-4/5	In-use	MP (Mainly SWM)	On-Test	DT-4/5	Volvo-Eicher	Terra 25	Broken
DT-5/5	In-use	MP (Mainly SWM)	On-Test	DT-5/5	Volvo-Eicher	Terra 25	Broken
110007 cont	In-use	SWM	110007	110007 cont	Tata	909	Broken
110049 cont	In-use	SWM	110049	110049 cont	Tata	909	Broken
110050 cont	In-use	SWM	110050	110050 cont	Tata	909	Broken
11-0036	In-use	SWM	11-0036	11-0036			Broken
11-0101	In-use	SWM	11-0101	11-0101			Broken
11-0103	In-use	SWM	11-0103	11-0103			Broken
13-0395	In-use	SWM	13-0395	13-0395	Hyundai		Broken
14-2712	In-use	SWM	14-2712	14-2712			Broken
Cont-ontest-2/4	In-use	SWM	On-Test	Cont-ontest-2/4	DFAC		Broken
Cont-ontest-3/4	In-use	SWM	On-Test	Cont-ontest-3/4	DFAC		Broken
Soil/Landfill Compactor	In-use			Soil/Landfill Compactor			

Source: SCIP, 2024

3.8.2 *Relationships and Responsibility for Operation and Maintenance of Waste Collection Vehicles*

The waste management department and mechanical department (MD) are responsible for the operation and maintenance of waste collection vehicles at KCC. Their responsibilities are presented in Table 3-11. WMD is responsible for purchasing fuel and driving vehicles. The MD is responsible for vehicle allocation, driving vehicles, the purchase and replacement of parts, workshop management, and spare parts management. However, KCC lacks designated authorities responsible for vehicle inspections.

Table 3-11 Vehicle Maintenance Condition

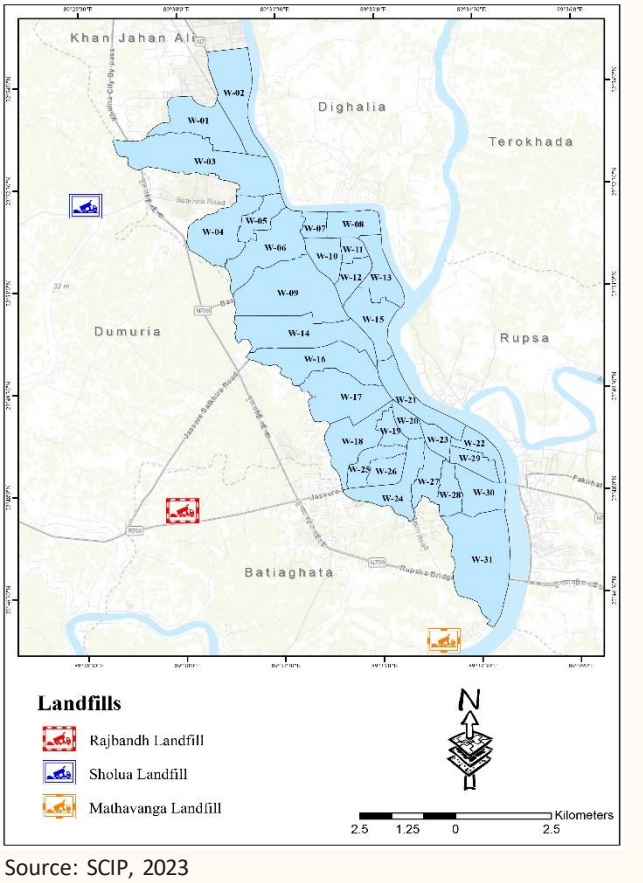
Ward No	WMD	MD
Vehicle Allocation	-	✓
Purchase of Fuel	✓	-
Driving Vehicle	✓	✓
Daily Inspection	-	-
Periodical Inspection	-	-
Purchase and Replacement of Parts	-	✓
Workshop Management	-	✓
Spare Parts Management	-	✓

Source: SCIP, 2024

3.9 Landfill Sites

3.9.1 *Overview of Landfill Site*

Within the jurisdiction of the Khulna City Corporation (KCC), waste disposal infrastructure currently centers around the Rajbandh open dump site, situated adjacent to the Khulna-Satkhira highway. Spanning an area of 20 acres, this landfill has been the sole active disposal site since its inception in 1977, located approximately 3 kilometers away from Zero Point, about 200 meters away from the Khulna-Satkhira highway. Geographically, it lies between the latitudes 22° 47' 47.87" N and longitudes 89° 29' 57.68" E. However, in response to the pressing need for more organized waste management, plans are underway to establish two additional landfill sites. The first site, located in Lobonchora, spans 22.70 acres and is designated for sanitary waste disposal, while the second site in Rajbandh covers 42 acres and is intended for general waste disposal. The construction of the Solua Sanitary Landfill is currently underway, further expanding waste management infrastructure. The geographic locations of these landfill sites are presented in Figure 3-17.



Source: SCIP, 2023

Figure 3-17. Location of landfill sites in Khulna

Table 3-12 Details of active landfill site in Khulna City

Status	Description
Current situation	Ongoing dumping of waste
Type of receiving waste	All types of municipal waste (mostly domestic waste and business waste)
Target receiving area	Entire KCC area, including 31 wards
Operating hours	Mostly in the daytime, the pick time is 11:00 AM to 5:00 PM
Area	20 acres,
Capacity for disposal	Unknown
Disposal methods	Under and inside the embankment, except the buffer zone
Main facilities	• Narrow embankment in the western and northern boundary • Drainage facility (Open ditch) • Leachate accumulation zone/ Buffer zone • Access road • Restroom for KCC employees/Storeroom

Source: SCIP, 2024

3.9.2 *Roles and Responsibilities of the Waste Management Department and Related Departments*

In KCC, the WMD is involved in the LFS operation. The mechanical department (MD) helps the WMD by providing heavy trucks. The responsibilities of the WMD and MD are presented in Table 3-13.

Table 3-13 Responsibilities of WMD and MD

Department	Responsibilities
WMD	• Landfill site acquisition, running and care. • Yearly budget preparation. • Construction and installation of weighbridge, outer embankment, car wash pool, lighting tower, dumping platform, leachate treatment plant, gas vent pipe, etc. • Environmental management by covering soil layers of the dressed wastes of the LFS. • Ensures the security of the LFS by stopping unwanted entry of unauthorized people.
MD	• Provides heavy equipment. • Provides driver for landfill operation.

Source: SCIP, 2023

3.9.3 *Disposal Amount*

As per KCC's claim, the total waste generated amounts to 1000 tons per day. Of this total, approximately 80% or 800 tons per day are collected and transported for disposal. However, the remaining 20% (200 tons/day) remains uncollected. This masterplan has been designed based on this assumption.

3.9.4 *Equipment for Landfill Operation*

Existing heavy equipment for landfill operation in the KCC area is presented in Tables 3-14. Currently, KCC has two types of heavy equipment: bulldozers for waste pushing and placement and also for waste compaction. Also, an excavator for waste excavation. However, KCC lacks wheel dozer, wheel loader and landfill compactor.

Table 3-14 Equipments and Capacity of Landfill Operation

Heavy equipment	Waste Pushing & placement	Waste Compaction	Waste Excavation (drainage ditch)
Bulldozer	✓	✓	x
Wheel Dozer	x	x	x
Wheel Loader	x	x	x
Excavator (Power Shovel)	x	x	✓
Landfill Compactor	x	x	x

Source: SCIP, 2024

3.9.5 *Current Situation of Operation and Management*

I. Waste vehicle management

Weighing facilities are not available at the Rajbandh Landfill site since it is an open, unsanitary landfill. Since there are no weighing facilities at the Rajbandh landfill, the total amount of waste arriving is calculated by multiplying the number of vehicles by their capacity. The entire amount of waste produced each day is around 1000 tons. To handle the fleet of vehicles, two supervisors work two shifts a day from 6 am to 6 pm. They oversee dumping and keep track of arrivals. Because there is no on-site washing facility, vehicles are disposed of without being washed.

II. Dumping management

The bulldozer operator at the Rajbandh open dumpsite starts working after the garbage is dumped, spreading the waste to avoid large mound formation. Their main responsibilities are to level the garbage pile and create space for other cars to drop down waste in the proper locations. To maximize site area utilization, the site manager encourages compaction and places a strong emphasis on leveling. The main components of trash management at the Rajbandh open dumpsite are leveling and spreading out debris.

III. Site facility management

KCC-appointed employees work in a single modest office space at the Rajbandh site. In addition to housing official documentation files, site data logs, and various project data, this room doubles as a resting and dining space for staff. Apart from that, it serves as a warehouse, including tools like shovels, buckets, bulldozer chains, gumboots, bulldozer oil, and basic machine repair supplies. There's also a drinking water tube well in the room, the only one on the whole property.

IV. Informal sector management

A group of unofficial waste collectors who work at the dump site and are not affiliated with the KCC collect recyclable waste. They function freely on the job site as independent contractors, lacking centralized management from landfill staff. They come and leave at will, devoid of any authority from the workers at the site. These collectors claim that no facilities are provided for them by the landfill officials or the KCC.

V. Medical waste management

Hospital waste is transported to landfills by NGOs like Sadiccha and Prodipan, and recyclable waste is then removed from these dumps by waste collectors. After being sorted, hazardous waste is given back to the NGOs, and the remaining material is sold to specific buyers at recycling stores. NGOs' vehicles used for transporting medical waste are not the same as those used for transporting municipal waste. Nonetheless, the location does not have a space set aside for the disposal of medical waste. Visual investigation reveals that the dump is filled with sensitive medical waste, which puts both staff members and unpaid workers at risk of injury.

VI. Safety management

As Rajbandh is classified as a non-engineered landfill, it lacks safety facilities. The site office included the only first-aid box, which was donated years prior by an NGO. The only protective gear (PPE) worn by the site workers and the informal waste collectors is gumboots; neither pair puts on gloves or a mask. In all kinds of weather, they operate without protection. Nobody is adhering to the central safety policy. The government shows a serious disregard for the safety of unofficial rubbish collectors. When waste collectors are stationed close to dumping sites, it could hinder their operation and jeopardize the safety of the bulldozer operator, according to observations made on-site excursions.

3.9.6 *New Extension Landfill Site Development Project Proposal*

The detailed information about the proposed landfill sites is presented in Table 3-15. The Sholua Sanitary Landfill and 3R Initiative Implementation Project, which has an area of 17 acres and 2 acres under construction, the Mathavanga Sanitary Landfill and Rajbandh Landfill Sites are proposed for future solid waste management in the KCC area.

Table 3-15 Landfill Sites in KCC area

Open dump site/ Landfill sites	Status	Location	Area (acres)
Sholua Sanitary Landfill	Under Construction	Beside the old Khulna-Satkhira highway, Sholua	17
Mathavanga Sanitary Landfill (including 3R)	Proposed	Mathavanga, Lobonchora	24.7
3R Initiative Implementation Project	Under Construction	Mathavanga, Lobonchora	2.0
Rajbandh Landfill Site	Proposed	Besides Fecal Sludge Management, Rajbandh	55 (21 old+21 new+13 recent)

Source: KCC, 2023

3.9.7 *Illegal Dumping*

In FY2022-2023, KCC generated around 1000 tons of waste daily, of which 80% (800 tons/day) was dumped in the existing landfill sites, and the remaining 20% (200 tons/day) accounted for illegal waste dumping (AA News Desk, 2023).

3.10 Medical Waste Management

3.10.1 *Categories of Medical Waste*

Several non-governmental organizations (NGOs) are struggling to address Khulna's medical waste management challenges. Presently, the medical waste disposal procedure involves depositing all types of waste in the nearest KCC bins or adjacent low-lying areas. Unfortunately, in certain hospitals, hazardous wastes are openly burned without proper consideration for air emissions or temperature control. The municipal waste collection service then collects this waste and transports it for eventual disposal alongside other municipal waste at municipal landfills. However, there is a pervasive lack of understanding among hospital staff regarding the dangers associated with improper handling and disposal of hazardous waste. Most staff possess only basic knowledge of healthcare and do not perceive medical waste processing or disposal as a significant threat. Consequently, waste is not segregated in any hospitals, as staff either do not recognize the need for segregation or are indifferent to its consequences. This results in the contamination of potentially recyclable components of general waste, posing considerable risks of occupational exposure for workers. Furthermore, there was no qualified waste management and disposal staff in any of Khulna's hospitals.

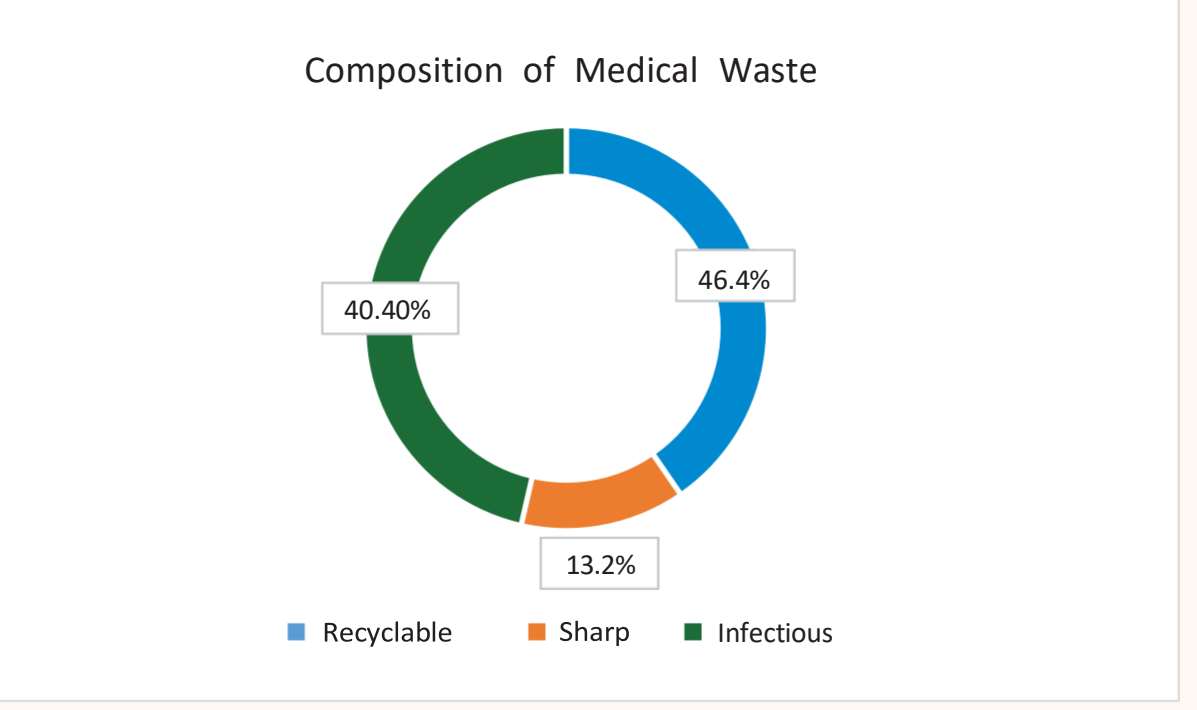
The medical waste generated in KCC in 2022 was about 3.72 tons/day. Table 3-16 shows the daily medical waste generated in 2022.

Table 3-16 Daily Medical Waste Generated in KCC

Ward No.	Amount (tons/day)	Collected by
1 - 18	1.77	Sadiccha
18 - 31	1.95	Pradipan

Source: KCC, 2023

Figure 3-18 shows the medical waste composition in KCC based on a study conducted in 2014. About 40.40% of the medical waste was infectious, 13.2% was sharp, and 46.4% was recyclable.



Source: KCC, 2023

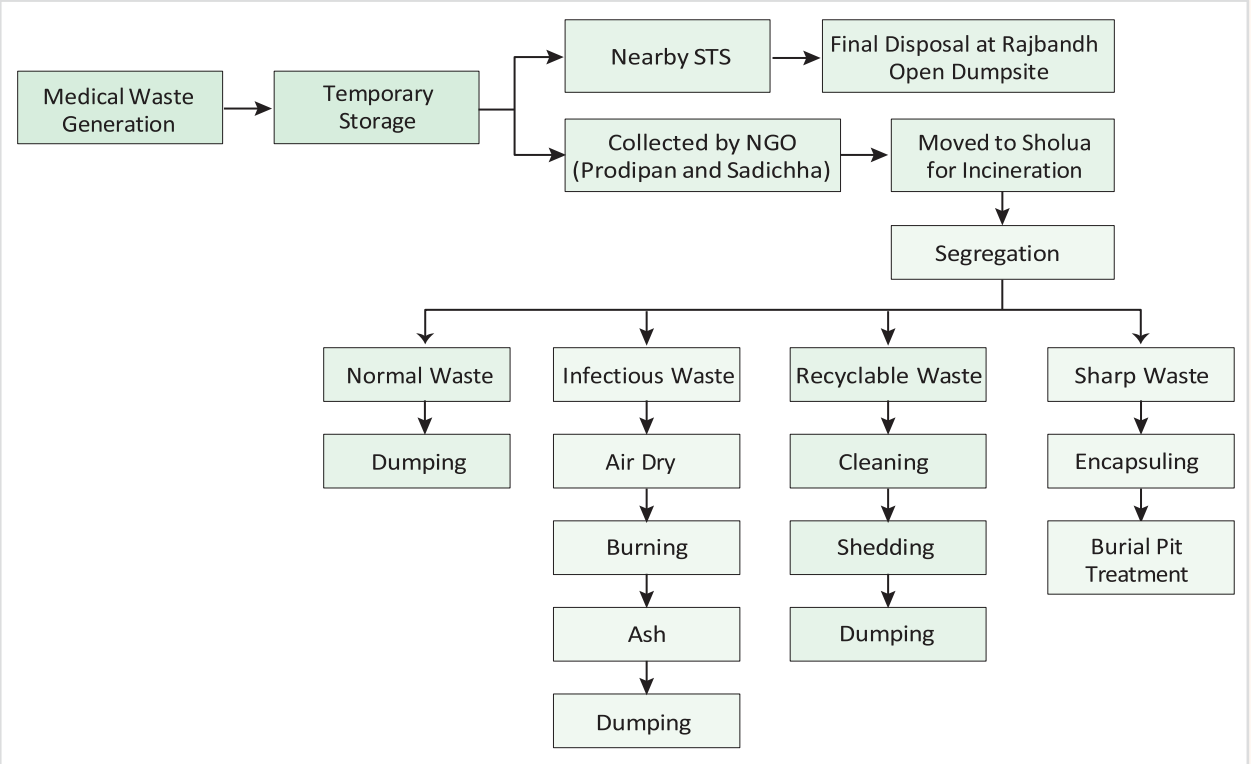
Figure 3-18. Composition of Medical Waste

3.10.2 *Medical Waste Flow and Treatment Process*

Figure 3-19 shows a waste flowchart for medical waste in KCC. Though in certain hospitals, hazardous medical wastes are openly burned without proper consideration of different safety aspects, collected wastes were further processed before being sent to the treatment plant. The treatment processes of wastes according to their types are described below, which were observed during the study period:

I. Recyclable Waste Treatment of Private Health Care Establishments (HCEs)

The collected reusable waste is cleaned properly after being soaked for 48 hours in a tank (41 x 41 x 31) of bleaching powder mixed with water, then shredded in the shredding device. After that, the reusable wastes are stored for recycling.



Source: KCC, 2023; Hossain, 2014

Figure 3-19. Medical Waste Flow in KCC.

II. Sharp Waste Treatment and Disposal of Private HCEs

The sharp wastes are deposited in bottles of 1.5 to 2-liter capacity at the generation points of private HCEs. These bottles with other sharp elements are then put in a sealed concrete chamber of (6.5x 9' x 7). There are a series of concrete chambers that were treated with burial pits. One after one chamber was filled and treated with a burial pit.

III. Infectious Waste Treatment and Disposal of Private HCEs

The infectious wastes are dumped after burning. If the wastes contain more moisture, it is air-dried in a shaded chamber for about 24 hours and then put in the burning unit. Kerosene fuel is spreading over the waste to accelerate burning. The burning continued for about 2 hours. After cooling down naturally (nearly 19 hours), the ashes are dumped in a nearby pit.

IV. Chemical and Radioactive Waste Treatment and Disposal of Private HCEs

The liquid chemical wastes are treated in an effluent plant Solid chemical and radioactive wastes are deposited with sharp elements in a sealed concrete chamber of (6.5x 9 x 7). There is a series of concrete chambers that were treated with a burial pit. One after one chamber was filled and treated with a burial pit.

3.11 Current Issues

The current system lacks a well-organized structure for managing waste. There is a lack of community participation and a need for more involvement from the community in waste management practices. The activities of informal sectors are not well integrated into the overall waste management system. The existing practices of waste collection and disposal are not efficient. For instance, it is estimated that of the 1000 tons of waste generated daily, between 20% remains uncollected. There is a shortage of human resources and vehicles for waste management. The existing practice of waste management has led to various emissions of greenhouse gases.

CHAPTER 04

CHAPTER 04

FRAMEWORK OF MASTER PLAN

4.1 Vision of the Master Plan

The vision indicates the best long-term course for Khulna city. Based on the goal for the next 15 years, the KCC Solid Waste Management Master Plan is created for the next 15 years.

Vision:

To promote integrated and sustainable solid waste management to achieve zero-unmanaged waste.

Integrated Waste Management

The Waste Management Department/Conservancy Department is responsible for collection, transportation and disposal. The WMD must be able to collaborate with different formal and informal sectors currently working with the waste collection, management and recycling system. Additionally, the approach of KCC is to distribute the collected waste into several completed and ongoing sanitary LFSs. The Integrated Waste Management must be able to adjust to the completed, ongoing and future waste management projects of KCC.

Sustainable Waste Management

Three components are necessary for the sustainability of the waste management system: human capital, infrastructure i.e., LFSs and vehicles and financial capacity. This master plan provides component wise strategy and policy to secure all of the above mentioned components of the waste management system. The key approach is to devise a mechanism that requires the lowest amount of human, infrastructure and financial requirements.

Zero-unmanaged Waste

The ultimate global objective is to ensure a zero-waste society. Currently, 80% of the waste generated in the KCC area is collected and is directly deposited at one landfill site (Rajbandh). The methodology of this study involves the application of the 3-R principles (Reduce, Reuse, Recycle) for waste management while preventing leakage in the waste flow. The strategy proposed by KCC for the three sanitary landfill sites aims to achieve zero-unmanaged waste by incorporating waste segregation, composting, recycling, waste-to-energy, and landfill site components.

4.2 Goals

Goals are set to realize the vision. Three goals of the master are given below:

i. Reduce the environmental impact of waste by ensuring full use of the waste management facilities, i.e., sanitary LFSs by 2040.

ii. Align public, formal and informal waste collectors to ensure an integrated management system.

iii. Generate public awareness and participation to promote less waste generation, more waste recycling and reuse, more composting and less landfilling.

4.3 Policy and Targets

The master plan has several policies to achieve the above-mentioned goals, which are mentioned below.

i. Sanitary LFSs are constructed timely manner to ensure a decentralized waste management system.

ii. Ensure human capital, infrastructure and financial resources for the functioning of the waste management components.

iii. Check-and-balance of the WMD to ensure efficient administrative, financial and utmost use of the existing facilities.

iv. The Ward-based approach to share waste management responsibilities at the field-level.

v. Promote waste reduction and the 3-R approach to achieve Zero-unmanaged waste.

vi. Public awareness, public involvement, and public relations all support "participatory solid waste management."

vii. In cooperation with the community, a hygienic collection system is built, such as "Fixed-time and Fixed-place" collection by compactors.

viii. Ward-wise CBO committee will be formed to monitor each ward's performance in SW collection, transportation, recycling and disposal activities. The committee, along with general people, will report directly report to the mayor through an online and anonymous system, which will be later evaluated.

xi. Performance-based incentives will be provided to each ward for ensuring competitive waste management.

xii. Each ward is required to take visible steps against the CBO and people's suggestions and complaints.

The relationship between the mission, goals and policies are illustrated in Figure 4-1.

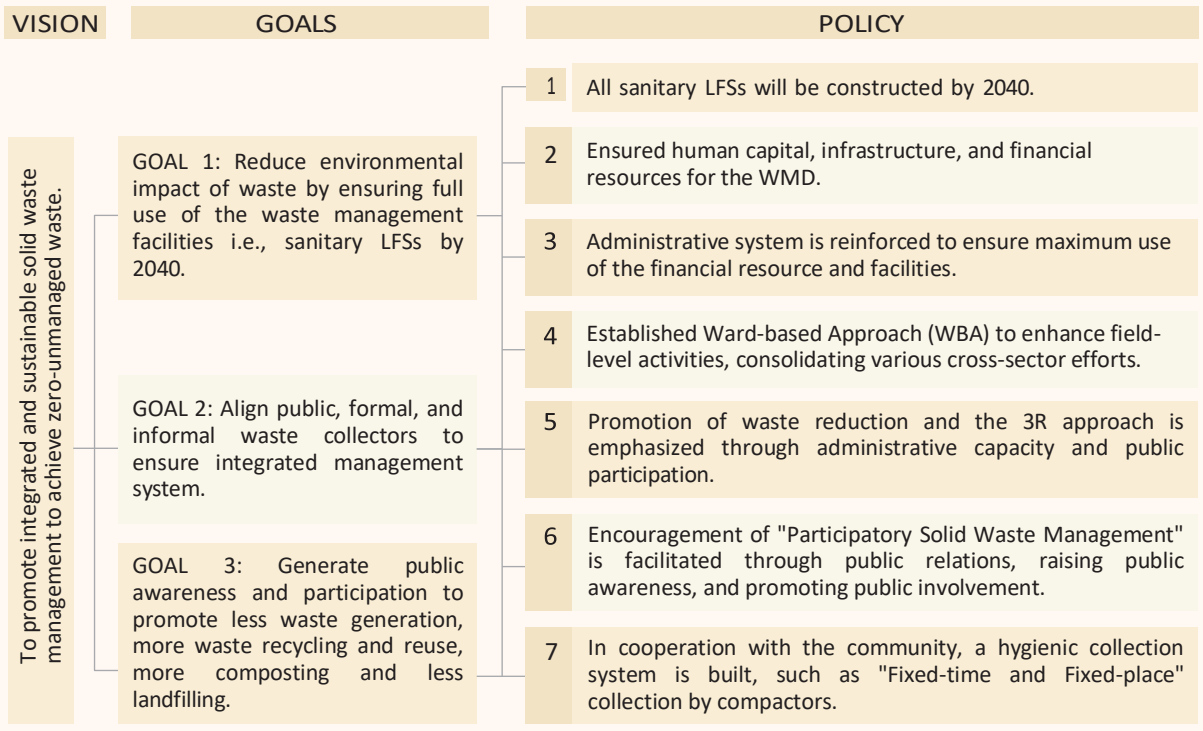


Figure 4-1. KCC Masterplan Framework

4.4 Target

Effective solid waste management can be achieved through four principal methods:

1. Expanding the capacity of the collection system to handle an increased volume of generated waste.
2. Introducing waste separation and recycling to reduce overall waste.
3. Minimizing the volume of residual waste through composting and waste-to-energy processes.
4. Establish an effective Door-to-Door (D2D) waste collection system by engaging a private operator under KCC's supervision.

This master plan highlights five key indicators-waste collection, composting, recycling, waste-to-energy, and landfill disposal-to objectively monitor KCC's progress towards achieving effective waste management. The goals for each indicator by 2040 are established, taking into account the estimates of waste generation and population growth presented in Chapter 5. Additionally, three scenarios have been developed for the periodic monitoring of these indicators.

(1) Waste Collection

Currently, the KCC collects 80% of solid waste utilizing all available vehicles. The waste collection rate is projected to increase to 87% by 2030 and 95% by 2040, provided that new vehicles are acquired, and more efficient collection systems are implemented.

Current situation (2023)	80%	Intermediate target (2030)	87%	Final target (2040)	95%

(2) Waste composting (reduction)

Currently, KCC lacks composting facilities. The introduction of a composting facility at sanitary landfill sites (LFSs) will significantly reduce the volume of waste destined for final disposal in landfills. KCC aims to achieve composting of 20% of the total waste collected at the three LFSs by 2030.

Current situation (2023)	0%	Intermediate target (2030)	15%	Final target (2040)	20%

(3) Recycling

Currently, KCC recycles approximately 0.03% of the collected waste. KCC Masterplan has set a target to increase recycling to 14.20% of collected waste by 2030 and 20% by 2040. To achieve these goals, KCC requires sanitary LFSs and a dedicated zone for informal recycling.

Current situation (2023)	0.03%	Intermediate target (2030)	15%	Final target (2040)	20%

(4) Waste-to-energy

All sanitary LFSs will be equipped with waste-to-energy and pyrolysis plants. The intermediate aim is to utilize 10% of the collected waste for waste-to-energy purposes by 2030.

Current situation (2023)	0%	Intermediate target (2030)	2.8%	Final target (2040)	5%

(5) Landfill Disposal

KCC aims to reduce waste disposal through waste composting, recycling and re-use for waste to energy. The intermediate target is to reduce the waste disposal amount by 55% by 2030. The final target is to reduce the waste disposal amount by 60%

Current situation (2023)	100%	Intermediate target (2030)	67.2%	Final target (2040)	65%

4.5 Scenario for Improvement of Solid Waste Management (Next 15 Years)

4.5.1 *Scenario Setting*

Prior to setting the policies mentioned above, this Master Plan first examined possible long-term SWM scenarios which the KCC may move forward to the vision and goals. Owing to the limited land availability and high land prices, three fundamental scenarios were given for improvement of SWM, as shown below:

Scenario 1: Keep on developing new LFS (LFS Scenario).
Scenario 2: Introduce 3R with intermediate treatment system.
Scenario 3: All priority projects of KCC waste management are complete.

These scenarios were compared to determine a long-term direction up to 2040.

Scenario 1: Keep on Developing New Landfill Site (LFS Scenario)

In this LFS scenario, KCC will take no initiatives to reduce waste generation from households. The target collection rate for 2040 is 95% of the total waste, amounting to an estimated 1640 tons/day. KCC transports all waste to Rajbandh landfill site.

Scenario 2: Completion of major waste management projects (LFS Scenario 2030)

In this scenario, 85% of the waste in the KCC area is collected (a total 1123 tons per day). The completion of the major waste management projects-the Mathavanga Pyrolysis Plan, Rajbandh (the new landfill), and Soula Sanitary landfill sites are operational, and the Rajbandh old site is closed.

Table 4-1 Waste management scenario in 2030

Total	Rajbandh (New landfill)	Mathavanga Pyrolysis (3R)	Soula
Landfill	366	20 ton	254
Compost	146		75
Waste to energy	38		20
Pyrolysis	23		12
Recycles	154		14
	728 ton	20 ton	375 ton

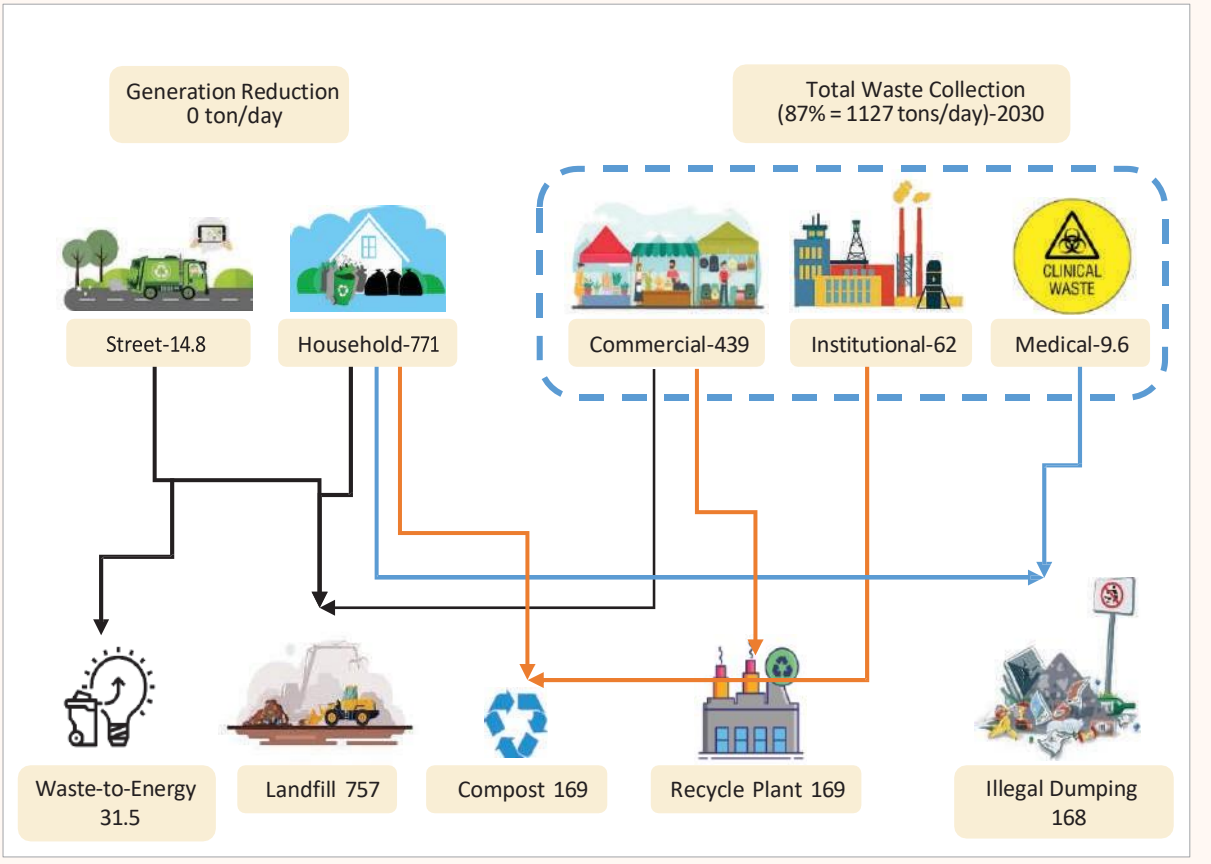


Figure 4-2. Conceptual waste flow of the waste management scenario in 2030

Scenario 3: All waste management projects are complete (LFS Scenario 2040)

In this scenario, approximately 95% of the waste in the KCC area, totaling 1,641 tons per day, is collected. By 2040, both the Mathavanga pyrolysis, Mathavanga landfill, Rajbandh new LFS, and Soula landfill sites will be operational. Approximately 718 tons of waste go daily to the Rajbandh LFS.

Table 4-2 Waste management scenario in 2040

Total	Rajbandh (New landfill)	Mathavanga Pyrolysis (3R)	Soula	Mathavanga Landfill
Landfill	486	20 ton	254	238
Compost	144		75	106
Waste to energy	38		20	28
Pyrolysis	23		12	17
Recycles	180		14	140
Total	718 ton	20 ton	375 ton	528 ton

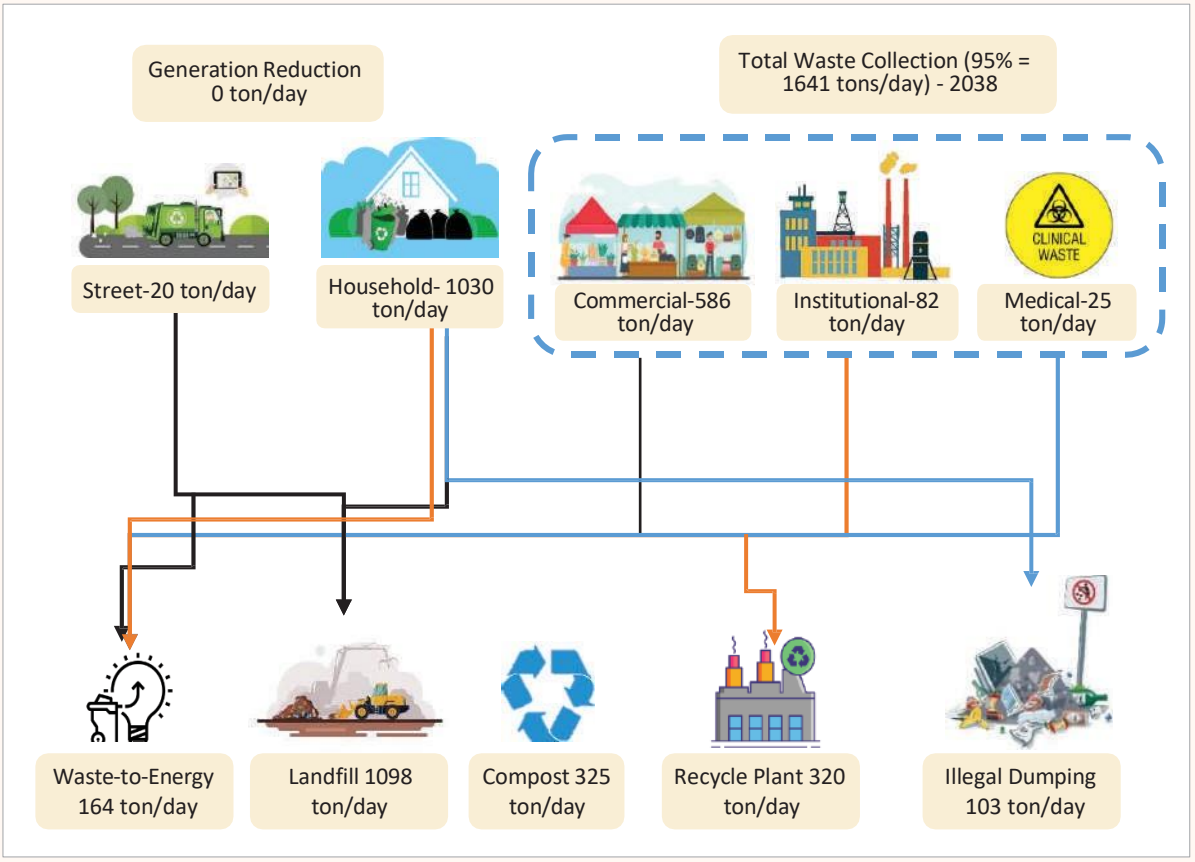


Figure 4-3. Conceptual waste flow of the waste management scenario in 2040

4.5.2 *Introduction of Engineering Landfill Sites*

The Bangladesh Solid Waste Management Rules 2021 adopt the National 3R (Reduce, Reuse, and Recycle) strategy for managing MSW. Consequently, all municipalities and city corporations are required to adhere to this national strategy, which emphasizes the use of sanitary landfills for waste management. As part of this initiative, three additional MSW processing units are currently being developed to manage the MSW in the KCC area. These are the Soula sanitary landfill, the Mathavanga sanitary landfill, and the 3R project. Figure 4-4 illustrates the Engineering/ Sanitary Landfill.

Figure 4-4. Engineering/ Sanitary Landfill

4.5.3 *Scenario Analysis*

We have developed three scenarios:

1. No action is taken.
2. Two out of three landfill sites, Soula and Rajbandh (new), will become operational by 2030.
3. All three sanitary landfill sites will be operational by 2040.

These scenarios incorporated the KCC's existing and future projects. It is understood that KCC will perform a Development Project Proforma (DPP) for each project, as such, guide the costs, manpower requirements aligned to the existing organogram, and potential risks.

The primary strategy involves the distribution of municipal solid waste (MSW) across these three initiatives. The Soula sanitary landfill is scheduled to commence operations in 2024. The Mathavanga site remains in the planning stages, while the 3R project, a completed pilot, processes 20 tons of MSW per day. The Soula sanitary landfill is designed to process 375 tons of MSW per day. The facility includes several components: landfill cells, compost plants, waste-to-energy plants, and pyrolysis units, with daily capacities of 254, 75, 20, 12, and 14 tons, respectively.

The three scenarios are presented in the following figures. The first scenario shows that the CC area will be divided into two zones for Soula and Rajbandh sites (Figure 4-5). The second scenario shows the addition of the Mathavanga pyrolysis plant, which will be operational by 2030 (Figure 4-6). The third scenario shows that the KCC area will be divided into three zones for three operational LFS (Figure 4-7).

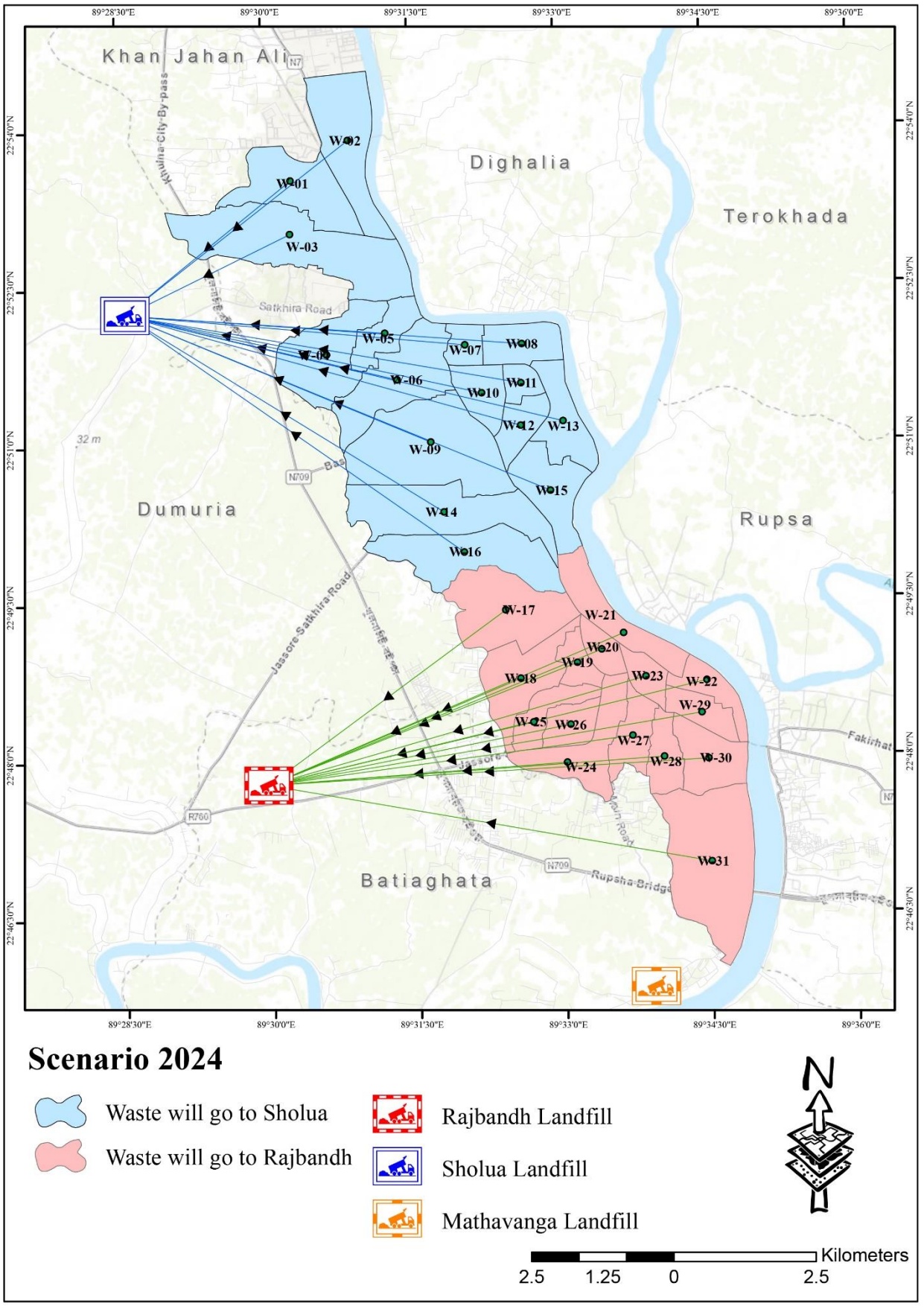


Figure 4-5: Scenario 1- No Action Taken

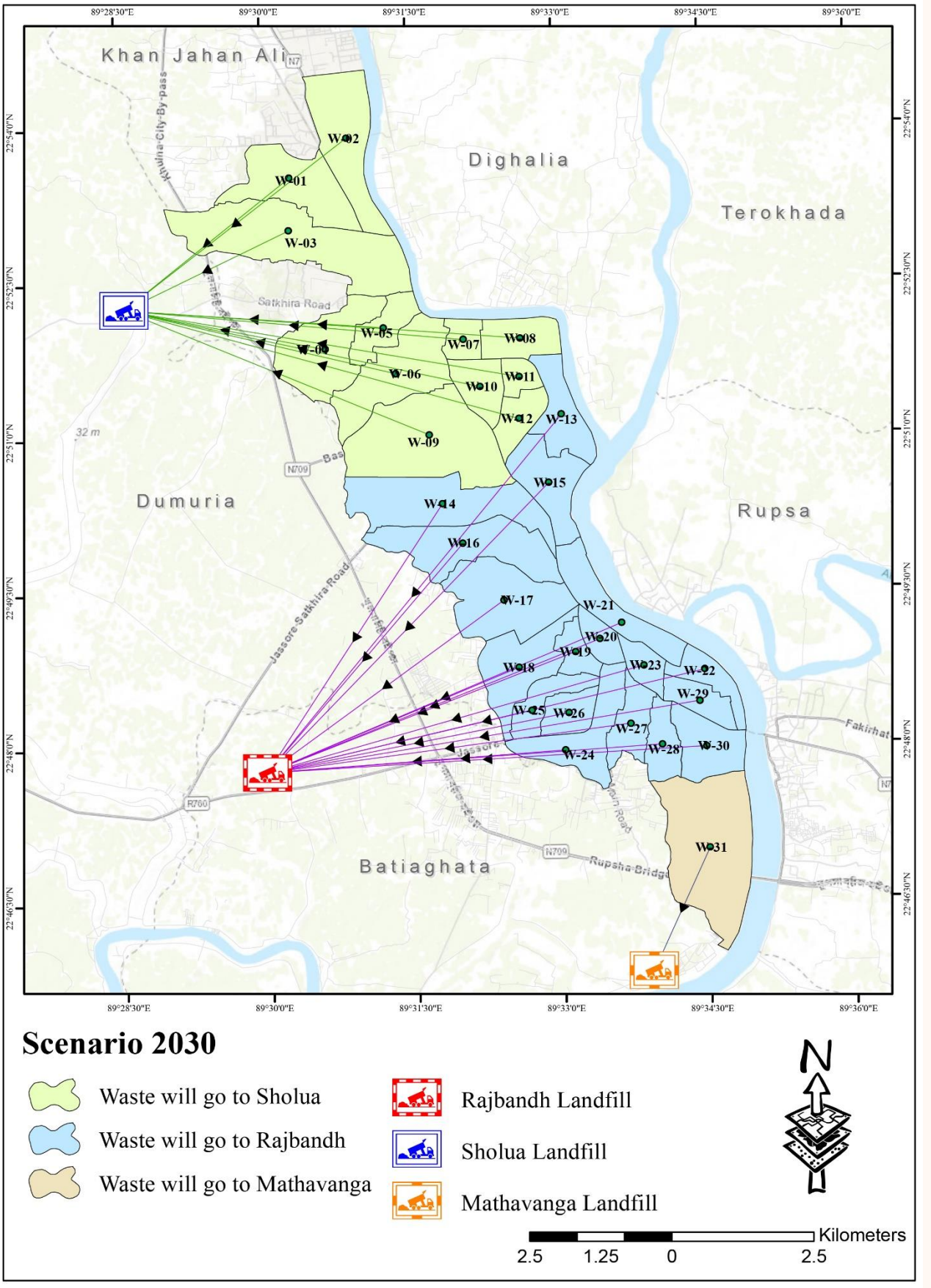


Figure 4-6: Scenario 2- Mathavanga Pyrolysis Plant is Open

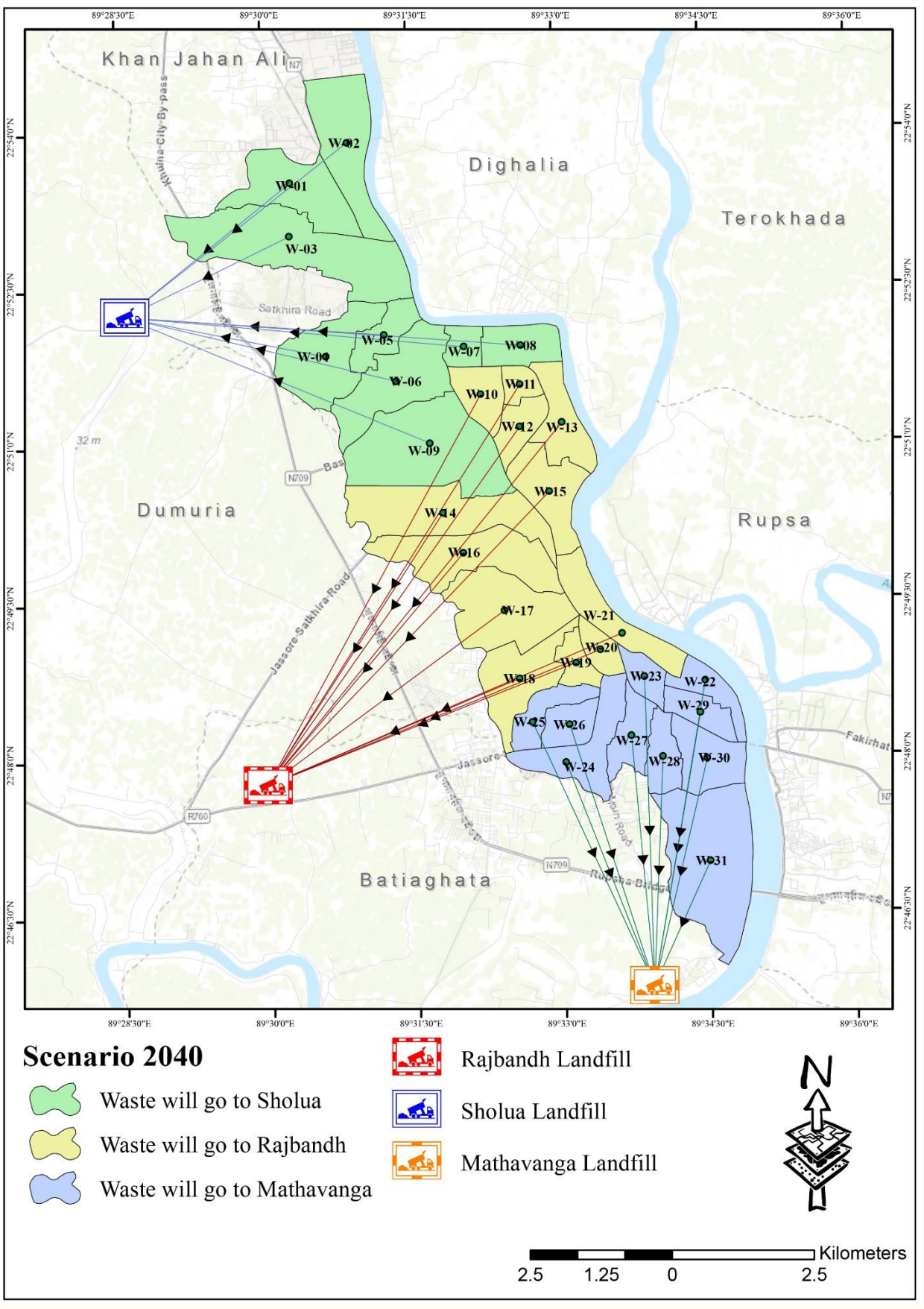


Figure 4-7: Scenario 3- Three LFS are Operational

4.5.4 *Scenario Setting for STS*

This Master Plan considered long-term SWM scenarios that the KCC could consider in order to reach its vision and goals, before establishing the aforementioned regulations. The following three basic scenarios were set up for the enhancement of SWM.

Scenario 2024

There are 81 STS in Khulna: 7 are in-house, 18 are open, and 56 are containers. 74.90% of KCC is served by these STSs. There are many harmful effects of open STS on people and the environment. To eliminate these effects, KCC should try to remove all the open STSs.

Table 4-3 Current STSs

STS Type	No.	Comments
Open STS	18	-
Container	56	-
In-house	7	-
Total	81	-

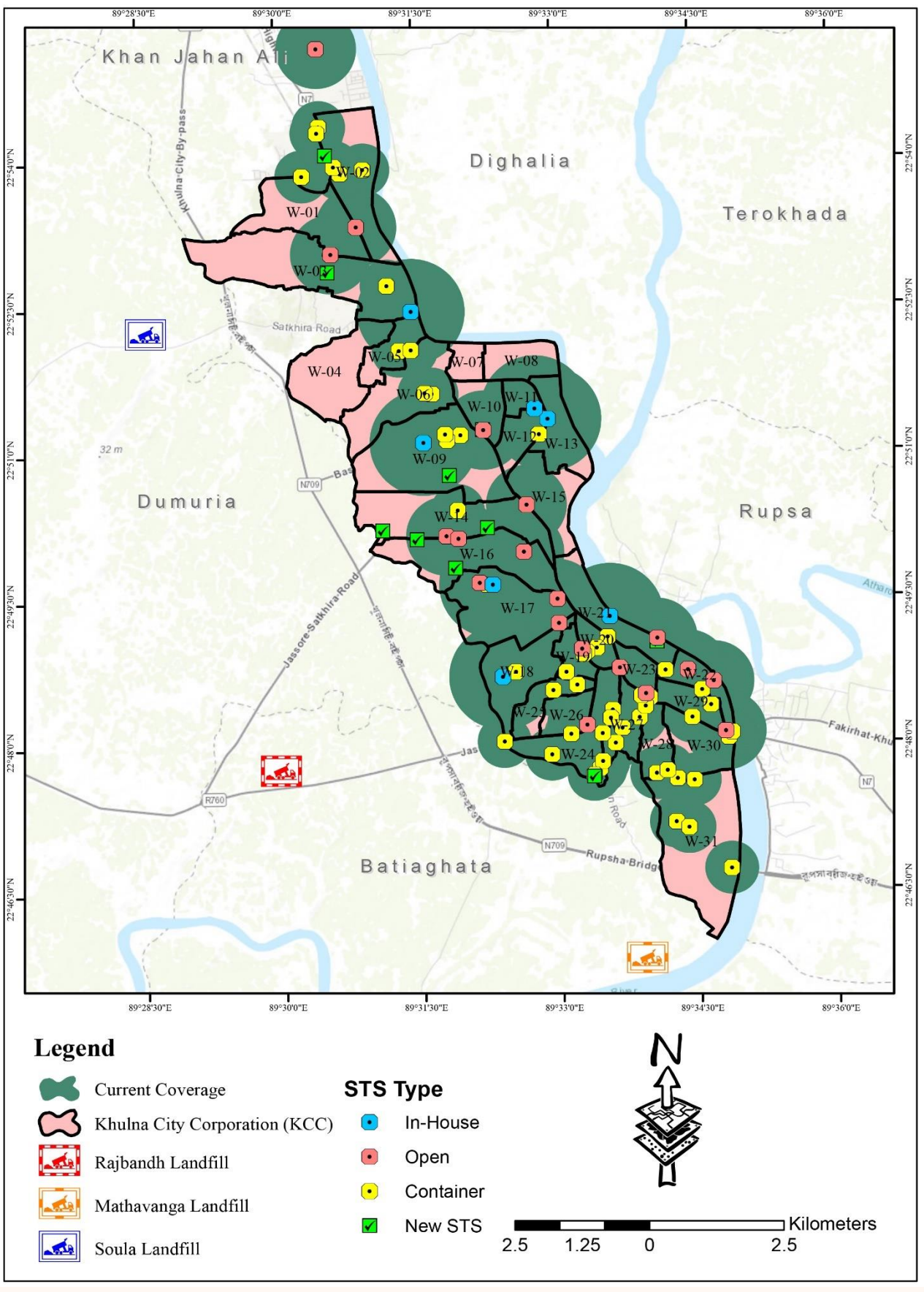


Figure 4-8. Scenario 2024

Scenario 2030

Already, KCC is planning to construct 10 new in-house STSs. The present status of those 10 STS is mentioned in Table 4-4. Those 10 new STS have the potential to cover 6 open STS (Sadar Hospital, Azizer Mor, Boyra Bazar, Mohessorpasa, Kalibari, Goalkhali). There will still be some unserved areas in the ward- 1,4,6,7,8,9,31. For serving these zones, 10 new containers will be placed accordingly (Table 4-5).

Table 4-4 STS Scenario by 2030

STS Type	No.	Comments
Open STS	12	Sadar Hospital, Azizer Mor, Boyra Bazar, Mohessorpasa, Kalibari, and Goalkhali will be covered by 10 new STS.
Container	66	10 new containers for covering the unserved zone
In-house	17	New 10 In-house STS will be constructed as planned by KCC.
Total	95	-

Table 4-5 Status of 10 new planned STS

STS Name	Ward No.	Status
Fulbarigate	2	Location selected
Near Kalibari Bazar	3	Location selected
Near Mujgunni Park	9	Tender in process
Goalkhali	10	Tender completed
Rayermohol	14	Searching to get land
Boyra Women's College	14	Done
Near Islamia College	16	Unknown
Azizer Mor	16	On-going
Sadar Hospital	21	Tender in process
Besides Nirala Graveyard	24	Will be operational after fly-over construction

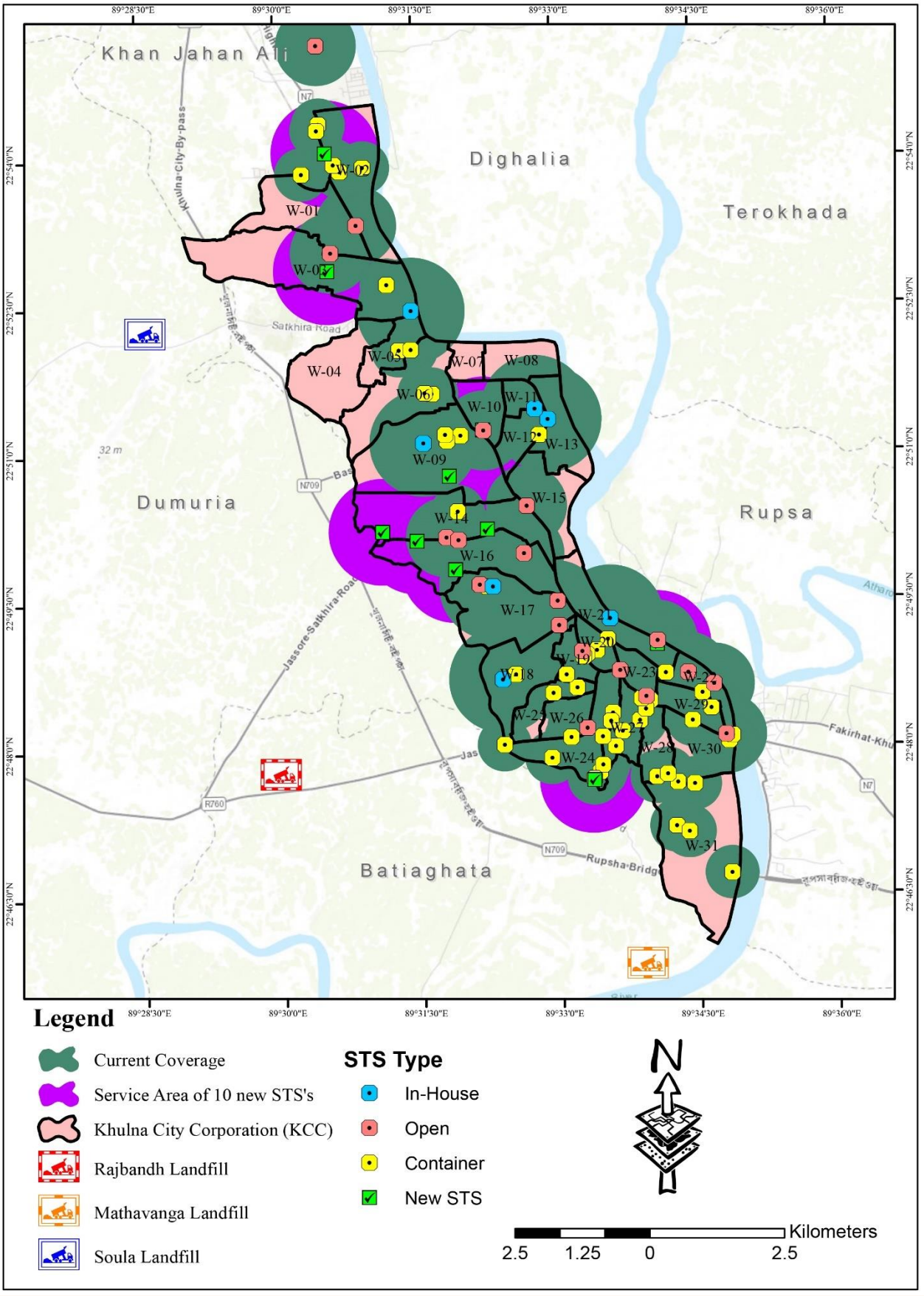


Figure 4-9 Coverage Scenario by 2030

Scenario 2040

By 2040, new 19 nos. in-house STS will be completed (Ward - 1, 4, 5, 6, 7, 8, 13, 15, 19, 20, 22, 23, 25, 26, 27, 28, 29, 30, 31). There will be no open STS in operation. 66 containers will be rearranged as required (Table 4-6).

Table 4-6 STSs status by 2040

STS Type	No.	Comments
Open STS	0	All open STS must be closed
Container	66	Containers can be rearranged as required
In-house	36	New 19 In-house STS (Ward - 1, 4, 5, 6, 7, 8, 13, 15, 19, 20, 22, 23, 25, 26, 27, 28, 29, 30, 31)
Total	102	-

4.5.5 *Road to Landfills*

Figure 4-10 illustrating the current shortest and optimized routes from Secondary Transfer Stations (STS) to three major landfill sites-Mathavanga, Sholua, and Rajbandh. These optimized routes were derived using GIS-based network analysis to ensure efficient transportation of solid waste while minimizing travel distance, time, and fuel consumption. Das et al. (2024) found the optimized network achieves a 9.40% reduction in travel distance and leads to approximately 11.6% savings in fuel costs. The current map reflects the present infrastructure. However, with the planned expansion of STSs and road networks, it is recommended to reassess and update route optimization at regular intervals to adapt to urban growth and infrastructural developments.

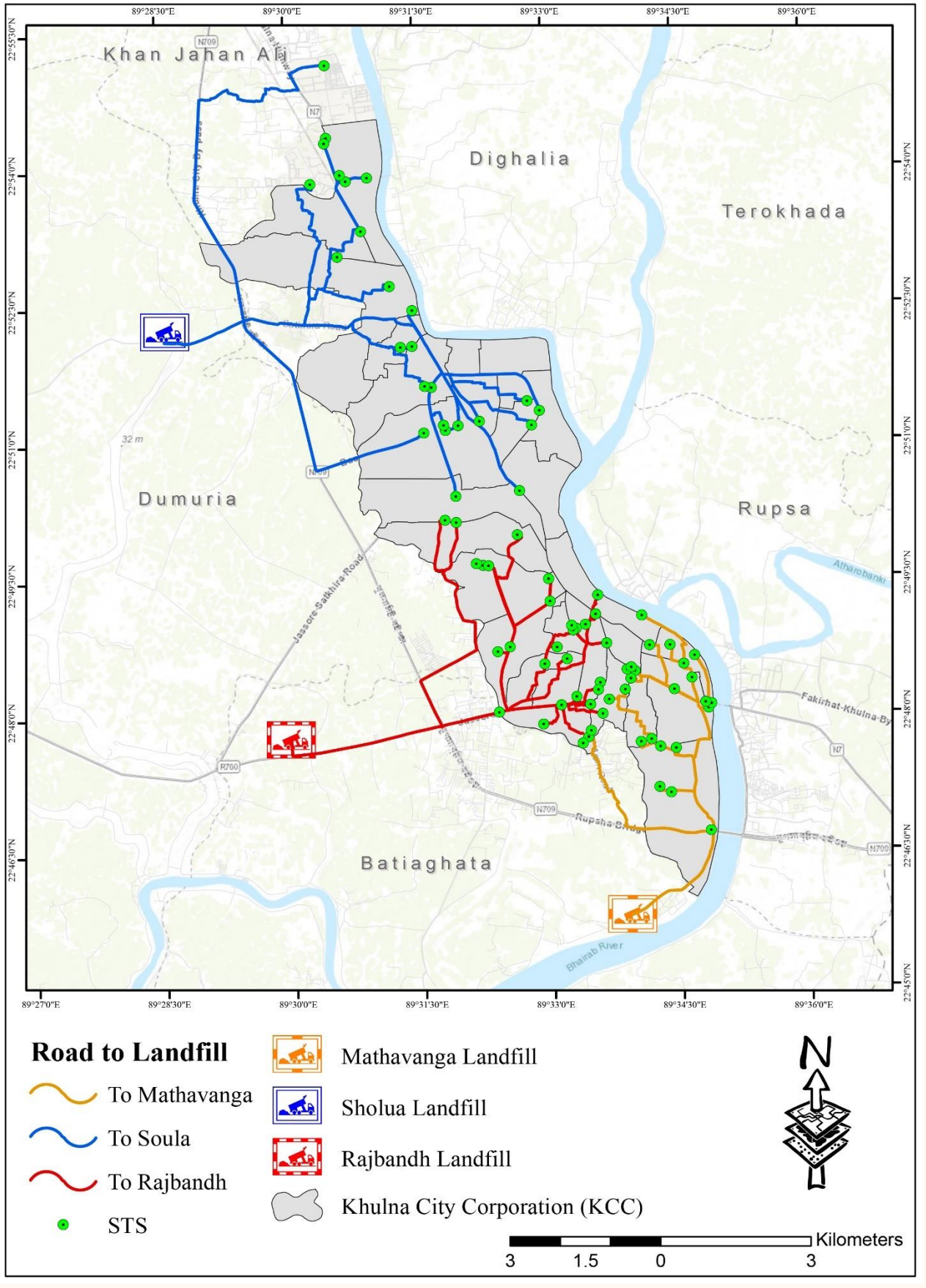


Figure 4-10. STS and Landfill Routes

4.6 Key Components

The KCC still has a lot of obstacles to overcome before it can advance. The KCC establishes policies as outlined in Section 4.3 and begins with 9 related components to accomplish better SWM by introducing 3R in LFSs and pyrolysis plants. These components fill in the gaps between the current state of WMDs and the ideal state that satisfies the vision and goals.

Component 1	Public relations, public awareness, and public involvement
Component 2	WBA activities
Component 3	Waste reduction
Component 4	Waste collection and transport
Component 5	Vehicle maintenance system
Component 6	Sanitary landfill
Component 7	Rules and regulations
Component 8	Organizational capacity
Component 9	Financial management

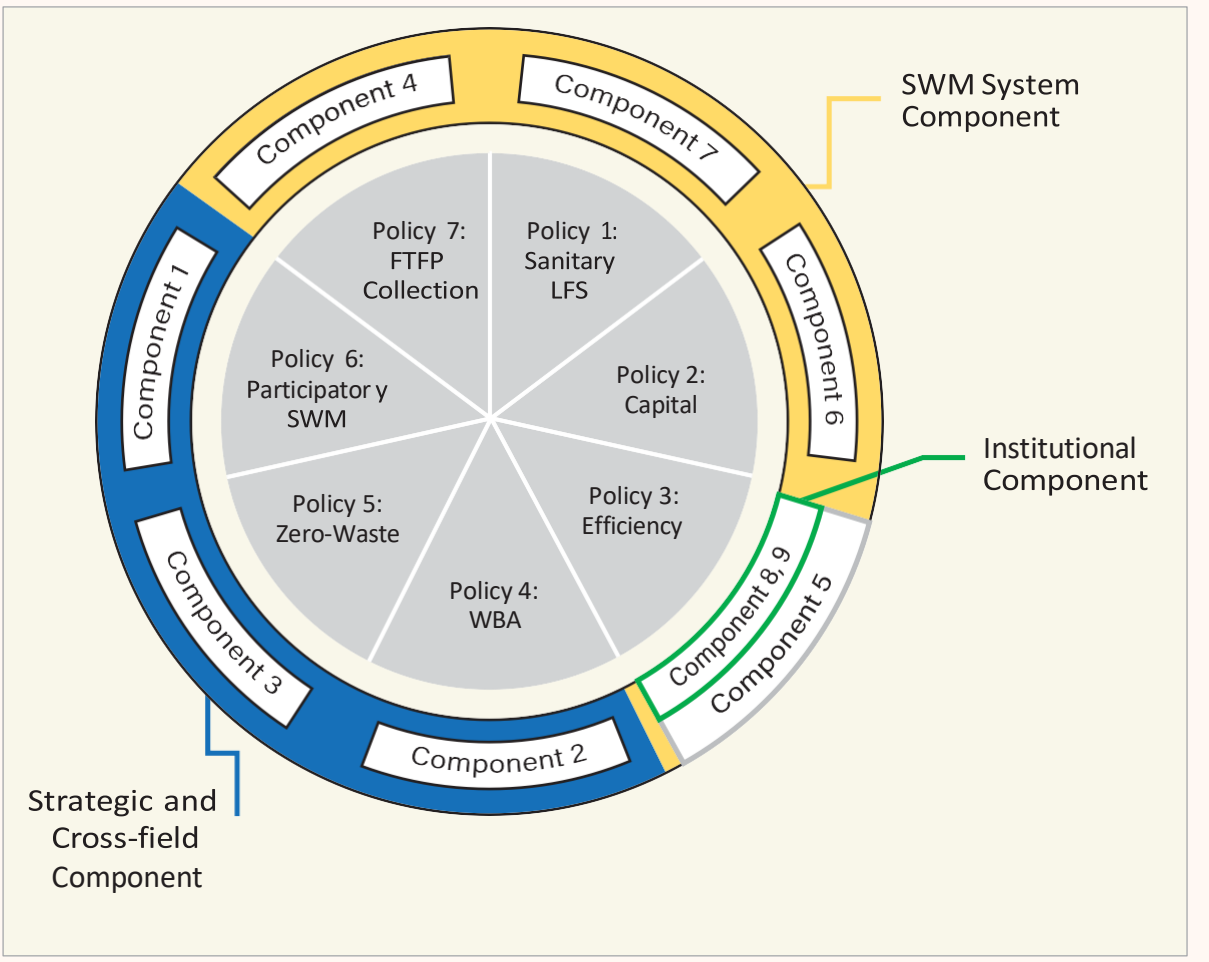


Figure 4-11. Policies and Key component of KCC Master Plan

Figure 4-11 describes the relationships between the policies and the components. The elements, which fall into three categories: "institutional," "strategic and cross-field," and "SWM system," are essential to the long-term viability of the KCC's institutional structure. The creation of a solid institutional basis linking the many WMD functions for sustainability is highlighted in this master plan. As explained in more detail in Section 4.6, each component has matching goals and tactics.

4.7 Objectives and Strategy

The Master Plan identifies the objectives and strategies in nine key components of SWM in KCC, as summarized in Table 4-7.

Table 4-7 Summary of the objectives and strategies

Objective	Strategy
Component 1: Public Relations, Public Awareness, and Public Involvement [C1]	
C1-01. Establish KCC's capacity to promote public involvement in SWM	• Enhance the organizational structure of the WMD to focus on public relations and awareness-raising efforts.
C1-02. Enhance public knowledge and understanding to work together	• Establish open communication channels with diverse stakeholders to facilitate active involvement and foster mutual understanding. • Encourage collaboration between KCC, universities, and companies to enhance the country's SWM sector.
C1-03. Stimulate public participation in waste management	• Formalize KCC's public relations and awareness initiatives. • Create and execute an information disclosure and sharing system within the WMD.
C1-04. Public relations and awareness-raising activities	• Engage the private sector and relevant key stakeholder for the awareness campaign • KCC's IMIS will be used as a tool for monitoring • Clearly marking the role and responsibilities of each stakeholder of KCC.

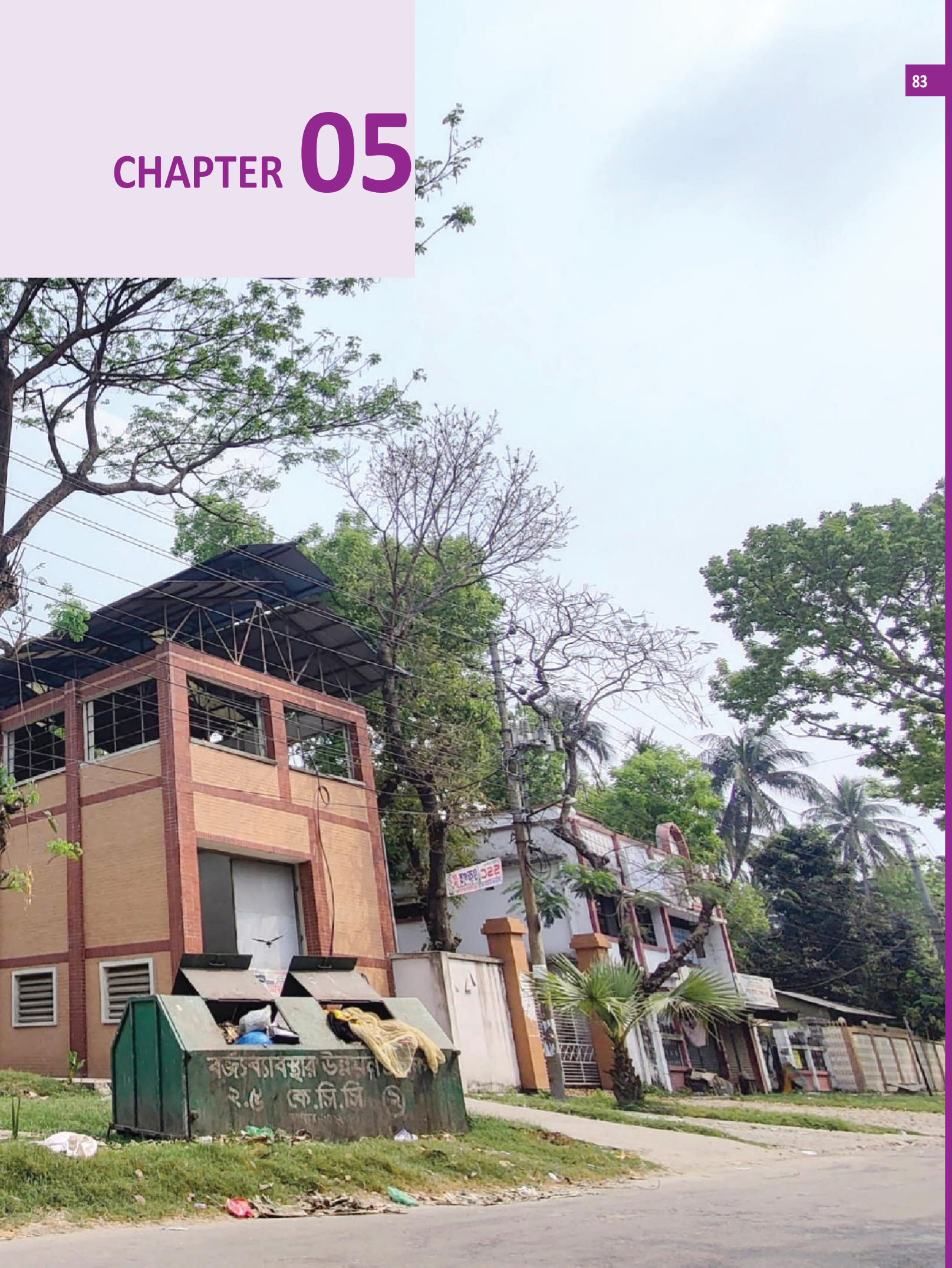
Objective	Strategy
Component 2: Ward-based Approach Activities [C2]	
C2-01. Improve the quality and efficiency of field-level SWM through WBA activities in existing wards, and expand WBA to new wards	• Promote Community Organizations/Community Institutions (CO/CIs) to undertake Ward-based Approach (WBA) activities through WBA core group meetings and other engagement activities. • Formulate Ward-based Approach Action Plans (AAP) in each ward to ensure appropriate allocation of community budgets and foster collaboration with the local community.
C2-02. Enhance institutional capacity, including planning skills of the conservancy wing within the WMD.	• Conduct training sessions and workshops for Community Organizations/Community Institutions (CO/CIs), cleaners, Public Sanitary and Cleanliness Promoters (PSCP), the community, and other stakeholders to encourage participatory SWM. • Provide education and training for cleaners on occupational safety measures within the wards. • Establish proper administrative procedures and a chain of command within the conservancy wing of the WMD in accordance with the administration procedure book.
C2-03. To improve waste collection, a Ward-based Approach will be used to outsource door-to-door services to a private operator.	• Partner with a private operator to manage Door-to-Door waste collection in each ward for more efficient and reliable service. • Develop tailored plans for each ward to allocate budgets effectively and encourage local community participation in waste management.
Component 3: Waste Reduction [C3]	
C3-01. Reduce the quantity of waste generated	• Prepare waste reduction plan. • Introduce 3R activities through WBA activities.
Component 4: Waste Collection and Transport [C4]	
C4-01. Promotion of community participatory waste collection	• Implement Fixed-Time Fixed-Place (FTFP) collection using compactors in all residential areas through community participatory waste management initiatives.

Objective	Strategy
C4-02. Expand the capacity of collection/ transport	• Procure waste collection vehicles and equipment. • Replace old vehicles with new vehicles. • Examine collection and transport operation methods for the expansion area. • Increase storage capacity of waste containers. • Implement capacity development of workers and drivers.
C4-03. Prepare for receiving the GAP vehicles	• Introduce GAP vehicles and the new collection system. • Increase the employment of drivers and workers for GAP vehicles. • Prepare a vehicle allocation plan for the GAP vehicles and containers.
C4-04. Unify KCC's waste collection management system	• Facilitate discussions and coordination among relevant departments within KCC to achieve unification. • Present the proposal for unification to decision-makers for official approval.
C4-05. Enhance the efficiency and sustainability of the Fixed-Time Fixed-Place (FTFP) waste collection system through community engagement, compliance measures, and operational improvements.	• Launch targeted campaigns to educate households and businesses about waste segregation and its benefits. • Offer rewards for good waste management practices and impose penalties for noncompliance with regulations. • Recruit and train sufficient personnel to support the system and assign the Waste Management Standing Committee an active role in monitoring and improvement efforts.
C4-06. Inclusion of CBOs, NGOs or the Private sector for the primary collection of waste	• Each ward should form a CBO-based LC that will monitor the performance of each ward. • NGOs and Private collectors will be encouraged to participate in the waste collection system (Door-to-Door). • Separation of waste will be encouraged and given financial support. • Ward-wise reward for efficient collection, transportation and disposal will be introduced. • Scrap dealers and their value chain will be encouraged by providing supporting services, i.e., a separate recycling zone.

Objective	Strategy
Component 5: Vehicle Maintenance System [C5]	
C5-01. Improve maintenance workshop operation and management and develop the capacity of workers and drivers	• Examine the outsourcing of maintenance. • Standardize maintenance works. • Introduce a new maintenance system.
Component 6: Sanitary Landfill [C6]	
C6-01. Improve extension Rajbandh LFS	• Properly dispose of and contain waste inside the LFS. • Repair the periphery embankment with an access road. • Install rainwater drainage, gas ventilation pipes, and leachate collection facilities. • Introduce the final soil cover on top. • Repair the leachate pond. • Continue to prepare dumping platforms and operation roads. • Compact a waste layer and shape its surface into a gentle slope.
C6-02. Conduct a safety closure at LFS	• Prepare a safety closure plan. • Secure a budget for safety closure
C6-03. Develop a future LFS	• Acquire land by facilitating the necessary legal procedures
Component 7: Rules and Regulations [C7]	
C7-01. Conduct daily SWM work in compliance with the administrative procedure book	• Compile the administrative procedure book in compliance with relevant laws and regulations. • Promote the implementation of the processes outlined in the administrative procedure book through training sessions and practical fieldwork in daily SWM practices.
C7-02. Enact SWM-related orders and WMD directives	• Develop and issue SWM-related orders and directives from the WMD promptly to facilitate the smooth and efficient execution of KCC activities. • Distribute the orders and directives to KCC staff for their adherence and implementation.
Component 8: Organizational Capacity [C8]	
C8-01. Strengthen the planning, coordination, monitoring, and evaluation capability of KCC	• Centralize the organizational functions of planning, coordination, monitoring, and evaluation within the WMD.

Objective	Strategy
C8-02. Cover collection and transport work, collection vehicle operation, and landfill operation work exclusively in the WMD	• Improve the capabilities of Zone Offices for secondary collection and transportation. • Conduct a study on the procedures for repairing conservancy vehicles and heavy equipment. • Restructure the organizational framework of the WMD to incorporate sections dedicated to collection vehicle management, waste collection, and landfill operation.
Component 9: Financial Management [C9]	
C9-01. Reform the SWM accounting system for budgeting and cost control	• Implement an updated accounting system to accurately track SWM costs. • Compile an annual budget report for the WMD. • Introduce a financial assessment system to evaluate SWM expenses and financial performance.
C9-02. Enhance financial capacity for Master Plan implementation	• Enhance revenue generation by reviewing the estate tax system, adjusting the conservancy rate of holding tax, and improving tax collection and user fee collection rates. • Develop a comprehensive financial plan to fund the implementation of the Master Plan and cover associated costs.

CHAPTER 05



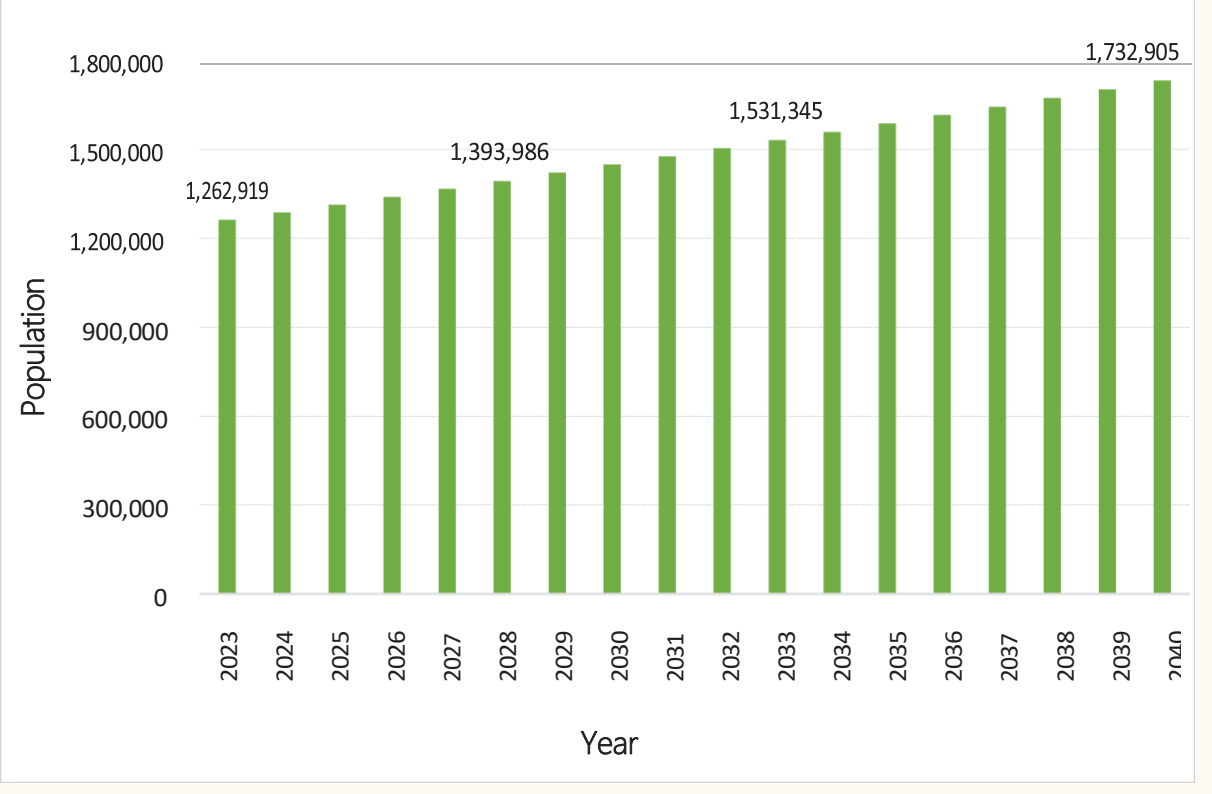
CHAPTER 05

MASTER PLAN FOR SOLID WASTE MANAGEMENT IN KHULNA CITY

5.1 Planning Basis

5.1.1 *Population Projection*

Figure 5-1 shows the projected population for 15 years in KCC. The population is estimated based on the population data provided by the KCC. By 2040, the population in KCC area will increase to about 1.73 million.



Source: KCC, 2024

Figure 5-1. Population Projection in KCC (2023-2040)

5.1.2 *Solid Waste Generation*

Figure 5-2 presents the estimation of municipal solid waste (MSW) generation from FY 2022-2023 to FY 2039-2040. In FY 2022-23, the total MSW generated amounted to 1001 tons per day, with a projected increase to 1879 tons per day by FY 2039-2040.

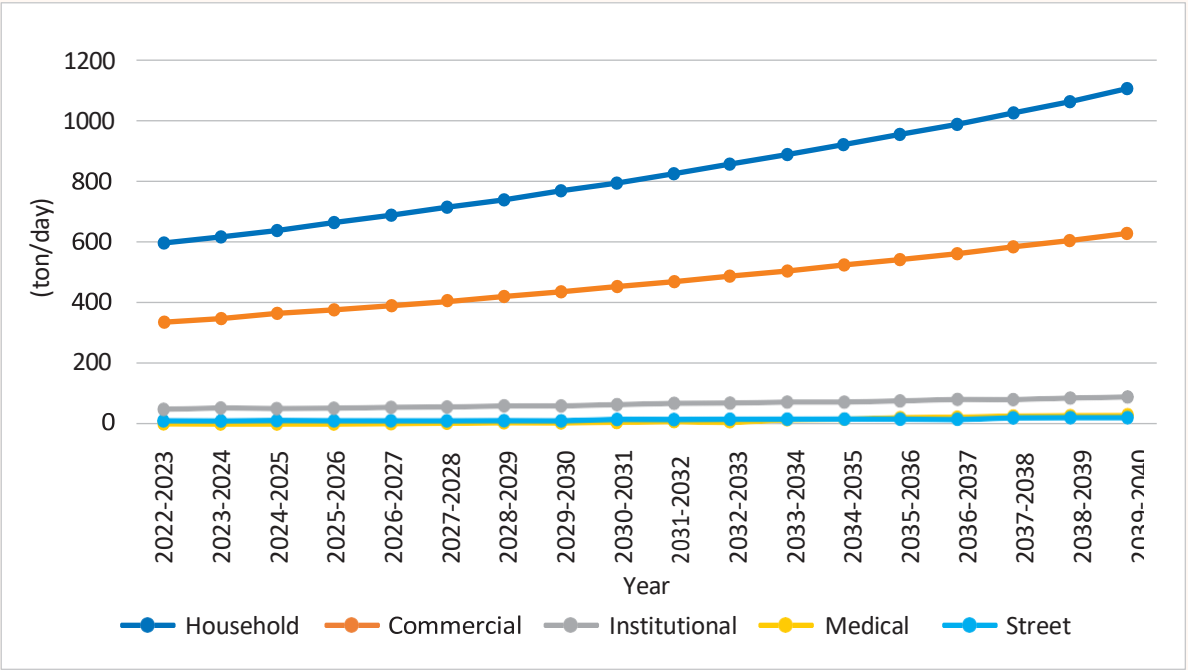


Figure 5-2. Estimation of Municipal Solid Waste Generation

This total waste generation encompasses household waste, commercial waste, institutional waste, street waste, and medical waste. During the Master plan period from FY 2022-2023 to FY 2039-2040, all categories of waste are expected to experience growth.

5.1.3 *Target Waste Collection Rate*

The present collection rate is 80%, and the target is to incrementally increase the collection rate each year. The target waste collection rate for the final year was set at 97% of total waste generation. Table 5-1 shows the daily target waste collection amounts and rates in each year from FY2022-2023 to FY2039-2040.

Table 5-1 Target Waste Collection Rate

Year	Waste Generation (tons/day)	Waste Collection (tons/day)	Waste Collection Rate (%)
2022-2023	1000.876	800	79.93
2029-2030	1290.718	1122.925	87
2039-2040	1879.746	1785.758	95

Source: SCIP, 2024

5.1.4 *Estimate of Waste Recycling*

Figure 5-3 depicts the target waste recycling statistics for the KCC area over the next 15 years. The desired waste recycling amount has been established to progressively increase from 27.73 tons per day in FY 2022-2023 to 200 tons per day by FY 2039-2040.

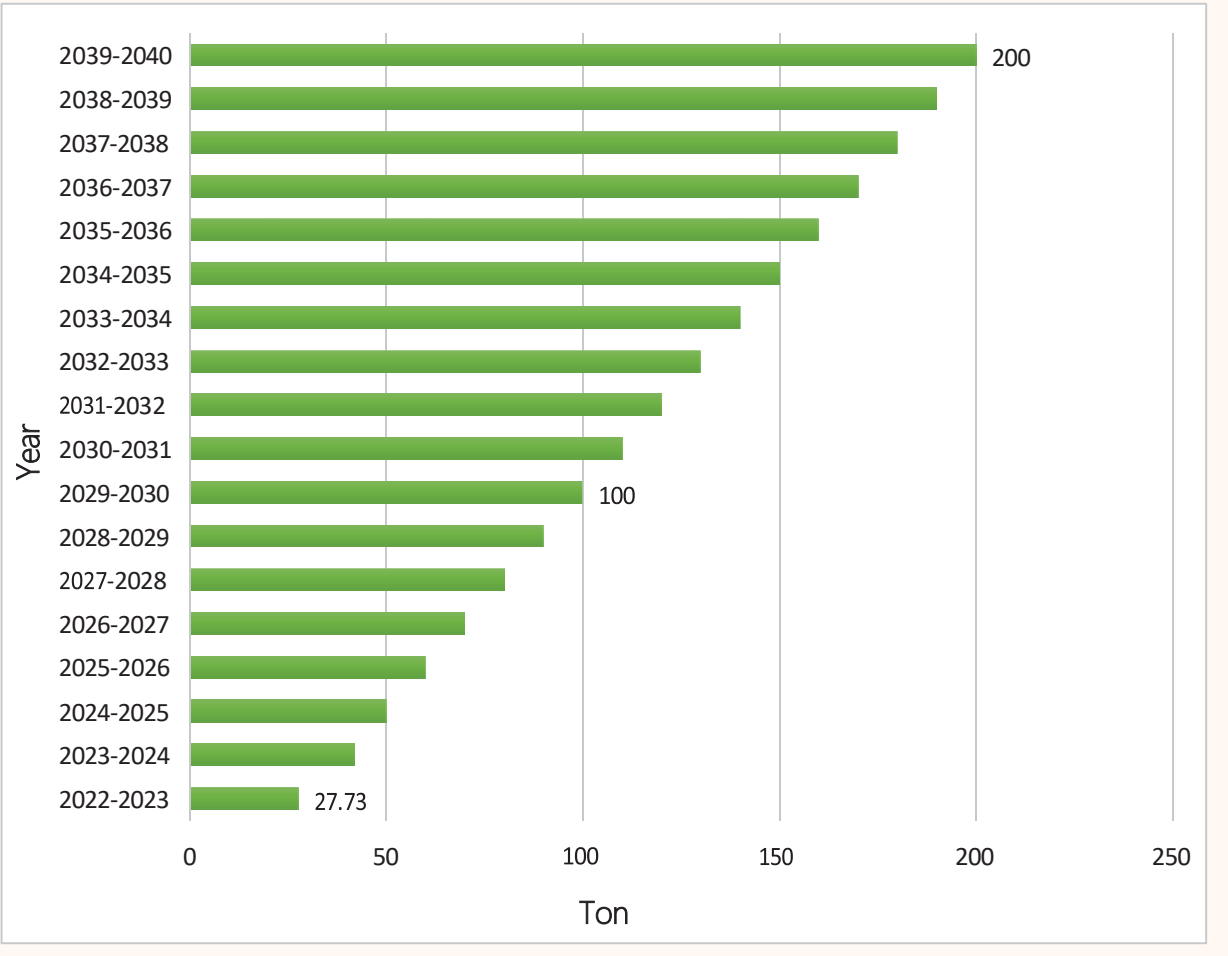


Figure 5-3. Estimation of Recycling

5.2 Public Relations, Public Awareness, and Public Involvement (Component 1)

5.2.1 *Establish KCC's Capacity to Promote Public Involvement in SWM {C1-01}*

Enhancing democratic local governance in the field of solid waste management (SWM) is achieved through two key strategies: (i) raising public awareness and (ii) developing public relations that facilitate communication between local governments and citizens. The public Awareness Centre (AWC) can plays a crucial role for strong connections among various stakeholders, including the community, non-governmental organizations (NGOs), news media, and other governmental entities. As an AWC is already established by SCIP Plastics project at KCC building, the KCC authority can continue the activities of AWC after ending this project (Figure 5-4). While KCC can specify the further activities of AWC based on future requirements. These can be followed:

I. Roles and Responsibility

The Awareness Centre (AWC) intends to take responsibility for waste management, which includes the planning and implementation of KCC's activities for raising awareness. They also intend to take responsibility for leading the disclosure of relevant information, liaising with the news media in collaboration with the Public Relations Department (PRD), and enhancing corporate communication strategies. The roles and responsibilities of AWC are summarized in Table 5-2.

Figure 5-4. (a) Awareness Centre Office Room, (b) AWC Workshop/Training Room

Table 5-2 Roles and Responsibility

Public awareness-raising activities	• Outline, supervision, and other support work. • Environmental education and 3R promotion to citizens. • Planning of city-wide awareness. • Public relations and public awareness strategy development, including regional public relations programs.
Information disclosure	• Information disclosure and sharing system planning. • Management of distributing information through various media tools such as press conferences, social media, websites, newspapers, annual reports, stakeholder consultation. • Development of an information disclosure policy.
Media relations	• Liaising with the news media. • Media monitoring and analysis for proactive public relations strategy. • Providing media training to spokespeople. • Development of media relations policy.
Corporate communications	• Coordination with stakeholders across KCC for public relations and increasing awareness. • Sharing information among KCC staff.

II. Staff/Employee Allocation and Official Approval

The appointment of a minimum of four full-time employees to manage the AWC is recommended. Employees with backgrounds in environmental studies and social sciences should be given preference because their expertise will enhance the effectiveness of sustainability and community engagement programs. At least one of these positions should be filled by a female employee to ensure gender inclusion in leadership, allowing other female stakeholders to feel comfortable participating in different awareness-raising programs. These individuals will be required to collaborate with and supervise additional employees within

the Waste Management Department (WMD) who are tasked with activities related to AWC. The KCC is expected to formally sanction AWC and its staffing (one part-time and four full time) after the end of SCIP Plastics Project (December 2025). Prior to this official approval, SCIP Plastics Project employees designated for this initiative will persist with the planning and negotiation processes necessary for the AWC framework. Concurrent with the pilot phase, recruited personnel shall initiate their AWC-related work, adhering to the previously mentioned roles and responsibilities. Consequently, AWC will be poised for immediate activation following its authorization. The staff/employee allocation of AWC are shown in Table 5-3.

Table 5-3 Staff/Employee Allocation

Sl No.	Designation
01	Advisor (Part-time)
02	Head of Awareness Centre
03	Trainer
04	Communication Material Designer
05	Supporting Staff

III. Coordination with the Public Relations Department

The AWC works closely with the PRD through the KCC's PR plan. The PRD, at the forefront of KCC public relations, issues formal communications relating to waste management, including press releases and public notices. Concurrently, AWC coordinates the content planning in content with relevant stakeholders. Additionally, the PRD conducts reviews of other public relations materials and disclosure documents as necessitated. The collaborative workflow of public relations in waste management is summarized in Figure 5-5.

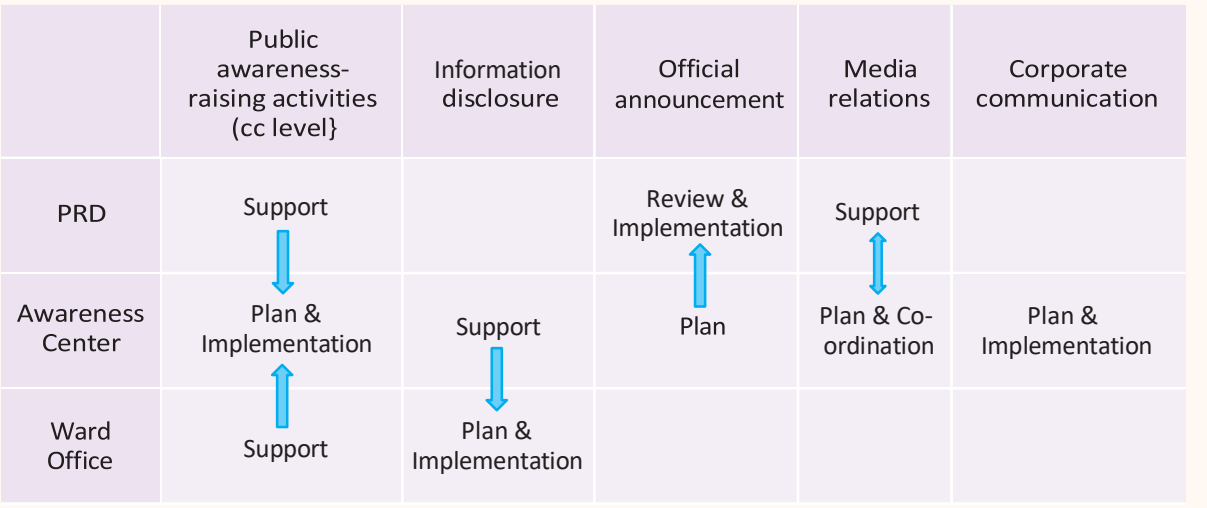


Figure 5-5. Work Relationships of Public Relations for Waste Management

IV. Financial Allocation by KCC or Sponsors

It is important to obtain and promptly distribute enough funding for KCC's public relations and awareness-raising initiatives. The following list includes the main expenses that must be funded from KCC's yearly budget or other funding sources including donations, for-profit businesses, and other organizations.

(i) AWC operation: salary for employees, office supplies, etc.

(ii) Consultation with key stakeholder groups: PCG and SWMSC meeting expenses

(iii) SWMSC operation: covering meeting expenses, etc.

(iv) Public relations initiatives: expenses for public consultations, publications, advertisements, public relations instruments, etc.

(v) Activities to raise public awareness: expenses associated with regional and local SWM campaigns, etc.

5.2.2 *Enhance Public Knowledge and Understanding to Work Together {C1-02}*

I. Public Consultative Group for Solid Waste Management Facilities

The PCG for a SWM facility will be introduced first here to provide multiple channels of contact among the project proponent, operator, KCC, and community for socially acceptable and sustainable facility operation. PCG meeting results such as discussion minutes should be widely available for accountability and transparency. The framework of the PCG is described below.

(1} Target facility

- SWM facilities such as an LFS, pyrolysis plant and recycling facility, STS, and other facilities are important for its operation wherever discussion among stakeholders occurs.

(2} Purpose

- To report the state of the facility operation.
- To consult with residents and other group members for improvement of facility operation'

(3} Group members

- Conservancy Department (CD), MoEFCC, representatives of nearby residents, a SWM site manager, environmental experts from universities.

(4} Information to be given from the facility side (examples}

- Planning phase
  - Background of development.
  - Conceptual plan and schedule.
  - Environmental and social effect assessment.
- Construction phase
  - Construction plan, schedule, and state.
  - Environmental and social measures to be adopted during construction.
- Operation phase
  - Operation state of facility including environmental and social monitoring data.
  - Financial information about its operation.

II. Information Exchange Meeting with Other City Corporations

Given the situation in Bangladesh, all city corporations must be facing similar issues, such as shortages of LFS and improper waste collection with increasing waste volume.

Proper waste management requires collection vehicle procurement, securing a sufficient landfill capacity, upkeep, skilled personnel, and, more importantly, enormous investment and O&M costs enough to continue the services. It suggests that the organization responsible for waste management should have strong governance among other departments and organizations within the city corporation to secure such costs.

Considering the future of solid waste management in the country, information sharing among city corporations is worth discussing the new issues, stimulating each other, and coming up with solutions for better practice.

The LGD will therefore plan a national SWM conference annually to share information and support among 12 city corporations and nearby local governments. AWC will closely support the LGD as a liaison for the meeting preparation, and the CD will take a leading part in the meetings as a high-level waste management practitioner. The meeting framework is outlined in Table 5-5. Prior to the meeting of the first 12 city corporations, general information on SWM is reported by each city corporation to understand how SWM is being performed in terms of organizational, financial, and operational aspects.

The information is then used as a reference in forthcoming meetings for growth. It is preferable that all reported data be consolidated into one data book to be officially published by the LGD and updated regularly, which would make the LGD's governance monitoring of the city corporations more efficient.

Table 5-4 Information Exchange Meeting for 12CCs

Host Organization	LGD
Members	LGD and 12 city corporations
Schedule	Annually
Topics (example)	- CD establishment - WBA activities - Waste management technology

5.2.3 *Stimulate Public Participation for Waste Management {C1-03}*

I. Planning Framework

The CD will use this Master Plan, which outlines activity frameworks and thorough methodology covering the following issues, as a basis for developing a communication plan as part of a public relations and public awareness strategy (Table 5-6).

Table 5-5 Planning Framework of Public Relations and Public Awareness

Planning Framework	Remarks
Awareness Centre (AWC)	• PR section establishment as part of CD reform
Mission, vision, and strategies of public relation and awareness raising	• Zero-waste campaign, 3R campaign, etc.
Promotion of community participation and environmental education	• Mass media relations- Marketing and promotions
Risk communication and grievance mechanism	• Responses and procedures to community complaints regarding environmental pollution, etc.
Information disclosure system	• Based on Bangladesh's Right-to-Information Act and incoming bylaws
Public Consultancy Group for SWM facility.	• Promoting community participatory facility development and operation
Information exchange meetings	• Coordinated by LGD

II. Public Relations and Awareness Raising Activities

Raising public awareness should primarily be accomplished locally at the community level through cost-effective and efficient means. As a control tower, AWC will oversee and keep an eye on neighborhood events carried out ward-by-ward in compliance with AWC's directives or CD's public relations and awareness campaign. AWC talks about and carries out the tasks related to CC-level awareness.

The following citywide public awareness initiatives are chosen for this Master Plan period based on the anticipated future. AWC oversees obtaining and allocating funding for these projects.

(i) Public training action and PCSP and cleaner's classes for Eid-Ul-Adha.
(ii) Clean Khulna Campaign/ Festival.
(iii) Information sharing via the website, magazine, and SNS.
(iv) Environmental teaching at schools.

III. Information Disclosure

Information sharing is necessary to raise public awareness of KCC's waste management efforts as well as to promote transparency and accountability. It is necessary to ascertain the information coverage for both proactive and request-based disclosure, as it may vary. We will carefully examine the information disclosure process using appropriate techniques and resources. Examples of information-related techniques and technologies are provided in Table 5-7.

Table 5-6 Examples of Methods and Tools for Information Disclosure

Information	Methods	Tools	Timing
Annual budget, annual activity plan, annual report	- Issue annual basis report and distribute to interested parties - Publish a summary on appropriate media - Explain to stakeholders	- Annual report (hardcopy) - Newspaper - KCC website - Stakeholder meeting	To be determined (annually)
SWM plan	- Issue a summary and explain to stakeholders - Publish a summary on appropriate media	- SWM plan summary (hardcopy) - Newspaper - KCC website - Stakeholder meeting	One month after release
Environmental monitoring data	- Process raw data and visualize them to facilitate understanding - Provide a summary on appropriate media - Explain to stakeholders	- KCC website - Stakeholder meeting	To be determined (annually)
EIA and Environmental Management Plan (EMP) for SWM facilities	- Disclose publicly for certain days at appropriate locations after issuing a notice in the newspaper - Explain to stakeholders	- Draft EIA report (hardcopy) - Final EIA report (hardcopy) - KCC website - Stakeholder meeting	Immediately after release

5.3 Ward-based Approach Activities (Component 2)

5.3.1 *Improve Quality and Efficiency of Field-level SWM {C2-01}*

I. Philosophy of WBA

The Ward-Based Approach (WBA) represents a progressive methodology designed to enhance the operational efficacy of Solid Waste Management (SWM) field activities. This strategy empowers field officers to exercise autonomy in their decision-making processes while ensuring that their actions are executed in a coordinated and methodical fashion. In cities like KCC, the decentralization of organizational structures is essential. Without it, the provision of public cleaning services and the administration of SWM tasks would be ineffectual. The underlying principles of the WBA are articulated in the four subsequent sections.

(1) Field-oriented SWM

The WBA establishes the specific duties and responsibilities of field officers to construct the foundation of SWM as a public service. Cleaning and waste collection services are conducted in practice by field officials such as CIs and cleaners. The community evaluates the quality of cleaning services through everyday routines in nearby regions. Field officers are first to hear complaints from residents. Ward SWM offices operate as the core of field operations in the assigned region, and it should be open to the community to sustain SWM harmony with society.

(2) Bottom-up and Decentralized Management Style

The SWM system for a large city must be different from that in a small town. The enormous population makes decision-making slow down by the leaders. Quality control of SWM is tough, and penetration of the policy from the top to the bottom takes time. Decentralization in the CD is necessary to avoid a malfunction of the administration. A bottom-up management approach is also a feature of the WBA. To accomplish decentralization and bottom-up management of the CD, the terms of reference (ToR), CI/CO/Conservancy Officer, and chain of command in the CD should be reassessed, and the power should be transferred to enable them to address the issues in their wards. In particular, middle management must be enhanced. Considering the present capacity of field officers, training on ward-wise planning, SWM data administration, and monitoring of WBA operations as a ward SWM officer is essential.

(3) Cross-organizational Structure

Several sorts of challenges occur at the field level, which are not fully addressed by the present scope of the work. For example, before the WBA was launched, the CI's duties included neither control of the working environment of cleaners nor community awareness building. The WBA provides a solution for filling the gaps in the existing work and facilitates linkage of the linked departments/divisions such as transport, mechanical, legal, finance, and public relations.

(4) Participatory SWM with Multiple Stakeholders

WBA 3 is meant to develop "community participatory SWM" through CUWG. The community is involved in the process of selecting the SWM system fit for that location in the context of social, environmental, cultural, and economic considerations. Even though SWM is a public service, collaboration in the community is inevitable. WBA 3 permits the development and ownership of a CAP. The community is not the sole aim; additionally, various stakeholders such as universities, journalists, cleaners, and PCSPs should be included in the process of SWM.

II. WBA Field Activity Implementation

WBA activities will be promoted and disseminated in all 31 KCC wards. For strengthening the WBA concept on-site, 14 major field activities will be implemented, as shown in Table 5-8.

Table 5-7 WBA Field Activities

	Main Activities
WBA 1	• Reinforcement of zone management. • Strengthening of planning and management capacity. - Ward-level WBA AAP based on CD directives. - Budget request and disbursement for WBA activities. - SWM administrative procedure book. • Improvement of data management system. • Construction of a ward office in all 31 wards of KCC.
WBA 2	• Provision of safety gear and awareness raising on OHSE • Formulation of the Safety and Sanitation Committee (SSC) • Distribution of Cleaners' Working Manual • Training of cleaners regarding the new concept of CD directives, such as waste reduction • A CBO based SSC committee will be formulated to monitor the overall safety and security of sanitation workers. Involvement of NGOs and universities will be encouraged.
WBA 3	• Promotion of community action with CUWG • Public awareness regarding the new concept of CD directives, such as waste reduction • Receipt of complaints by the community
WBA 4	• Unsanitary dustbins and container closure • Improvement of primary and secondary collection based on the SWM data
WBA 5	• Formulation of ward committee comprising concerned citizens who can monitor the everyday scenario of SWM • Make a competitive environment for sustainable SWM in every ward

III. Safety and Sanitation Committee Management (WBA 2}

A safety and sanitation committee (SSC) will be organized for each workplace such as the landfill and ward office to create a safe and sanitary working environment. An example of the SSC structure and activities at a ward office is shown in Table 5-9.

Table 5-8 Examples of Safety and Sanitation Committee

Member	CI, leader of the cleaners, six representative cleaners
Frequency	Once a month
Activity	• Confirm the safety and sanitation of work (cleaner manual). • Analyze the cause of injury. • Analyze the cause of the accidents. • Safety patrol (work supervision). • Report to zone office; zone office compiles a report of SSC and shares it with other zones. The report is filed in the zoning office. • Organize a zone-level SSC annually and issue a report to each ward in the meeting.

IV. Community Unit Working Group (WBA 3}

The CUWG is responsible for collection improvement and waste reduction. The CI will activate the WBA 3 activities further with the CUWG in accordance with the Master Plan. WBA 3 will be further promoted in partnership with AWC and PRD.

V. Cross-Organization Structure

The WBA incorporates a cross-organizational structure and demands cross-field activities. WBA 1 to WBA 4 explain the key domain and activities, which substantially stimulated CIs to promote field activities in the prior project.

Owing to the rapid economic expansion and population overflow, SWM will become more complicated and diversified. Expectations for quality in the public cleaning service from the community and society will be higher. Field officers require flexibility and excellent judgment on the field; otherwise, SWM cannot be sustained correctly. In theory, the WBA aspires to comprehensive ward-wise SWM under the ward office for developing policy and budget execution. This also involves flexibility in daily activities and tolerance in the scope of the task to manage all concerns arising in a ward, which in turn requires creative actions to bridge the gap among current assignments, organizations, and interactions with stakeholders. Social, cultural, and economic contexts also must be examined. In the Master Plan, five domains that closely link the WBA are found, as indicated in Figure 5-6.

[Main domains closely related to the WBA]

- Institution (law and regulations).
- CD organization improvement.
- Public awareness and public relations.
- New concept and facility of waste treatment, including sanitary landfill, and WtE.
- Waste collection and transport, including FTFP collection by compactor

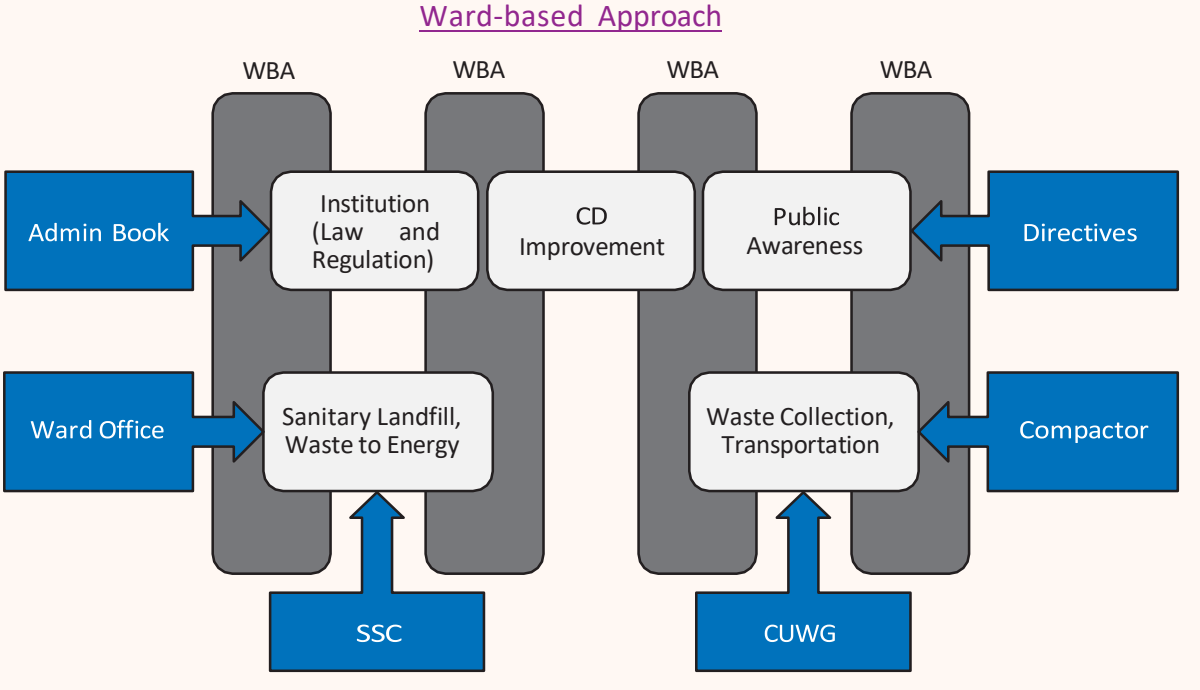


Figure 5-6. Main Domains Closely Related to WBA and Its Function

5.3.2 *Enhance Institutional Capacity of the Conservancy Division {C2-02}*

I. Bottom-up and Decentralized Management

(1) Reinforcement of Zone Management

The top-down management style has been in implication for a long time in KCC. This management approach is ideal especially when begun by strong leadership in emergencies.

The optimum population size for SWM is considered between 100,000 to 150,000; a bigger population creates issues with SWM. KCC has a population of 1.26 million, and the cleaning services are controlled by the CD exclusively. Ward-wise SWM is an effective and suitable management strategy considering the manageable population size.

The WBA is a bottom-up management approach. Field activities are promoted separately by the CO/CI. The WBA works in a well-organized and methodical manner because field officers such as COs/CIs fully understand their roles, and middle-management officers such as Conservancy Officer manage and supervise their jobs appropriately. In this context, the job description and chain of command should be evaluated and modified. Several training programs are provided for building managerial abilities in the CD.

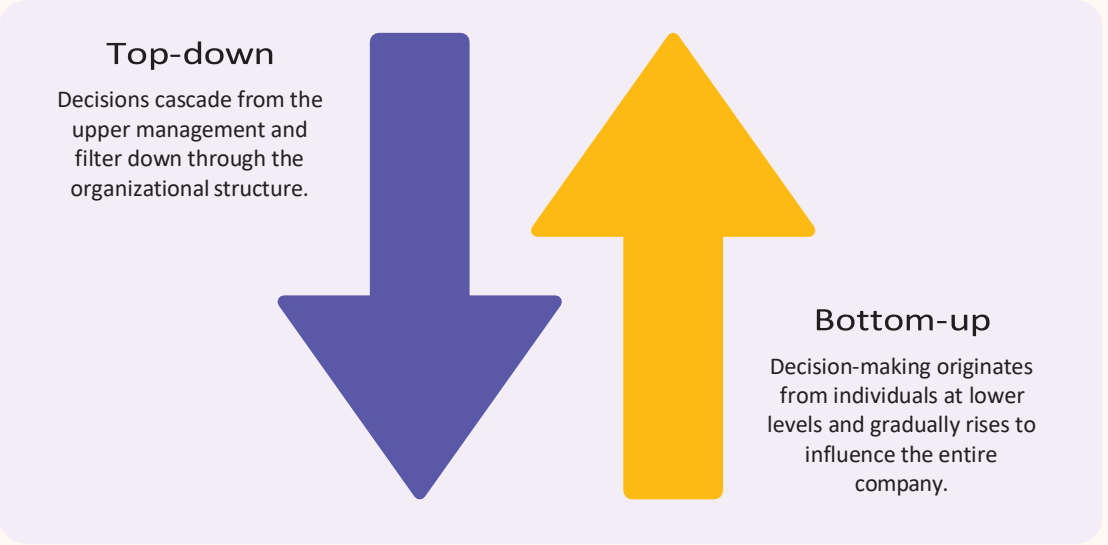


Figure 5-7. Top-down and Bottom-up Management Styles

(2) Strengthening of Planning and Management Capacity

An annual activity plan for SWM should be prepared at each level, including 31 Wards and the CD, based on CD directives. The CD directives should be revised following the Master Plan. One of the primary topics that must be reflected in field activities is "Waste Reduction." Such innovative planning enables the CD to disseminate the new concept and policy.

The annual activity plan will exhort proper budget disbursement. The budget plan should be prepared and assessed on the premise of the annual activity plan and should proceed per the SWM administrative procedure book. The main factors for strengthening the planning and management capacity are summarized below.

[Key factors for strengthening the planning and management capacity]

- CD directives and SWMSC.
- Ward-level WBA AAP based on CD directives.
- Budget request and disbursement for WBA activities.
- SWM administrative procedure book.

Examples of the budget request and approval procedure are shown in Figure 5-8. For example, when each ward office prepares a WBA budget at the end of the fiscal year and submits it to the Conservancy Officer, the Conservancy Officer compiles a budget distribution plan in each zone and submits it to the Chief Waste Management Officer (CWMO). The Chief Waste Management Officer (CWMO) then assesses the plan and submits it to the CEO and mayor for approval. An office order will be issued and endorsed for this procedure in KCC. The SWM administrative procedure book should be reviewed periodically to incorporate new directives or regulations.

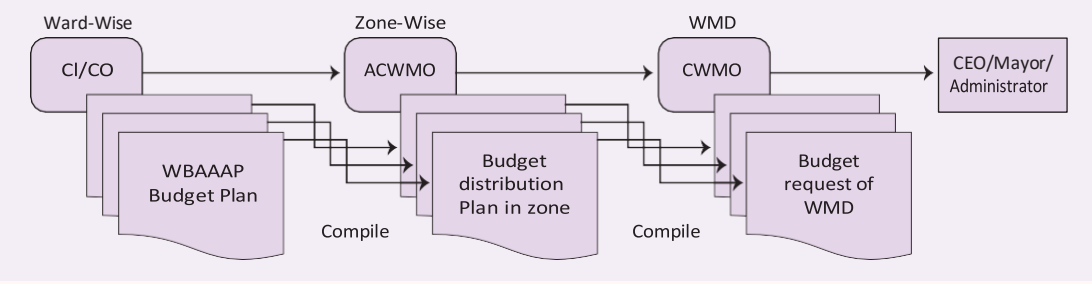


Figure 5-8. Example of Budget Approval Process in KCC

(3} Improvement of the Data Management System

The daily and occasional reporting system from CIs to the Conservancy Officer necessitates recording to utilize the information for SWM improvement. Operation and management based on the acquired data are fundamental for enhancing the current situation by analyzing data and implementing measures. Examples of data management elements are shown below. KCC will issue an annual SWM Report that includes ward-wise population and refuse collection amounts. These SWM data will be beneficial for better communication with the CSP, cleaners, and the community.

The Conservancy Division's institutional capacity enhancement plan prioritizes improving the data management and reporting process. It is proposed that Solid Waste Management (SWM) services be linked to the Management Information System platform. The platform would be modified to include SWM-specific features and functionalities, allowing for extensive data visualization and analytics to aid in informed decision-making. To assist this integration, a feasibility study would be carried out, the IMIS platform would be adapted, and personnel would be trained to ensure its deployment. This effort would boost KCC's waste management capacity while also considerably improving service performance.

[Example of Data Management Items]

- Annual activity plan and report
- Cooperation with community
- Primary and secondary waste collection
- Management of cleaning appliances and equipment
- Management of cleaners
- SSC activities
- Local cleanliness
- Budget plan and report

(4} Organization of Ward Office Management

The center of field-level activities is the ward office, and the CI's role is to oversee the ward office. A ward office needs a management system that gives the CI more capacity and power within the ward to properly administer the ward. An example of the organizational structure in a ward office is shown in Table 5-9, which consists of five sections: labor adjustment, waste reduction, operation and maintenance, permission and guidance, and management and planning.

Table 5-9 Example of Organization for Ward Office Management

Ward SWM Office	1. Management and Planning Section 2. Operation and Maintenance Section 3. Permission and Guidance Section 4. Waste Reduction Section 5. Labor Adjustment Section

II. Training and Workshop

(1) WBA Related Training

WBA training programs are planned to involve various stakeholders. Table 5-10 shows examples of WBA-related training. These programs will be developed based on existing training modules. A training module for drainage cleaners and planning/SWM data management will be newly established.

Table 5-10 Examples of WBA training

Training Program	Contents
1) WBA Training (CI Training)	- Training of Trainers for Workshop
2) Zone Level Training	- WBA Introduction
3) Road Cleaner Workshop	- WBA 2
4) Drainage Cleaner Workshop	- Safety and Sanitation (WBA2) - Risk Management
5) PCSP Workshop	- WBA 4b
6) CUWG Workshop	- WBA 3
7) Drivers Workshop	- WBA 4a
8) CD Directives/Planning Seminar	- CD Directives - Planning of Ward-wise Annual Activity Plan - SWM Data Management
9) Admin Book Seminar	- SWM Administrative Procedure Book
10) Medical Waste Seminar	- Awareness raising on Medical Waste - Risk Preparation

5.4 Waste Reduction (Component 3)

5.4.1 *Reduce Waste Amount Generated {C3-01}*

Waste reduction, often described as 3R, is a key tactic used to minimize the disposal of waste to LFSs. Figure 5-9 represents examples of 3R.

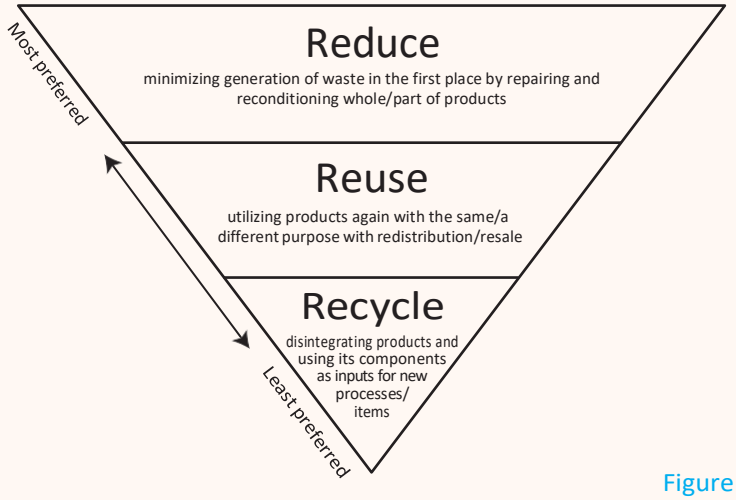


Figure 5-9. Examples of 3R

For encouraging waste reduction initiatives such as 3R, the involvement of citizens is important. Therefore, KCC will perform such tasks efficiently and effectively, making use of the WBA function. The waste reduction activities plan at the WBA is presented in Table 5-11.

Table 5-11 Waste Reduction Activity Plan in WBA

WBA	Activities
WBA 1	Ward Office Management: • CD directives are revised to emphasize the importance of waste reduction. • Measures for waste reduction are clarified by each ward in the WBA AAP based on the CD directives. • Conservancy Officer monitors the progress of WBA activities and promotes waste reduction regularly.
WBA 2	Safety and Sanitation Education for Cleaners: • Cleaners are trained to persuade citizens to contribute to waste reduction
WBA 3	Community Participation: • CUWG of each ward takes responsibility for the promotion of waste reduction in a target area. • Main activities are for reduction and source separation at the household. Details of these activities are discussed by CUWG and are determined based on the social and cultural backgrounds of each area.
WBA 4	Waste Collection Improvement: • Collection of recyclables separated at source is introduced for improvement of the conventional waste collection system. • The FTFP collection system encourages the participation of the community, which helps the CD to interact with the community for waste reduction.

Many waste pickers are working in Khulna. Before implementing waste reduction initiatives, KCC will assess the impact on their work and may take initiatives if the research results indicate a negative impact on their livelihood.

5.5 Waste Collection and Transport (Component 4)

5.5.1 *Promotion of Community Participatory SWM {C4-01}*

Even if the goal is to establish hygienic and efficient garbage collection and transportation, traditional waste collecting methods, such as container collection, have disrupted the city's landscape and increased traffic. Expanding FTFP collection using plastic bins and compactors must be taken into consideration to address these problems and replace the current collection strategy. Collaboration across communities is needed for FTFP collection. WBA 3 facilitates connection between residents and the KCC, while WBA 4 promotes the collecting of FTFPs. The FTFP collection's target areas will be expanded to include every residential area.

5.5.2 *Expand the Capacity of Collection and Transport {C4-02}*

The CD will purchase garbage collection vehicles and equipment. In general, new compactor trucks should be used in place of outdated arm-roll trucks and container carriers, while dump trucks should be used for cleaning streets and drainage systems. The goal is to replace 50% of KCC's waste collecting vehicles with compactor trucks. Given that many departments at KCC oversee the collecting vehicles in addition to CD, communication and cooperation between relevant departments must be highly promoted for effective administration.

Furthermore, a thorough and prompt examination of the trash collection and transport operation for the expanding region is necessary. The expansion area has very little SWM practice. It is essential to hire and train new drivers and collect employees for the growth area.

By FY 2024-2025, a vehicle purchase plan will be created to accomplish FTFP collection throughout the KCC using plastic bins and compactors. The prerequisites for determining the required number of vehicles are listed in Table 5-12. It is supposed that roadway and drainage cleaning is done with dump trucks.

Table 5-12 Assumption for calculating necessary number of vehicles

Item	Assumption
Vehicle Lifetime	20 years (50% of the procured vehicles are scrapped after 15 years)
Replacement condition	Arm roll and container carriers are replaced with compactor trucks.
Vehicle Type	Compactor: Dump truck = 8:2 (Dump truck is allocated for street and drainage cleaning

Considering the vehicle lifetime and waste generation, Table 5-13 estimates the required number of garbage collection vehicles by vehicle type in FY 2029-2030. The number of vehicles required for FY 2039-2040 is shown in Table 5-14. The KCC must have trebled the number of cars by FY 2039-2040.

Table 5-13 Waste collection vehicle planning in FY 2029-2030

Type		Capacity (tons}	Vehicle Nos.		Total
			Existing	Procured by KCC	
Dump Truck	Small Truck	3	23	7	30
	Medium Truck	7	4	4	8
	Large Truck	13	5	3	8
Container Carrying Trucks	Small Container	2.5	2	2	4
	Medium Container	4.5	2	2	4
	Large Container	5	2	2	4
Compactor		6	5	5	10
Total		-	43	25	68

Table 5-14 Waste collection vehicle planning in FY 2039-2040

Type		Capacity (tons}	Vehicles		Total
			Existing	Procured by KCC	
Dump Truck	Small Truck	3	20	5	25
	Medium Truck	7	5	6	11
	Large Truck	13	8	10	18
Container Carrying Trucks	Small Container	2.5	2	2	4
	Medium Container	4.5	2	2	4
	Large Container	5	2	2	4
Compactor		6	10	5	15
Total		-	49	32	81

I. Storage Capacity of Waste Container

An eight-trip maximum is typically allowed for a container carrier, with an average of four excursions. However, due to a lack of containers in the KCC area, the number of journeys is restricted. This situation is impeding efforts to raise the rate of waste collection. To make effective use of the container carriers, the CD will place more containers in the KCC area.

II. Capacity Development of Workers and Drivers

The CD promotes mutual support among cleaners and cleaners' groups. One way to show support is to assist other groups with their job after completing their own. It is also recommended that drivers assist cleaners in loading rubbish into compactors. Such on-the-job training helps to improve organizational governance and shift the cleaners' and drivers' perspectives toward respect and cooperation.

5.5.3 *Unify KCC's Waste Collection Management System {C4-04}*

According to TD's official work statement, TD, not the CD, oversees managing the majority of the collecting trucks in the KCC. Due to this circumstance, it is exceedingly difficult for CD to flexibly assign the vehicles to collect unscheduled garbage when needed. There are not enough collecting vehicles owned by the CD to cover the whole KCC region. For better garbage collection and sound waste management, the collection vehicles and their drivers ought to be within the CD's purview. To achieve the CD, difficult problems including protecting drivers' welfare and appeasing vested interests would need to be resolved. As a result, high-level officials' decision-making is essential, and associated departments' discussions should be highly encouraged for a seamless transfer.

5.6 Vehicle Maintenance System (Component 5)

5.6.1 *Maintenance Workshop Operation and Management {C5-01}*

I. Workshop Management Rules

CD needs to create workshop management guidelines to create consistency in operations and a well-functioning workshop. Table 5-15 and Figure 5-10 provide examples of the management rules' contents as well as the workshop's organizational structure.

Table 5-15 Examples of Workshop Management Rules

Contents
(1) Job Description of each level
(2) Rules on General Affairs
(3) Work Rules
(4) Rules on Working Time and Holidays
(5) Guidelines for Reporting System and Forms
(6) Safety and Sanitation Standards
(7) Guidelines for Safety and Sanitation Improvement i. General Rules ii. Chief Manager of Safety and Sanitation iii. Safety and Sanitation Committee iv. Safety Gear v. Medical Examination and Other Health Management Methods vi. Education and Training for Safety and Sanitation
(8) Rules on Staff Training

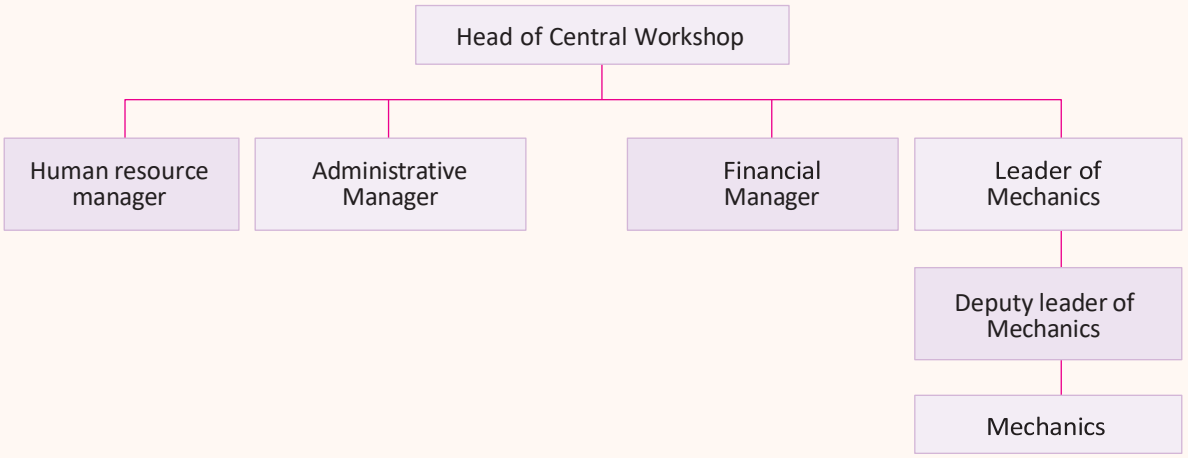


Figure 5-10. Example of New Workshop Structure

II. Workshop and Maintenance System Reform

Currently, collecting trucks are managed, maintained, and operated by three departments: CD, ED, and TD. Nevertheless, no procurement, repair, or comprehensive maintenance plan is in place. The CD should be the only organization in charge of collecting vehicle operation, maintenance, and unification. That is, the workshop, which the ED owns for the purpose of collecting vehicles, ought to be a part of the CD together with the ownership of the vehicles, and the drivers involved in the collection vehicle operation ought to be gradually transferred to the CD.

III. Preventive Maintenance Method Introduction

To avoid major mishaps or malfunctions, routine daily or monthly maintenance and inspection are crucial. One way to maintain a car is to keep track of each part's expiration date through preventive maintenance. The following is a summary of the primary preventative maintenance items.

1) Inspection Types:
   (i) Daily pre-work inspections.
   (ii) Daily post-work inspections.
   (iii) Weekly inspections.
   (iv) Monthly inspections.
   (v) Annual inspections.
   (vi) Two-year inspections.

2) Inspection Procedures
   (i) Inspection data are used to establish the normal replacement interval, and replacement will be carried out on a regular basis.
   (ii) A check sheet that contains the prior replacement time serves as the basis for inspection.
   (iii) Whether a replacement is necessary is determined by the mechanic overseeing the examination.
   (iv) The inspection findings are examined to assess the replacement of parts.
   (v) The driver confirms the state of the vehicle.
   (vi) Outsourcing is used for repairs other than filter or oil replacement.

3) The Two-Year or Annual Inspection

   The CD does the inspection if the car was purchased within the last five years. The inspection is contracted out for cars that were purchased more than a few years ago.

4) System for Managing Spare Parts

   It is necessary to design software for an inventory management system.

IV. Preventive Maintenance Method Introduction

Preventive maintenance is implemented for the workshop operation, as previously said, to increase the collecting trucks' productivity. The primary goal of preventative maintenance is to foresee major failures by changing parts at the workshop beforehand. The car is delivered to a private workshop that is contracted out to fix major malfunctions. Additionally, this approach improves the Mean Time Between Failures (MTBF). To create a better maintenance system, it is critical that more data be gathered and examined.

5.7 Sanitary Landfill (Component 6)

This Master Plan plans the sanitary landfill development to meet the KCC's pressing needs for garbage disposal. The two phases of the development plan are as follows:

1) The first phase (FY 2029-2030): Sholua sanitary landfill, Rajbandh sanitary landfill and Mathavanga Pyrolysis plant.
2) The second phase (FY 2039-2040): Sholua sanitary landfill, Rajbandh sanitary landfill, Mathavanga Pyrolysis plant and Mathavanga sanitary landfill.

5.7.1 *Construction of Sanitary Landfill {C6-01}*

The Sholua sanitary landfill is designed to process 375 tons/day MSW (Figure 5-11). The facility comprises several components, such as landfill cells, compost plants, waste-to-energy plants, and pyrolysis, which can receive 254, 75, 20, 12, and 14 tons of waste daily, respectively. The landfill site is already developed and ready for operation.

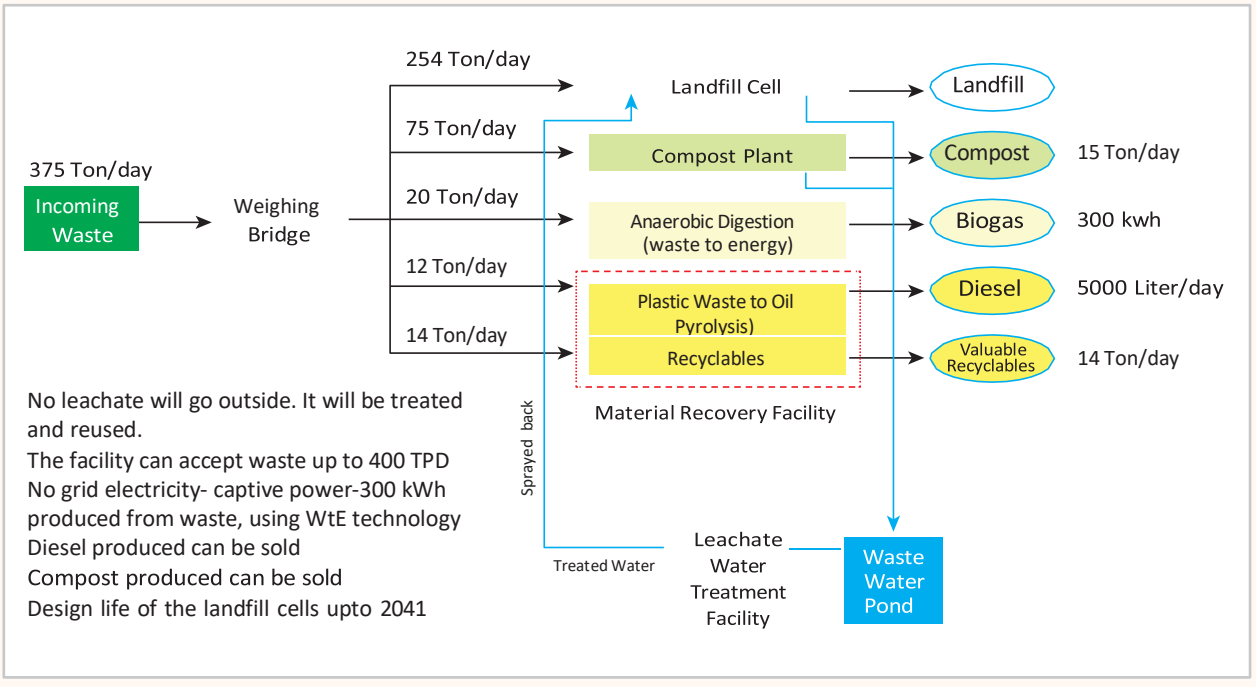


Figure 5-11. Waste processing capacity of Sholua LFS

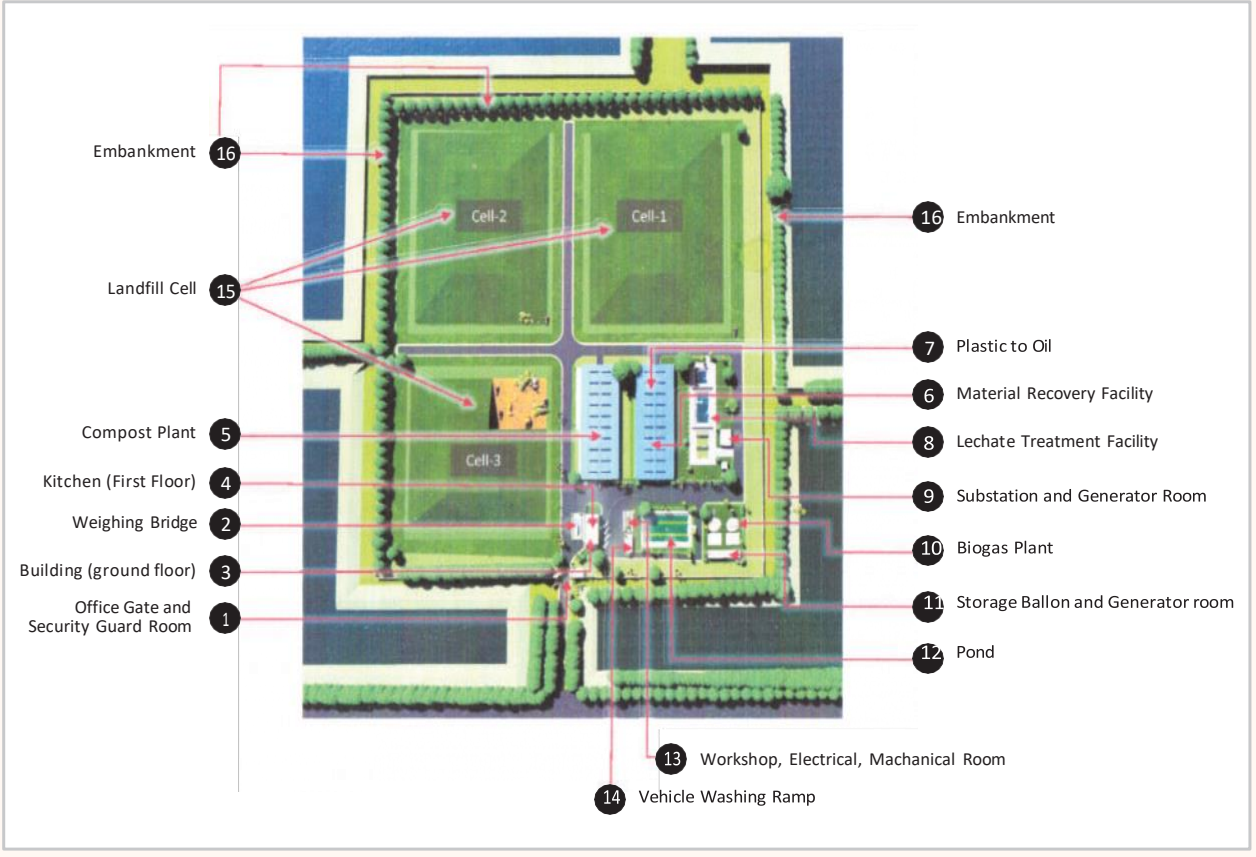


Figure 5-12. Layout plan of Sholua sanitary landfill

I. Future Sanitary Landfills

The Rajbandh open dumpsite will be closed by 2030 (SCIP 2023). The newly acquired 42-acre land in Rajbandh will be used as a sanitary landfill site; however, the project has not been initiated yet. The Mathavanga 3R initiative has a pyrolysis plant that is currently operational and can process 20 tons of MSW per day. The Mathavanga Sanitary landfill is a proposed project that has been in the planning phase. Table 5-16 shows the present and future landfill projects of KCC.

Table 5-16 Present and future waste management projects of KCC

Open dump site/Landfill	Status	Location	Area (acres}
Rajbandh open dump site	Active	Beside Khulna-Satkhira highway, Rajbandh	20
Sholua sanitary landfill	Under Construction	Beside the old Khulna-Satkhira highway, Sholua	17
Mathavanga sanitary landfill	Proposed	Mathavanga, Lobonchora	22.7
3R Initiative Implementation Project	Under Construction	Mathavanga, Lobonchora	2.0
Rajbandh Landfill site	Proposed	Beside Fecal Sludge Management, Rajbandh	42

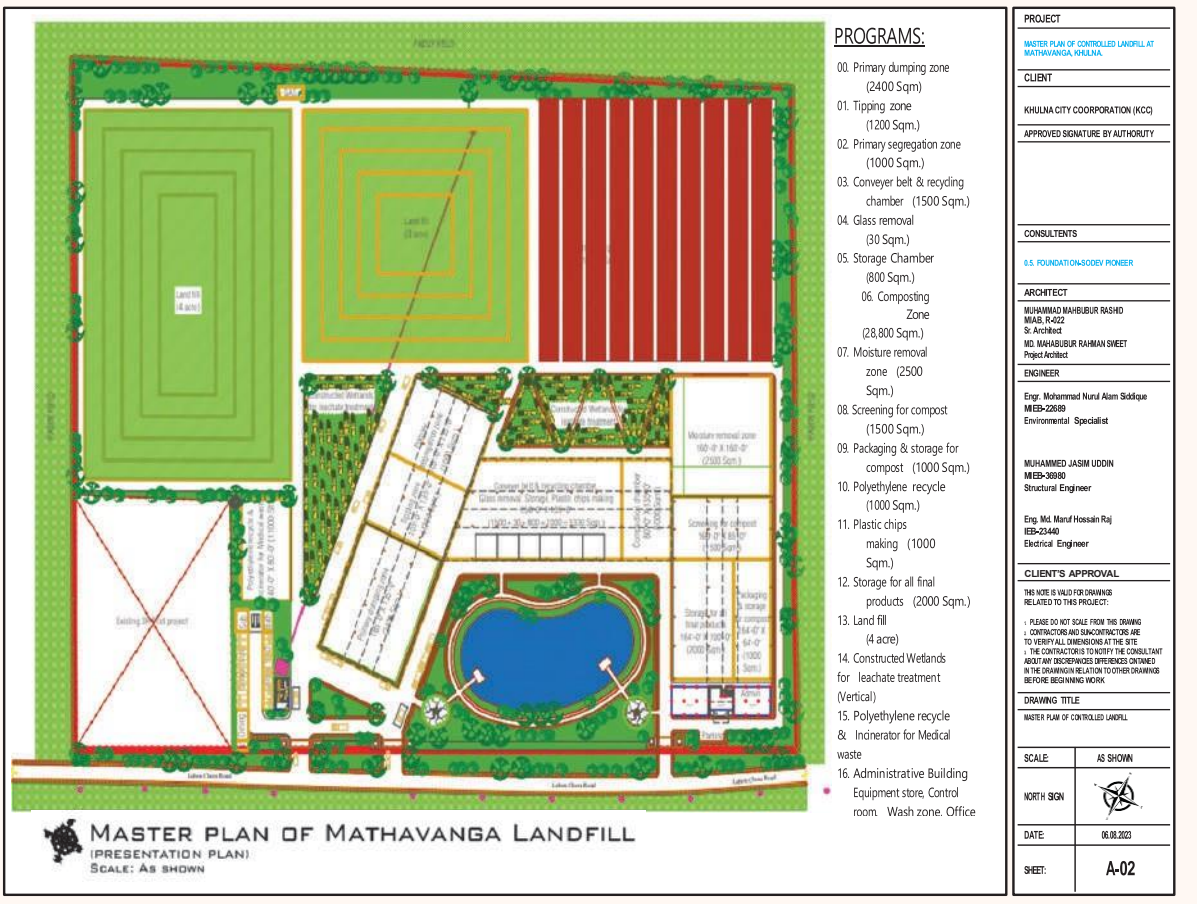


Figure 5-13. Layout of Mathavanga Landfill site

II. Timeframe of the Future Project

The construction and operational timeframe of the ongoing and future landfill projects in KCC are summarized in Table 5-17. The exiting Rajbandh open dumping site will be used till 2030. Construction of the proposed Mathavanga Sanitary LFS will start from FY2029-2030 and will be operational by FY2039-2040.

Table 5-17 Timeframe of the KCC's current and future projects

Timeframe Projects	2022 - 2023	2023 - 2024	2024 - 2025	2025 - 2026	2026 - 2027	2027 - 2028	2028 - 2029	2029 - 2030	2030 - 2031	2031 - 2032	2032 - 2033	2033 - 2034	2034 - 2035	2035 - 2036	2036 - 2037	2037 - 2038	2038 - 2039	2039-2040
Rajbandh open dump site	Closed by 2030																	
Sholua Sanitary landfill																		
Mathavanga sanitary landfill									Completed by 2040									
3R Project	Operational																	
Rajbandh Landfill site																		

5.8 Rules and Regulations (Component 7)

5.8.1 *Conduct Daily Solid Waste Management Work in Compliance with Administrative Procedure Book {C7-01}*

The formal steps and the authority of the administrative procedures are described in the SWM Administrative Procedure Book, often known as the Admin Book. Additionally, it facilitates mutual understanding between the proposal's approvers, including the CI, CO, EE, and CWMO, and the drafter. It is necessary to arrange workshops and training sessions for KCC employees and associated stakeholders to spread the administration book procedure. The Administrative Book will be updated on a regular basis to reflect changes to laws and regulations as well as real-world experience. A review committee comprising the CWMO, sub-group leaders from the WBA Core Group, legal and financial professionals, will be formed to oversee the creation of the Admin Book.

5.8.2 *Enact Waste Management Related Orders and Waste Management Department Directives {C7-02}*

Office orders serve as essential tools for the Waste Management Department (CD) to effectively carry out its operations. Timely issuance of these orders is crucial to prevent any delays in fulfilling vital waste management responsibilities. These orders are guided by the overarching framework established by existing CD directives, which delineate the department's activities over a five-year period.

Before an office order receives the mayor's final approval, it undergoes a rigorous review process led by the Solid Waste Management Steering Committee (SWMSC). This committee convenes to thoroughly discuss and deliberate on any proposed instructions, ensuring that they align with the department's objectives and adhere to regulatory requirements. Only after receiving the SWMSC's approval does the office order proceed for the mayor's consideration and ultimate endorsement.

5.9 Organizational Capacity (Component 8)

5.9.1 *Strengthen Planning, Coordination, Monitoring and Evaluation Capacity of KCC {C8-01}*

I. Organizational Reform of Waste Management Department

The Master Plan recommends a new Management Division within the Waste Management Department (CD) to enhance its functions. This Division will work with the existing Engineering and Waste Collection Divisions. The purpose is to better organize, coordinate, oversee, and evaluate CD operations. Figure 5-14 represents the revised CD organizational structure, highlighting several newly established sections.

The Management Division will consist of four key sections:

1. Planning and Strategy Section: This section will handle solid waste management planning, business operations and improvements, and short-term business policies. It will also manage data collection, departmental coordination, business administration, internal audits, research and technology development, and emergency responses.
2. Rules and Regulations Section: Responsibilities here include developing and revising CD directives, updating the administrative book, issuing office orders, and managing documents.
3. Personnel Management Section: This section will oversee labor management and welfare, ensure workplace safety, and allocate workers. It will also focus on enhancing the capabilities of CD staff through training programs.
4. Awareness Centre: This centre is tasked with developing and implementing KCC's waste management and public awareness campaigns. More details on this section can be found in section 5.2.1.

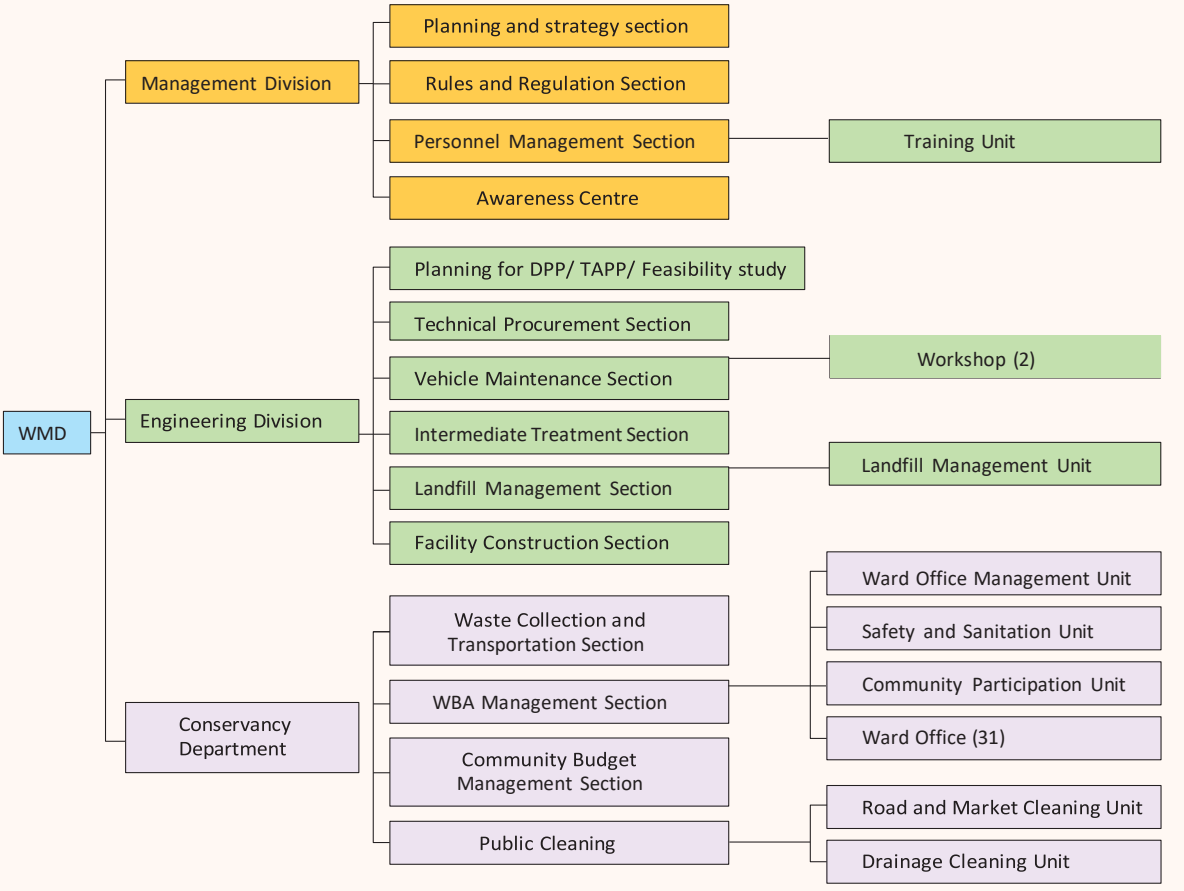


Figure 5-14. Proposed Organization Structure of CD

Capacity Development Program

1) Capacity Development of Management Personnel

Developing the capacity of CD staff, particularly management personnel, is crucial to strengthen organizational and human resources management for delivering uninterrupted services to citizens; awareness Center of the KCC is designed to do just that. Clear job descriptions, roles, responsibilities, and command chains within the CD are necessary to establish a seamless and reliable SWM system, fostering institutional resilience in response to rapid economic growth and social changes. Additionally, temporary staff exchanges between management personnel and field officers could be beneficial for fostering mutual understanding of their respective roles in a practical context.

2) Occupational Safety and Sanitation Management (WBA 2)

To enhance the working environment for cleaners and mitigate occupational hazards, three objectives outlined in WBA 2 focus on safety and sanitation awareness: providing safety gear, establishing the Safety and Sanitation Committee (SSC), and introducing the Cleaner's Working Manual. However, further improvement requires the development of rules and regulations pertaining to occupational safety, including safety regulations and accident compensation measures.

3) Staff Training Course

Enhancing both individual and institutional capacities within the CD is crucial, with staff training tailored to their respective positions playing a significant role. The Personnel Management Section's training unit conducts regular SWM training courses for staff members, including specialized programs for management personnel. Furthermore, technical training courses are offered to enhance the skills of technical personnel within the department.

Below is a sample staff training course curriculum:

- Labor Management
- Organization Management
- Time Management
- Presentation Skills
- Logical Thinking
- Budget Management
- Policy Making
- Strategy Development
- Risk Management
- Leadership
- Personnel Management
- Personnel Evaluation
- Information Disclosure
- Basic Theory of Solid Waste Management (SWM)

This comprehensive curriculum covers a wide range of essential skills and knowledge areas relevant to staff members within the Waste Management Department.

4) Collaboration with Educational and Research Institutions

Solid Waste Management (SWM) is an evolving area of focus for research and development within public administration, academic institutions, and private enterprises, particularly in the realm of innovative technologies and their practical application. To foster advancements in waste management sustainability, KCC actively encourages partnerships with universities and companies, aiming to bolster expertise and promote collaborative efforts in this critical domain.

5.9.2 *Cover Collection and Transport Work, Cooperation Vehicle Operation and Landfill Operation Work Exclusively in CD {C8-02}*

I. Engineering Division

The Engineering Division is tasked with spearheading the implementation of modern technologies, particularly the development of intermediate treatment facilities in sanitary landfill sites. This division comprises five sections:

- Preparation of DPP/ TAPP/ Master Plan/ Feasibility Study: Responsible for assessment of current and future SWM, land acquisition for Engineering landfills and financial feasibility analysis for different KCC projects.
- Technical Procurement Section: Responsible for procuring equipment related to waste collection, heavy vehicles for landfill management, spare parts, maintenance tools, and consumables, as well as managing purchase processes and records.
- Vehicle Maintenance Section: Initially part of the Engineering Division but slated for transfer to the Waste Management Division (CD), this section will focus on systematic and strategic vehicle maintenance, including budget planning, regulatory compliance, staff training, policy development, and internal restructuring.
- Landfill Management Section: Responsible for landfill planning, construction, operation, and maintenance, as well as data management, legal coordination, staff allocation, and budgeting.
- Facility Construction Section: Tasked with planning, developing, and managing facilities such as ward offices, workshops, and parking lots. This section also handles data management, legal coordination, staff allocation, and budgeting.

II. Waste Collection Management Division

The Waste Collection Management Division aims to centralize conservancy services and waste collection for better efficiency. It consists of four sections:

- Waste Collection and Transport Section: Responsible for planning waste collection, managing data, developing effective collection systems, executing waste collection, handling legal processes, allocating staff, and securing budget.
- WBA Management Section: Handles planning and implementation of Waste Bin Areas (WBAs), data collection at ward level, WBA maintenance, ward office administration, coordination with WBA stakeholders, allocation of Community Initiatives (CI), budget allocation, and implementing administrative procedures at the field level.
- Community Budget Management Section: Manages community budget allocation for WBAs to ward offices and oversees budget management.
- Public Cleaning Section: Manages planning for road, drainage, and market waste cleaning, staff allocation, budget allocation, and procurement planning for cleaning tools.

III. Privatization

Privatization can be effective in certain aspects of solid waste management (SWM), but it requires careful contract management and daily operation supervision. Examples of potential privatization roles include:

1. Collection of household waste from the Secondary Transfer Stations (STS).
2. Street cleaning within designated ward areas.
3. Transporting street waste to open spots using hand trolleys or pickup vans.
4. Transporting waste from STSs and open spots to Landfill Sites (LFS).
5. Transporting waste from drain cleaning operations to LFS.
6. Managing operations at LFS.

A potential working field of privatization is shown in Figure 5-15.

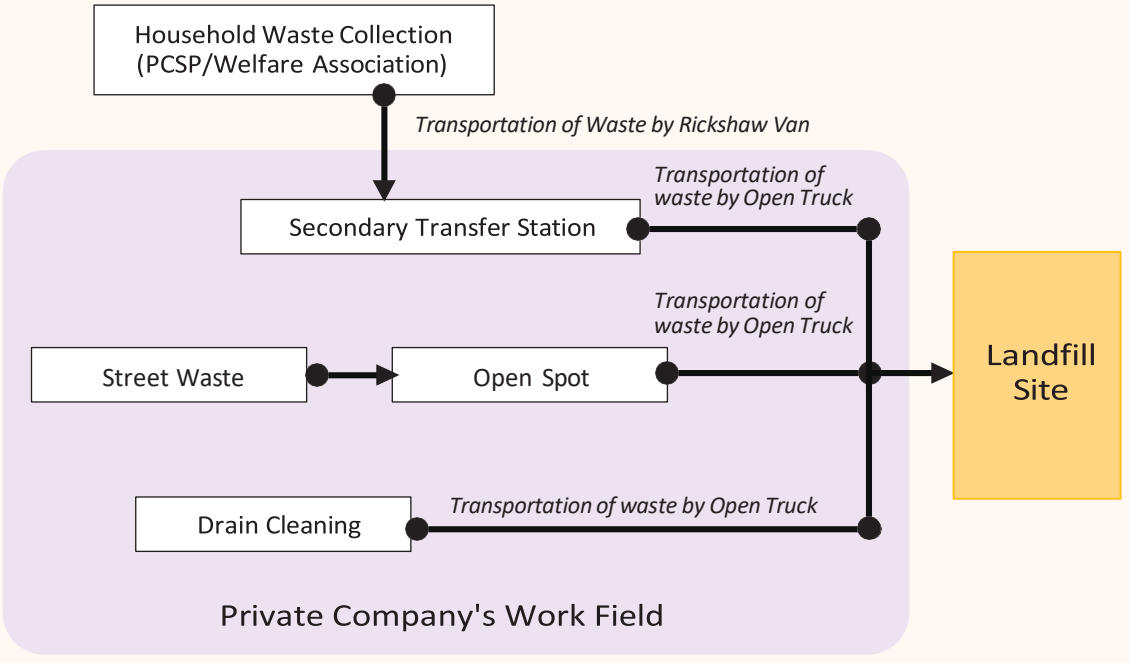


Figure 5-15. Potential Field of Privatization

5.10 Financial Management (Component 9)

5.10.1 *Reform SWM Accounting System for Budgeting and Cost Control {C9-01}*

I. Accounting System Modification and Annual Budget Report

The current accounting system lacks the necessary categorization to effectively manage Solid Waste Management (SWM) costs, making it difficult to assess their validity. To address this, it's crucial to modify the system to explicitly exhibit SWM costs by category. The KCC should then prepare an annual budget report, offering transparency and accountability to citizens as a public service provider while illuminating the validity and issues surrounding expenditures. This report, informed by the categorized SWM costs, will guide budget allocations for the following year, ensuring resources are allocated efficiently and in alignment with organizational objectives.

II. Financial Assessment

The introduction of financial assessment within the Waste Management Department (CD) should be guided by two primary objectives: firstly, to ensure accountability to citizens, and secondly, to improve the accuracy of the department's budget requests. To achieve these objectives, it is imperative to establish standard values for budget planning, which would enable the CD to evaluate the validity of draft budget plans effectively. These standard values serve as benchmarks against which proposed expenditures can be compared, aiding in the identification of discrepancies and ensuring alignment with organizational goals. Examples of such standard values are provided in Table 5-18, offering a reference point for assessing budgetary needs and enhancing fiscal transparency and accountability within the CD.

Table 5-18 Criteria and standards for financial assessment

No	Criteria	Standards
1	Road working distance per cleaner	0.3 km/person/day
2	Drainage cleaning distance per cleaner	0.2 km/person/day
3	Waste collected daily per cleaner	2.0 tons/person/day
4	Fuel consumption by compactor per ton of waste	2.0 L/ton
5	Fuel consumption by container carrier per ton of waste	2.5 L/ton

Source: SCIP, 2023

5.10.2 *Enhance Financial Capacity for Master Plan Implementation {C9-02}*

I. Reassessment of Conservancy Tax

The KCC administers the collection of holding tax, a levy calculated by multiplying the holding tax rate per square foot, officially established in each ward, by the size of the house or flat. The annual assessment of housing or flat value by the Revenue Department, based on property valuation, determines the amount of tax payable. While the waste treatment cost is funded through the conservancy tax, the current system does not segregate the four mentioned taxes, leading to ambiguity regarding the actual amount collected as conservancy tax. Presently, conservancy tax is levied at a rate of 2% of the housing or flat value, despite regulations permitting an increase to 7%. In instances of significant government investment in Solid Waste Management (SWM) infrastructure, such as Waste-to-Energy (WtE) facilities, operational costs should be primarily borne by citizens, aligning with the "polluter pay" principle, thereby warranting careful consideration for potential long-term increases in the conservancy tax rate.

II. Financial Allocation for the Master Plan Implementation

The Khulna City Corporation is tasked with developing a comprehensive long-term financial plan to bring the Master Plan to fruition. For major investments outlined in the report, including initiatives like the 3R Project, Sholua Sanitary Landfill, and Mathavanga Sanitary Landfill, potential subsidies from the national government and foreign donors may be explored, contingent upon the specific development context. However, it is emphasized that the operational expenses of CD facilities and regular public cleaning services must be fully covered by the KCC using revenue generated from the conservancy tax. Detailed breakdowns of the required capital and operational costs for these endeavors are provided in Chapter 6.

5.11 Medical Waste Treatment

5.11.1 *Establishment of Proper Organizational Structure*

The KCC holds the responsibility for medical waste management, with support from NGOs playing a complementary role in this domain. It is viable to sustain the existing privatized system with effective oversight from the KCC. To ensure proper governance and oversight, the Medical Waste Management Committee should be established as the primary decision-making body for medical waste within the KCC. This committee would be tasked with determining suitable reporting mechanisms, conducting thorough problem analyses, devising appropriate countermeasures, and establishing an audit system for medical waste treatment conducted by NGOs or private businesses. Regular inspections by the committee would be essential to verify the functionality and compliance of these treatment facilities.

5.11.2 *Improvement of Existing Medical Waste Treatment*

I. Estimated Amount of Waste

Table 5-19 represents the calculated daily amount of medical waste in KCC area during 2023 to 2040.

Table 5-19 Estimated Daily Amount of Medical Waste

Year	Infectious (kg}	Sharps (kg}	Recyclables (kg}	Total (kg}
2023	1694.70	553.71	1946.39	4194.81
2024	1907.56	623.26	2190.86	4721.68
2025	2147.15	701.54	2466.03	5314.72
2026	2416.83	789.66	2775.76	5982.25
2027	2720.38	888.84	3124.40	6733.62
2028	3062.06	1000.48	3516.82	7579.36
2029	3446.66	1126.13	3958.54	8531.33
2030	3879.56	1267.58	4455.73	9602.86
2031	4366.83	1426.79	5015.37	10808.98
2032	4915.30	1605.99	5645.30	12166.59
2033	5532.66	1807.70	6354.35	13694.71
2034	6227.57	2034.75	7152.45	15414.77
2035	7009.75	2290.31	8050.80	17350.86
2036	7890.17	2577.98	9061.98	19530.13
2037	8881.18	2901.77	10200.16	21983.11
2038	9996.65	3266.23	11481.31	24744.19
2039	11252.23	3676.47	12923.36	27852.06
2040	12665.51	4138.24	14546.53	31350.28

II. Waste Treatment Method

1) Waste Discharge

Waste sorting by using different bins has already been introduced. When the number of targets HCEs grows, a similar approach can be applied.

2) Waste Collection and Transport

To collect waste properly, the separation of the waste collection systems in KCC needs to be considered.

3) Intermediate Treatment

The management of infectious waste involves distinct treatment methods based on their moisture levels, with autoclaving required for waste containing over 33% moisture and incineration for waste with moisture levels below 33%. In the current scenario, it's projected that 65% of infectious waste will undergo incineration, 30% will be autoclaved, and 5% will be buried. Table 5-20 provides details of the expected quantities of infectious and sharp waste, along with the requisite capacity of the treatment center. If 80% of infectious waste continues to be destroyed, and with an incinerator capacity of 3,000 kg/day, it's estimated that between one to five incinerators will be necessary to accommodate the load.

Table 5-20 Estimated Infectious, Sharp Waste Generation

Year	Annual Incineration (Infectious, Sharp}	Incinerator (Operation: 240days*, 24 hours} (Capacity of Unit: 3,000kg/day/unit}	
		Required Capacity	Required Incinerator
	ton	kg/day	Unit
2023	820.6721	2248.42	1
2024	923.7485	2530.82	1
2025	1039.771	2848.69	1
2026	1170.367	3206.48	2
2027	1317.365	3609.22	2
2028	1482.826	4062.54	2
2029	1669.069	4572.79	2
2030	1878.704	5147.13	2
2031	2114.669	5793.61	2
2032	2380.271	6521.29	3
2033	2679.233	7340.36	3
2034	3015.745	8262.31	3
2035	3394.522	9300.06	4
2036	3820.874	10468.15	4
2037	4300.776	11782.95	4
2038	4840.954	13262.89	5
2039	5448.978	14928.70	5
2040	6133.369	16803.78	6

4) Final Disposal and Recycling

A final dumping pit can be provided within the area of LFS. Shredded and incinerated waste can be disposed of at the LFS in the same way as other general waste. Recycling may also be performed with other recycling companies.

III. Cost of Construction, Operation and Maintenance

The budget for five incinerators by 2040 is unknown. The KCC needs to conduct feasibility study before embarking on the priority projects. Additionally, the KCC needs to propose required number of staffs for O&M of the present and future projects.

5.11.3 *Improvement of Segregation and Enhancement of Facilities*

An effluent treatment plant for liquid waste needs to be installed in major hospitals or established as a centralized facility. When the centralized facility is established, appropriate wastewater tankers and storage tanks in the hospital need to be installed. The size of facilities and equipment must be established following the need for liquid waste creation. The required facilities vary depending on the kind of liquid, such as infection, examination, and dialysis.

The Bangladesh Atomic Energy Commission needs to teach HCEs about proper radioactive waste segregation and storage. Specialized containers, storage, and vehicles, as well as proper disposal locations, are needed. Solid pharmaceutical, chemical, anatomical, and pathological waste can be collected with infectious waste when proper incinerators are installed, and no additional segregation after collection is desirable to prevent operational dangers. Pharmaceutical and chemical liquid waste need specialized treatment plants and separate collection.

Most medical waste facilities are extremely specialized. As a result, following proper survey and cost calculation, it is desirable to privatize each category of waste. Because capital investment in facilities has the potential to be significant, the public-build-private-operate model, in conjunction with finance from foreign donors, should be considered. The whole approach needs to be considered with relevant stakeholders, such as the KCC's Medical Waste Management Committee.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CHAPTER 06

CHAPTER 06

BUDGET AND PRIORITY PROJECTS

6.1 Budget

This Waste Management Masterplan does not provide any specific budget. On the contrary, the plan provides a detailed time frame for completion of the priority projects. It is suggested that the KCC conducts a timely feasibility study and DPP for every project and subsequently formulate the financial requirements.

6.2 Priority Projects

The Masterplan has provided detailed activities, targets and a timeframe in chapter 4 and 5. Upon consultation with the Masterplan stakeholders, the priority projects are identified below.

Table 6-1 Priority Projects

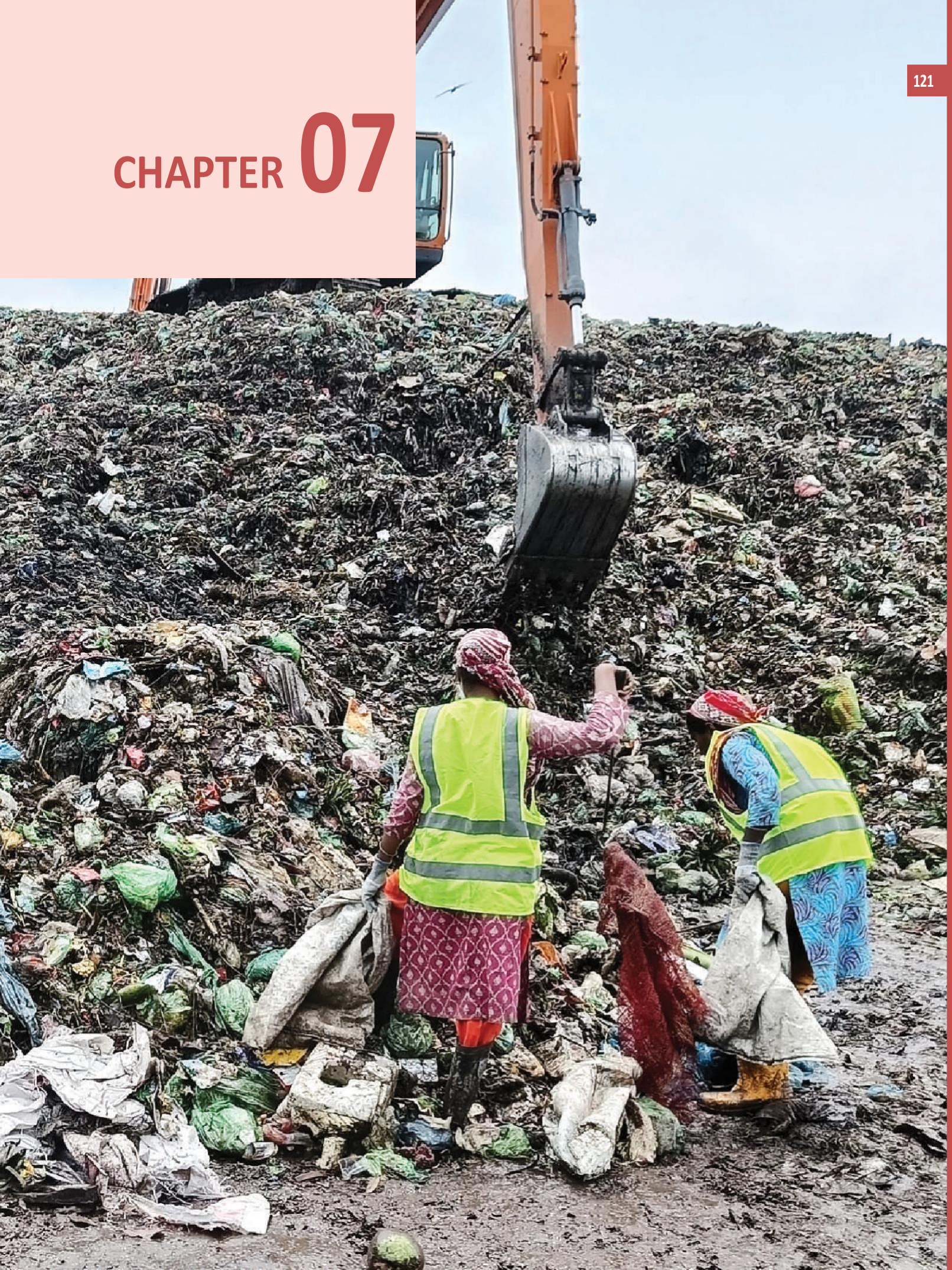
Facility	Purpose	Components
Improving inner-city waste collection	Increase collection efficiency, reduce public littering	• Improve community bins. • Transfer station designed to capture separated materials or to allow separation process. • Motorized door to door collection vehicles possibly for source separated material. • GPS truck tracking. • Vehicle fleet solely dedicated to waste collection. • Compactor trucks for non-biodegradable waste fraction. • Cooperation with the private (recycling) sector for collection. • A dedicated area for waste management in every building, which will be a requirement for KDA to approve building permission.
Rajbandh landfill	Site containment and site closure	• Improving site containment (embankment and fencing) • Improving access road • Leachate and storm water management (during operation and post-closure) • Landfill gas management (post closure) • Site monitoring: Air emissions, soil, groundwater.

Facility	Purpose	Components
		• Site closure plan: implementation of top-cover and final contouring • Post-closure aftercare and monitoring: groundwater monitoring scheme and rehabilitation of site.
Composting	Turning separately collected organic waste into a valuable compost product reducing the volume of waste going to landfill	• Land and Location are required • Organic waste separation at source sorting facility for the segregation of non-biodegradables • Shredders or grinders to break down organic material • Loaders for turning and aerating compost windrows • Sieving equipment for finished compost from remaining organic matter • Feasibility of central facility versus smaller decentralized facilities. • Pilot projects for waste separation at source
Awareness Raising	To increase public awareness regarding waste management	• Expanding KCC staff to include specialized trainers and graphic designers for communication and community engagement on littering and source separation. • Increasing awareness among school and college students about waste separation at source • Pilot scale source separation campaign among NGOs and community based waste workers and non-collection in not separated at source • Introduction of environmental awareness among students by incorporating 4R strategy for waste management in curriculum • Increasing awareness among local/Community leaders/influencers, informal sector actors, and city dwellers • Preparation and distribution of awareness materials • Workshops and demonstration areas for showcasing creative reuse projects and up cycling techniques.

Facility	Purpose	Components
E-Waste Management Center	To collect, dismantle, and recycle electronic waste in an environmentally friendly manner, preventing hazardous substances from contaminating the environment.	• Collection points for e-waste. • Dismantling area with proper ventilation and protective gear. • Equipment for shredding, sorting, and separating electronic components. • Recovery processes for valuable materials like metals and precious metals. • Hazardous waste storage and treatment facilities for managing toxic components at regional level for cost-effectiveness.
Dedicated Recycling Zone	To collect, sort, and process recyclable materials such as paper, plastic, glass, and metal.	• Sorting facilities for different types of recyclables. • Balers and compactors to compress recyclable materials. • Material recovery facilities (MRFs) for further processing. • Education and Awareness Center for promoting recycling among the community.
Pyrolysis Plant	To convert non-recyclable plastics and rubber into useful products like fuel oil, gas, and char, reducing the volume of waste going to landfills and decreasing dependency on fossil fuels.	• Feasibility study to continue pyrolysis plants as it depends on the success of recycling. • Offer financial incentives for non-recyclable plastic to increase waste separation and provide feed stock to pyrolysis reactors for thermal decomposition of waste materials. • Condensers and separators to collect and refine pyrolysis products. • Emissions control systems to minimize air pollution. • Storage and distribution facilities for recovered products.
Medical Waste Management Facility	To safely collect, handle, and dispose of biomedical waste generated by healthcare facilities, preventing the spread of infectious diseases and protecting public health.	• Segregation and containment areas for different categories of medical waste. • Autoclaves or other sterilization equipment for treating infectious waste. • Incinerators or alternative treatment technologies for non-recyclable medical waste. • Training facilities for healthcare workers on proper waste handling procedures.

Facility	Purpose	Components
Construction Waste Management Facility	To collect, sort, and recycle construction and demolition waste, promoting resource efficiency and reducing environmental impacts.	• Sorting and processing equipment for different types of construction materials. • Crushing and screening machinery for processing concrete, asphalt, and bricks. • Storage areas for salvaged materials suitable for reuse. • Education and Training Center for construction industry stakeholders on waste reduction practices.
Reuse Centers	To promote the reuse of items that are still functional but no longer needed by their original owners, extending product lifecycles and reducing waste generation.	• Collection points for reusable items such as clothing, furniture, and household goods. • Inspection and refurbishment areas for assessing the quality and safety of donated items. • Retail or distribution outlets for selling or distributing reused products to the community.

CHAPTER 07



CHAPTER 07

CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

Khulna is promising to be a mega-urban area in the southwestern region of Bangladesh while playing a central role in administrative, financial and regional development. With a growing population and the changing dynamics of consumption pattern, the waste generation-to-disposal requires special attention. Currently, the CC is not capable of collecting all its SW, and subsequently, is unable to dispose of SW in a sanitary manner. This Masterplan aligns the KCC's current and future projects along with a time frame to achieve zero unmanaged waste by 2040.

The key aspects of the masterplan are: (i) decentralization of SWM through sanitary landfills; (ii) setting targets for waste reduction through composting, recycling, waste-to-energy and landfilling; (iii) closing all open dumping and using sanitary landfills by 2040; and (iv) priority projects for SWM. It is necessary that the KCC secures the required funding by conducting a feasibility study for the priority projects. Finally, it is necessary that KCC imposes legislative action against unmanaged waste in the form of fines.

The major suggests following major directions for a sustainable SWM of KCC:

- Completion of the proposed STS instead of open container within the proposed timeframe of the Masterplan, by 2040
- Administrative efforts made for enhancing the governance capabilities
- Strengthening the Conservancy Department by supporting with sufficient manpower and expansion of WBA
- Comprehensive public awareness programs to encourage every citizen for source separation and sustainable SWM
- Introduction of a SWM administrative procedure book that utilizes existing laws and office orders.
- KCC should try to achieve zero unmanaged waste and to a long-term goal of zero carbon emission.

7.2 Recommendations

7.2.1 *Extended Boundary of KCC*

The KCC is set to double its existing coverage. Additionally, the city population are settling in the peripheral areas. Therefore, sprawling KCC area requires additional plan for SWM considering their waste generation and disposal behavior dynamics.

7.2.2 *Separate Zone for Recycling*

It is suggested that KCC dedicate a separate zone for informal shops recycling a significant portion of the SW generated. The zone could be placed outside KCC area and besides the Rajbandh's newly acquired area.

7.2.3 *Awareness Creation among Community People*

The KCC can take initiative to cover 100% of the adult household head to go through mandatory waste management training comprising of source separation, recycling and reusing of SW. This can be achieved through making training a mandatory part of all donor supported projects.

7.2.4 *Aligning Different Projects for Sustainable SWM*

Many donor's supported projects are in progress in Khulna city. However, the projects are self-centered and rarely align their activities with KCC's SWM. Therefore, alignment of donor supported projects for SWM of KCC can ensure better public service.

7.25 *Covering Open Drain*

Open drain in Khulna city is often the refuse of SWM. To support zero unmanaged waste target, the KCC is recommended to ensure covering all major drains of the city.

7.26 *Future Expansion of STS and Landfill*

The projected requirements for STSs in 2040 are identified in figure 4-10 and the predicted routes are marked. However, locational analysis of STSs is done because location selection is a democratic process and must be decided based on negotiation with local stakeholders. The proposed landfill sites and their respective land requirements are sufficient for the year 2040; therefore, no additional land is required.

7.27 *Building Approval Plan and Land Use Plan*

It is recommended that the identified STS and landfills are demarcated in the land use plans of KDA. This will ensure sustainable multisector planning for Khulna city. Subsequently, it is expected that strict building codes will be enforced by the KDA which will ensure SWM system.

7.28 *Coordination between KCC and K-WASA for Faecal Sludge Management*

KCC should take initiative to ensure coordination with KWASA and relevant donor agencies for sustainable faecal sludge management. It is understood that most of the KCC dwellers are habituated to direct desludging to nearby drains and open spaces, which is a great environmental problem for the city. A sustainable SWM for KCC must ensure treatment and disposal of faecal sludge in an environmental friendly manner.

7.29 *Functional Coordination between KDA and KCC*

A function coordination between KDA and KCC during building approval or post housing development to stop illegal sewerage connection to the drain and FSM management. Strict guidelines need to be developed so that FSM is considered as a MSW and a necessary initiative to manage it sustainably. Additionally, KCC should emphasize on a designated space for waste separation at source and recycling as a pre-condition for build plan approval by the KDA.

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