OFFICE OF THE DEPUTY PRIME MINISTER
MINISTRY OF LOCAL GOVERNMENT
REPUBLIC OF KENYA

CITY COUNCIL OF NAIROBI

PREPARATORY SURVEY FOR INTEGRATED SOLID WASTE MANAGEMENT IN NAIROBI CITY IN THE REPUBLIC OF KENYA

FINAL REPORT
VOLUME 2 MAIN REPORT

OCTOBER 2010

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

CTI ENGINEERING INTERNATIONAL CO., LTD.

NJS CONSULTANTS CO., LTD.

All Kenyan Shilling amounts including project costs shown in this report are stated in 2010 prices unless otherwise indicated. The amounts were estimated based on foreign prices by applying currency exchange rates for interbank rates as of 1st of June 2010, namely; USD1.00 = KSh 75.8 = JPY 91.35.

PREFACE

In response to a request from the Government of Republic of Kenya, the Government of Japan decided to conduct “The Preparatory Survey for Integrated Solid Waste Management in Nairobi City” and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Masakazu Maeda of CTI Engineering International Co., Ltd. and consisted of experts from CTI Engineering International Co., Ltd. and NJS Consultants Co., Ltd. from October 2009 to October 2010.

The study team held discussions with the Kenyan counterparts and conducted field surveys at the study area. Upon returning to Japan, the study team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of the study and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the Kenyan counterparts for their close cooperation extended to the study.

October 2010

Izumi Takashima
Vice-President
Japan International Cooperation Agency

October 2010

Mr. Izumi Takashima
Vice-President
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir:

We are pleased to submit herewith the Final Report on the Preparatory Survey for Integrated Solid Waste Management in Nairobi City in the Republic of Kenya.

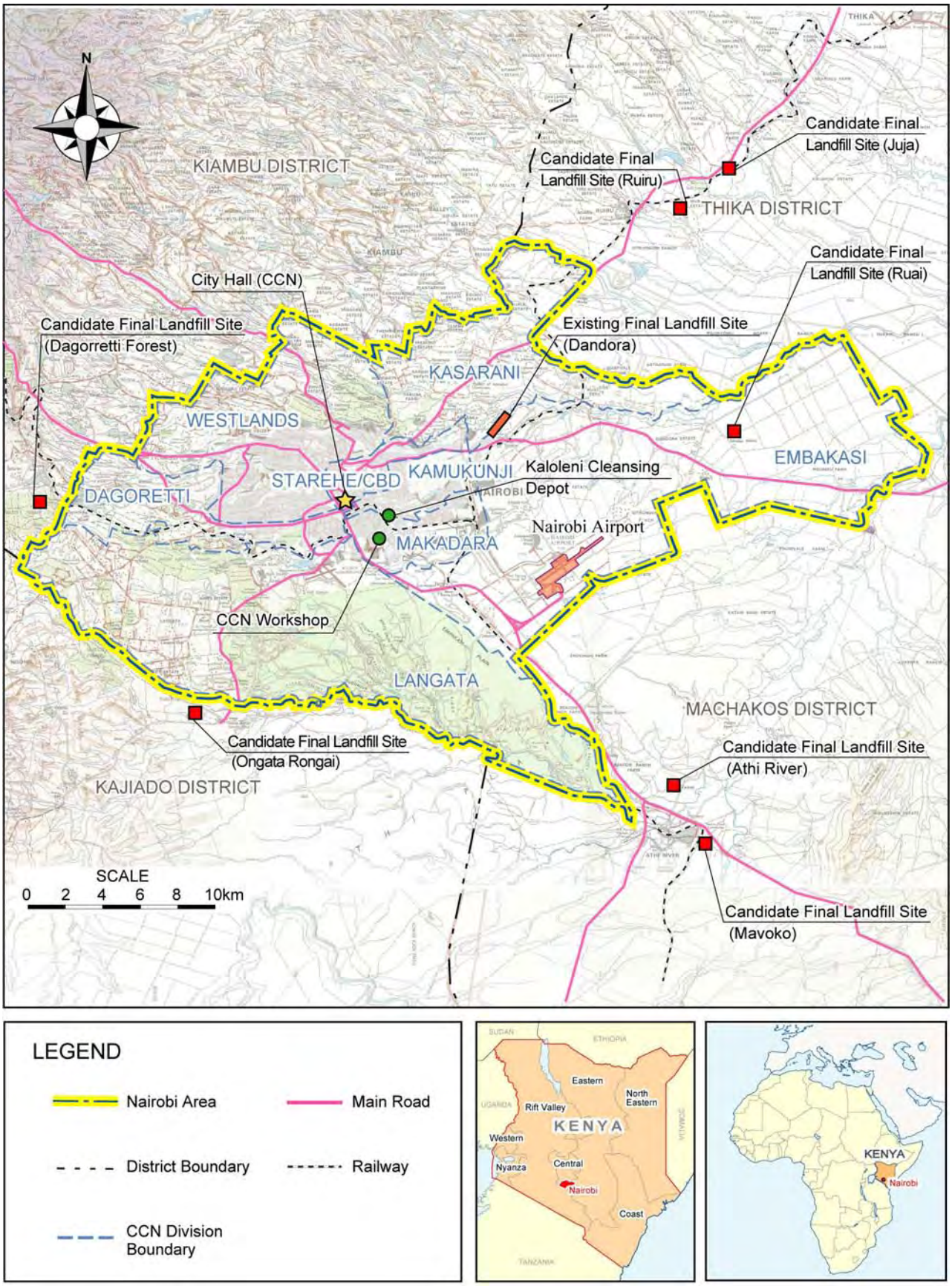
The survey was conducted by CTI Engineering International Co., Ltd. and NJS Consultants Co., Ltd., under a contract with the Japan International Cooperation Agency (JICA) during the period from October 2009 to October 2010. In conducting the survey, particular attention was paid to the review of the previous master plan formulated by JICA in 1998 and to its update to formulate a new master plan of solid waste management (SWM) for Nairobi City. In view of the urgency and necessity to improve public cleanliness and public health and protect the environment, action plans are proposed in the new master plan and technical viability and financial affordability are identified. We recommend that the Government of the Republic of Kenya and the City Council of Nairobi, the executing agency, should promote all of the action plans to the next stage of project implementation at the earliest possible opportunity.

We wish to take this occasion to express our sincere gratitude to the Government of Japan, particularly, JICA, the Ministry of Foreign Affairs, and other offices concerned. We also wish to express our deep appreciation to the Office of the Deputy Prime Minister and the Ministry of Local Government, the City Council of Nairobi and other authorities concerned in the Government of the Republic of Kenya for the close cooperation and assistance extended to the JICA Survey Team during the preparatory survey.

Finally, we sincerely hope that the results of the survey will contribute to the solution and/or mitigation of solid waste management problems in Nairobi City and that the amicable relationship between both our countries will further continue in the future.

Very truly yours,

Masakazu Maeda
Team Leader
Preparatory Survey for Integrated
Solid Waste Management in Nairobi City



LOCATION MAP

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Volume 2 **MAIN REPORT**

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- **Section A** **Waste Amount and Composition Analysis**
- **Section B** **Organisational, Institutional and Human Resources Development Study**
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Volume 4 **DATA BOOK**

PREPARATORY SURVEY
FOR
INTEGRATED SOLID WASTE MANAGEMENT
IN NAIROBI CITY
IN
THE REPUBLIC OF KENYA

FINAL REPORT

VOLUME 2

MAIN REPORT

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ABBREVIATIONS AND ACRONYMS

Organisations, Programmes and Projects

AfDB	:	African Development Bank
AFD	:	Agence Française de Développement (French Development Agency)
CBO	:	Community-Based Organisation
CBSK	:	Central Bureau of Statistics Kenya
CCDP	:	Comprehensive Capacity Development Programme
CCN	:	City Council of Nairobi
DoE	:	Department of Environment
EMCA	:	Environmental Management and Coordination Act
EPZA	:	Export Processing Zone Authority
GEF	:	Global Environment Facility
GOJ	:	Government of Japan
GOK	:	Government of Kenya
JICA	:	Japan International Cooperation Agency
JKIA	:	Jomo Kenyatta International Airport
KARA	:	Kenya Alliance of Residents Association
KENAO	:	Kenya National Audit Office
KIE	:	Kenya Institute of Education
KMP	:	Kenya Municipal Programme
KNBS	:	Kenya National Bureau of Statistics
KENSUP	:	Kenya Slum Upgrading Programme
KTB	:	Kenya Tourist Board
LATF	:	Local Authority Transfer Fund
MEMR	:	Ministry of Environment and Mineral Resources
MOF	:	Ministry of Finance
MoLG	:	Ministry of Local Government
MoNMD	:	Ministry of Nairobi Metropolitan Development
MoPH	:	Ministry of Public Health
MCN	:	Municipal Council of Nakuru
MWI	:	Ministry of Water and Irrigation
NCWSC	:	Nairobi City Water and Sewerage Company
NEMA	:	National Environment Management Authority
NGO	:	Non-Governmental Organisation
NMSP	:	Nairobi Metropolitan Services Project
NPO	:	Non-Profit Organisation
NWSC	:	Nairobi Water and Sewerage Company
ODPM	:	Office of the Deputy Prime Minister
PEC	:	Public Awareness, Environmental Education and Community Participation
PMU	:	Project Management Unit
SIDA	:	Swedish International Development Cooperation Agency
SWMCRF	:	Solid Waste Management Capital Revolving Fund
SWMORF	:	Solid Waste Management Operating Revolving Fund
SWMPC	:	Solid Waste Management Public Corporation
UNEP	:	United Nations Environment Programme
WATSAN	:	Kibera Integrated Water, Sanitation and Waste Management Project
WB	:	The World Bank
WRMA	:	Water Resources Management Authority
WSRB	:	Water Services Regulatory Board
WSRS	:	Water Sector Reform Secretariat
WSRSC	:	Water Sector Reform Steering Committee

Technical Terms

ASG	:	Apparent Specific Gravity
ATP	:	Affordability to Pay
BBS	:	Budget Breakdown Structure
BOD	:	Biochemical Oxygen Demand
BOT	:	Build, Operate and Transfer
BPO	:	Business Process Outsourcing
CBD	:	Central Business District
CBS	:	Cost Breakdown Structure
CILOR	:	Contribution in Lieu of Rates
COD	:	Chemical Oxygen Demand
CTF	:	Constituency Development Fund
DBFO	:	Design-Build-Finance-Operate
DO	:	Dissolved Oxygen
EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
EPZ	:	Export Processing Zone
FCP	:	Foreign Currency Portion
FIRR	:	Financial Internal Rate of Return
GDP	:	Gross Domestic Product
GRDP	:	Gross Regional Domestic Product
HRD	:	Human Resources Development
IEE	:	Initial Environmental Examination
ISWMP	:	Integrated Solid Waste Management Plan
JPY	:	Japanese Yen
KSh	:	Kenyan Shilling
LCP	:	Local Currency Portion
MDG	:	Millennium Development Goal
MP	:	Master Plan
MRF	:	Material Recovery Facility
OIM	:	Operating Income Margin
PA	:	Preparatory Action
PAYT	:	Pay-As-You-Throw
PCD	:	Per Capita GDP (Gross Domestic Product)
PDM	:	Project Design Matrix
PCM	:	Project Cycle Management
PO	:	Plan of Operation
PPP	:	Public-Private Partnership
PPPP	:	Public-Private-People Partnership
PSC	:	Public Sector Comparator
PSP	:	Private Service Provider
PU	:	Preparatory Unit
QCBS	:	Quality and Cost Based Selection
3R	:	Reduce, Reuse, Recycle
RBM	:	Results-Based Management
RMLF	:	Road Maintenance Levy Fund
SCF	:	Standard Conversion Factor
USD	:	United States Dollar
VAT	:	Value-Added Tax
VfM	:	Value for Money
WACS	:	Waste Amount and Composition Survey
WBS	:	Work Breakdown Structure
WTP	:	Willingness to Pay

CHAPTER 1. INTRODUCTION

1.1 Background of the Survey

The City of Nairobi is the capital of the Republic of Kenya and the largest administrative, commercial and industrial centre of the country. Nairobi City has been experiencing rapid population growth largely due to rural-urban migration and natural rate of increase, and the population of the city is presently estimated at 3 million. As a result of this rapid increase in population, the generation rate of solid waste as of 2009 is estimated at approximately 1,850 tons/day.

A half of the present solid waste generation is left uncollected or illegally dumped inside the city and the remaining is carried to a final disposal site. The final disposal site, however, is an open dumping type landfill and this, therefore, has a detrimental effect on the surrounding environment. Since this situation is creating problems in hygienic, environmental as well as aesthetic conditions for the people of Nairobi City, solid waste management is an urgent issue requiring prompt resolution.

From 1996 to 1998, the Government of Japan (hereinafter referred to as "GOJ") carried out *the Study on Solid Waste Management in Nairobi City in the Republic of Kenya* through its technical assistance programme. This study included the formulation of a master plan composed of a collection and transportation plan, a waste reduction and recycling plan, and a final disposal plan. A feasibility study was also implemented, and an institutional and legal restructuring plan, a private sector involvement and financial improvement plan, a waste collection system improvement plan, and a construction plan for a new final disposal site were proposed in the study. Based on the master plan and feasibility study results, the City Council of Nairobi (hereinafter referred to as "CCN") had established environmental regulations, promoted private sector involvement and conducted institutional restructuring, including reduction of personnel expenses.

On the other hand, the construction of a new landfill site and improvement of waste collection system could not be carried out due to insufficient funds from the Government of Kenya (hereinafter referred to as "GOK"). Under the circumstances, the Ministry of Environment and Mineral Resources, GOK and the United Nations Environment Programme (hereinafter referred to as "UNEP") formulated the *"Nairobi Rivers Rehabilitation and Restoration Programme"* in July 2008 to improve the environmental conditions in the Nairobi River Basin. Illegal dumping and wastes discharged from many slums along the rivers have resulted in the pollution of rivers in Nairobi, so that an integrated solid waste management system in Nairobi City is essential as one of the components of the Programme.

The GOK had requested technical assistance from the GOJ to formulate the integrated solid waste management plan for Nairobi City and conduct a feasibility study on the construction of a new final disposal site and a transfer station for solid wastes. In response to the request, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of technical cooperation programmes of the GOJ, had decided to undertake the ***Preparatory Survey on Integrated Solid Waste Management in Nairobi City in the Republic of Kenya*** (hereinafter referred to as "the Survey") from August 2009 to September 2010.

1.2 Necessity of the Survey

The Kenya National Economic Plan, i.e., Kenya Vision 2030, states in its social strategy that Kenya is to become a clean, secure, and sustainable environment by the year 2030. To realise this strategy, the plan also explains the importance of improvement of pollution and waste management. Additionally, the National Solid Waste Management Strategy drafted by the Office of the Deputy Prime Minister and the

Ministry of Local Government in 2008 provides a framework to help meet the Kenya Vision 2030 and the Millennium Development Goals (MDGs) in terms of health, poverty reduction and protection of the environment [Detailed argument on policy level is described later in **Subsection 2.3.1(8)**, page 2-21].

In general, the main driving forces for development and modernisation of solid waste management (SWM) are portrayed as follows[1]: (Note: *Figures affixed to a word or at the end of a sentence refer to the source listed at the end of this main report.*):

- Public Health
- Environment
- Resource Value of the Waste
- Climate Change

Public Health: Uncollected and accumulated waste in streets increase contact possibilities and offer very good conditions for the propagation of germs, insects, rats and other disease vectors. Also, those wastes often clog drains and result in the stagnation of water, the breeding of mosquitoes or the contamination of water bodies from which the population normally takes water for consumption, cooking and cleaning.

Environment: Uncollected waste brings contamination of water, air and land, and the same phenomenon might occur even if the waste is collected but uncontrolled. Especially, the contaminated water, leachate, should be minimised and not released into the groundwater and the surface water. Moreover, a pile of waste is often burned spontaneously and causes the emission of toxic substances to the air like dioxins.

Resource Value of Waste: Many waste pickers work on the streets and at the disposal sites. They collect and use or sell materials recovered from waste. This kind of activity can be seen anywhere in the world and from old times up to now, and it secures the livelihood of millions of people in informal settlements.

Climate Change: Proper waste management and promotion of 3R (reduce, reuse, recycle) will contribute to the reduction of greenhouse gas emissions, such as methane and carbon dioxide. Methane forms when organic materials decompose in the absence of air, a process called anaerobic decomposition. Application of a sanitary landfill method will bring e semi-aerobic conditions of the site and reduce the methane emissions.

As explained in detail in **Chapter 2**, the above four (4) issues coincide with the present situation in Nairobi; in other words, low level of waste collection rate, and illegal and uncontrolled disposal sites are the two major problems in the SWM of Nairobi. Development and modernisation of SWM is therefore definitely required for implementation of proper SWM that will result from reviewing and updating the existing master plan through the Survey.

1.3 Objectives of the Survey

The objectives of the Survey are as follows:

(1) To review the current situation of waste management in Nairobi City and revise the existing Master Plan; and

(2) To develop human resources for solid waste management (hereinafter referred to as “SWM”) in the course of the Survey with full commitment of the concerned authorities of the Government of Kenya.

1.4 Scope of the Survey

1.4.1 Survey Area

The Survey covers the whole area of Nairobi City as shown in the Location Map, which includes six (6) landfill candidate sites outside of Nairobi City.

1.4.2 Types of Solid Waste

The types of solid waste surveyed are limited to household waste, market waste, commercial waste, street sweeping waste and office waste. The survey on hazardous waste is limited to only the policy suggestions and recommendations in the Master Plan.

1.4.3 Survey Scope

The Survey covers the following items:

1. Collection, review and analysis of related data and information
   a. Natural, economic, social and environmental conditions
   b. Laws, regulations, policies, land use plans and development plans relating to the Survey
   c. Conditions regarding Solid Waste Management in Nairobi City (physical, operational, institutional, financial and other aspects)
   d. Related projects (on-going and planned)
   e. Other relevant data and information
2. Field survey
   a. Amount of solid waste and its composition
   b. Current solid waste collection and transportation arrangements (time and motion study)
   c. Existing dumping site and facilities including groundwater and leachate quality analysis
   d. Recycling market, possibility of material recycling and thermal recycling
   e. Present situation of waste pickers
   f. Public awareness on solid waste management
   g. Initial Environmental Examination (IEE)
   h. Others
3. Evaluation of the present conditions and identification of the problems
   a. Social and economic/financial analysis
   b. Legal system and organisational structure concerning solid waste management
   c. Management conditions
4. Establishment of planning framework and forecasting through projection on:
   a. Population growth, city plan, urban development plan and land use plan

b. Economic growth and changes in living condition

c. Trends in quality and quantity of solid waste

d. Others

5. Establishment of basic strategies

a. Technical aspects

b. Financial aspects

c. Institutional and managerial aspects

d. Social aspects

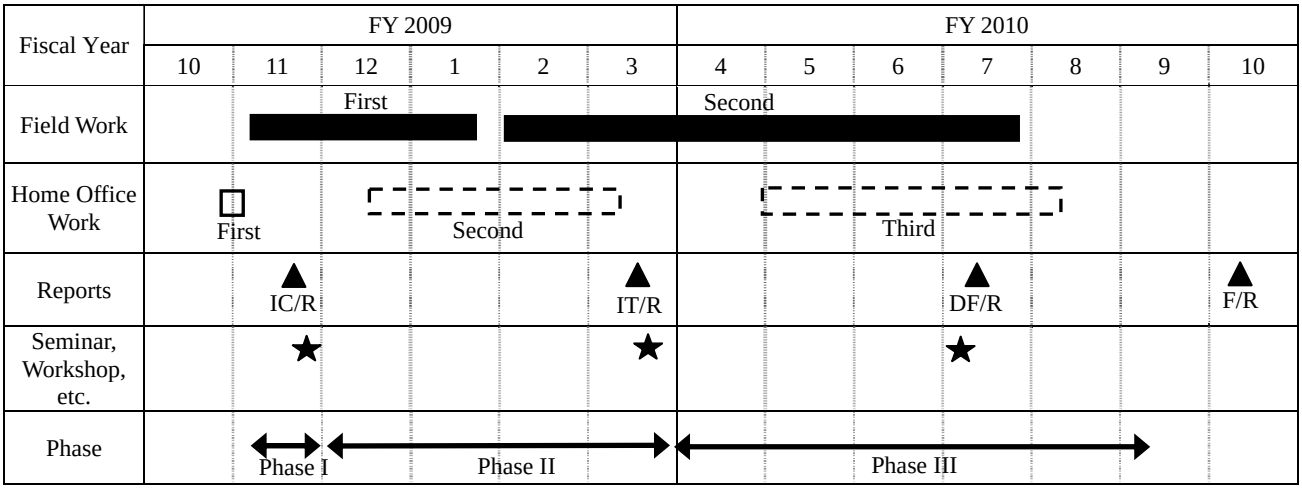
e. Environmental and hygienic aspects

6. Updating of the existing Master Plan including institutional and financial aspects

7. Preparation of the implementation plan of priority programme(s) and project(s)

1.5 Survey Schedule

The Survey, in principle, is to be carried out through the field works in Kenya and the home office works in Japan in accordance with the tentative schedule shown in **Figure 1.5.1**. The total duration of the Survey is approximately 11 months. The Survey is divided into three phases, namely; Phase I which focuses on the dissemination of survey contents and the establishment of the implementation system of the Survey; Phase II which conducts a basic survey; and Phase III which includes updating of the existing master plan of SWM. Reports are to be presented at times shown in the same figure. A workshop, seminar and other meetings are to be held in each survey phase.



Legend: IC/R: Inception Report, IT/R: Interim Report, DF/R: Draft Final Report, F/R: Final Report

Figure 1.5.1 Overall Survey Schedule

1.6 Staffing Schedule

The Survey is to be carried out by the Kenyan counterparts and the JICA Survey Team as listed in the following table.

Table 1.6.1 Members of the Steering Committee and the Survey Team

Name	Affiliation or Designation/Field of Expertise
Steering Committee	
Victor Ogutu (Chair)	Office of the Deputy Prime Minister and the Ministry of Local Government
Silas Nyambok	Office of the Deputy Prime Minister and the Ministry of Local Government
Leah Oyake	City Council of Nairobi
Eng. Christine Ogut	City Council of Nairobi
Eng. Gordon Okello	City Council of Nairobi
Isaac Muraya	City Council of Nairobi
J.K. Barreh	City Council of Nairobi
Alfred Ndwara	City Council of Nairobi
Peter Miriti	Ministry of Nairobi Metropolitan Development
Caroline Wamai	Ministry of Environment and Mineral Resources
Ibrahim Longolomoi	Ministry of Public Health and Sanitation
Benjamin Langwen Malwa	National Environmental Management Agency
Eng. Peter Mangiti	Ministry of Water and Irrigation
Eng. S.K. Kamau	Ministry of Finance
Justus Githinji	Ministry of Energy
Yoichi Inoue	JICA Kenya Office
John Ngugi	JICA Kenya Office
Technical Working Group	
Leah Oyake (Chair: Nov. 2009 – Apr. 2010)	City Council of Nairobi
Eng. Christine Ogut (Chair: May – July 2010)	City Council of Nairobi
Silas Nyambok	Office of the Deputy Prime Minister and the Ministry of Local Government
Peter Miriti	Ministry of Nairobi Metropolitan Development
Eng. B. K. Njenga (– Mar. 2010)	City Council of Nairobi
Eng. Gordon Okello	City Council of Nairobi
Wilson Maritim	City Council of Nairobi
Jennifer K. Nyagah	City Council of Nairobi
Isaac Muraya	City Council of Nairobi
Mario K. Kainga	City Council of Nairobi
Marrian Kioko	City Council of Nairobi
Dr. Barasa	City Council of Nairobi
G.N. Kihoro	City Council of Nairobi
Tsala Halima a	City Council of Nairobi
C.O. Caleb	City Council of Nairobi
J.K. Barreh	City Council of Nairobi
Justus Githinji	City Council of Nairobi

Name	Affiliation or Designation/Field of Expertise
JICA Survey Team	
Masakazu MAEDA	Team Leader / Solid Waste Management Expert
Takehiko OGAWA	Organisation & Institution / Human Resources Development Expert
Sampei NAKANISHI	Collection & Transportation Expert
Satoshi YAMAMOTO (Nov. 2009 – Jan. 2010)	Waste Analyst / Hazardous Waste Management Expert
Edna Cruz BAYAN (Apr. – May 2010)	Waste Analyst / Hazardous Waste Management Expert
Takaaki FUKUSHIMA	Final Disposal & Facility Planner
Sebastian Guillermo JARA RESQUIN	Public Awareness / Environment and Social Consideration Expert
Masaharu TAKASUGI	3R & Intermediate Treatment Expert
Kiminari TACHIYAMA	Financial Analyst / Economist
Daniel NEAGARI	Administrative Coordinator

CHAPTER 2. DESCRIPTION AND EVALUATION OF CURRENT CONDITION

2.1 Introduction

The JICA Survey Team started the first field work in Nairobi on 8 November 2009 and completed it on 26 January 2010, to collect relevant data and information, to investigate candidate disposal sites, and to conduct waste generation and composition analysis, public awareness survey, etc. The results were used as basic data for reviewing the Master Plan formulated in 1998. This chapter presents the current condition of solid waste management (SWM) in Nairobi, mainly, in terms of institutional, financial and technical aspect.

Firstly, the generated waste amount and composition in the city at present were compiled based on the results of the field survey described in **Section 2.2** when all of the data were not sorted out yet. From the institutional point of view, the analysis and evaluation of the present arrangements, not only for institutional but also organisational and human resource management aspects, were carried out as described in **Section 2.3**.

In view of the technical approaches, collection and transportation, 3R and intermediate treatment and disposal studies were conducted as described in **Sections 2.4, 2.5 and 2.6,** respectively. Public awareness on SWM is considered in **Section 2.7** as well, based on the result of the public awareness survey and field investigation. **Section 2.8** covers environmental and social considerations on the current situation of SWM, as well as water, sewage, and air quality in the city.

Finally, as other important components for implementation of the SWM programme, the city's economic and financial condition are as analised in **Section 2.9**, and the current condition of hazardous waste such as hospital and industrial waste are as additionally described in **Section 2.10.**

2.2 Waste Generation and Composition Analysis

2.2.1 Waste Amount and Composition Survey (WACS)

(1) Objective of the Survey

The Solid Waste Amount and Composition Survey (hereinafter referred to as "WACS") is to be conducted as a part of the study for updating the SWM Master Plan to identify the amount and composition of the different types of waste generated in Nairobi City. The characteristics of representative municipal solid waste are to be obtained through the WACS for domestic waste, commercial waste, institutional waste, market waste, street waste, etc., at the waste generation sources and the waste disposed at the disposal site. The result/analysis of WACS are to be used as the basic data to formulate the waste collection, 3R, intermediate treatment and waste disposal plans for the review, updating and formulation of the SWM Master Plan.

The WACS is to started in December 2009 and continue up to March 2010 to cover the wet and dry seasons. The results of field survey are as discussed below.

(2) Waste Amount Survey

(a) Waste Samples for Survey

The survey was conducted for wastes at the following generation sources:

- Residential area
- Commercial establishments
- Public facilities
- Markets
- Road cleansing activity

(b) Survey Method

Waste sampling at the target areas mentioned above was conducted continuously for eight (8) days. The first day of the survey period was the test day of surveying waste amount, and the sampled data of the remaining seven (7) days were the valid data for the analysis of waste amount. (The sampling on the first day was excluded from the actual analysis because the wastes on the first day may contain wastes generated before the sampling date and the sampled waste may contain more quantity of waste compared to the actual condition.)

The survey included the sampling of amounts of recycling materials of self-treated waste at each generation source. The unit generation amount at each generation source was verified through the examination with existing data.

(c) Classification of Waste Generation Source

The generation sources were classified into nine (9) areas, as follows:

(i) Residential area (5 areas: High Income, Middle Income, Low-Middle Income, Low Income, and Slum). [Refer to **Item (3) of Subsection 2.7.1** for the concept of classification and income level of each group.]

(ii) Commercial area (shops, restaurants, hotels and others);

(iii) Public facility;

(iv) Market; and

(v) Public road.

The total number of samples taken for the waste amount and composition survey is as shown in **Table 2.2.1**. The composition survey includes physical and the three components for chemical analysis: moisture content, ash content and combustible content. Wastes generated from factories and medical facilities such as hospitals and clinics were excluded from the survey.

Table 2.2.1 Number of Samples for the Waste Amount and Composition Survey

Sampling Area	Waste Amount Samples	Waste Composition Samples	
		Physical	Chemical
1. Residential area			
a. High Income	30	3	1
b. Middle Income	30	3	1
c. Low-Middle Income	30	3	1
d. Low Income	30	3	1
e. Slum	30	3	1
2. Commercial establishment			
a. Restaurant	15	3	1
b. Shops, hotel/guest houses, etc	45	6	2
3. Public facilities (schools, institutional buildings, public and private offices in city center, etc)	30	3	1
4. Market	30	3	1

Sampling Area	Waste Amount Samples	Waste Composition Samples	
		Physical	Chemical
5. Road waste	30	3	-
6. Sample from waste collection vehicles at landfill site	0	30	10
Total	300	63	20

(d) Waste Amount Survey Results

The waste generation amount per capita per day of each generation source is as shown in **Table 2.2.2**. The average waste generation amount per capita per day of the five income groups in residential areas ranges from 0.302 kilogrammes per capita per day (kg/c/d) to 0.674 kg/c/d, as shown in **Figure 2.2.1**.

Table 2.2.2 Waste Generation Rate of Each Generation Source

Generation Source	Unit	Weight Generation (kg/day)
1. Residential area		
a. High Income	person	0.567
b. Middle Income	person	0.674
c. Low-Middle Income	person	0.474
d. Low Income	person	0.302
e. Slum	person	0.417
2. Commercial establishment		
a. Restaurant	establishment	38
b. Shops	establishment	0.5
c. Hotel/Guest Houses		
Standard Hotels	establishment	350
Lodging/Guest House	establishment	100*
d. Industrial Plant	establishment	150*
e. Other Establishments	establishment	0.5*
3. Public facilities		
a. Offices	establishment	137
b. Schools	establishment	76
4. Market	market	2,045
5. Roads	km	106

Note: * Not included in the waste amount survey but waste generation based on direct interview with the person-in-charge of waste management of the specific establishment.

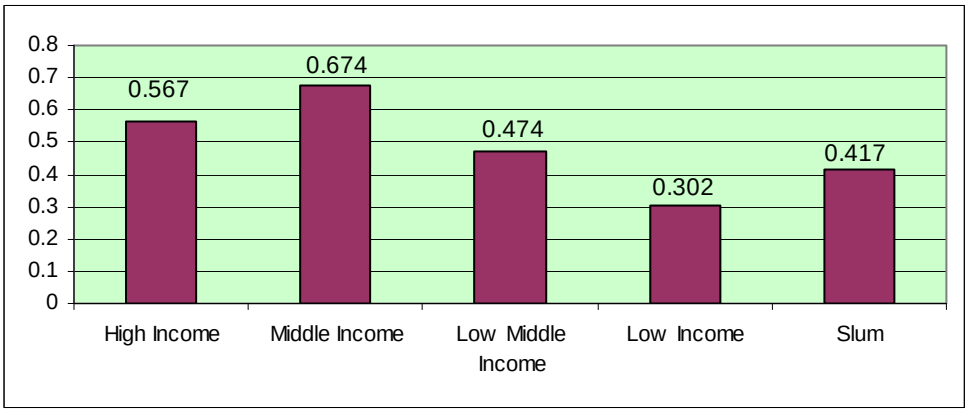


Figure 2.2.1 Waste Generation per Capita in Residential Area

The per capita waste generation from the high income group is lower than the middle income group because the high income group has a larger family size of about 5.1 compared to the middle income which has only 3.6 as average household members. The waste generation per capita from the low income group is also lower compared to the slum area. This is because most of the types of waste being generated from the slums are dirt or sand, based on the waste composition survey, considering that the slums are located in unpaved areas and most of the houses have earthen floors or not cemented.

The waste generation per capita obtained in the current study dropped in comparison with the 1998 JICA Master Plan Study[2] except for the middle income group. This may be due to the living condition of the residents and the difference of economic status in Nairobi City from 1998 to 2009. Waste generation amounts per capita as obtained from the WACS have reasonable values compared to the result of the 1998 JICA Master Plan Study and also with other countries.

The worldwide economic stagnation in the last 10 to 13 years have also influenced the economy of Kenya and the economic situation of the people in Nairobi City also affected the way of saving finite resources. In view of this situation, the waste amount in Nairobi City did not increase as estimated before and the per capita waste generation amount also did not increase except for the middle income group.

2.2.2 Physical Composition of Solid Waste

Information and data on the physical composition of solid wastes are important in the selection and operation of equipment and facilities, disposal strategy and disposal process. The components considered in updating the previous master plan are food waste; paper; plastic; rubber and leather; textiles; yard waste; lumber and logs; glass; metals; dirt, ash, stone and sand; unclassified residual waste; batteries/dry cells; and other domestic hazardous waste.

The average waste composition from the wet and dry season surveys was adopted to calculate the physical composition of waste. The results are summarised in **Table 2.2.3** and presented in **Figure 2.2.2**.

Table 2.2.3 Waste Composition of Each Generation Source

(Unit: %)

Waste Composition		High/ Middle Income	Low-Middle Income	Low Income / Slum	Shops	Restau-rant	Hotel	Public Facilities	Market	Road
Food Waste		66.38	65.95	58.94	46.15	88.88	85.17	71.48	89.10	16.61
Paper	Recyclable Paper	3.67	3.74	4.55	14.02	0.94	0.65	1.66	0.81	13.14
	Recyclable Cardboard	0.94	0.36	0.11	2.91	0.58	0.50	0.34	3.72	1.97
	Mixed Paper	2.51	0.00	3.01	1.39	0.00	0.00	0.95	0.00	0.17
	Diapers	4.83	12.89	4.75	0.45	0.15	0.00	0.07	0.00	0.00
	Subtotal-Paper	*11.96*	*16.99*	*12.41*	*18.77*	*1.66*	*1.15*	*3.02*	*4.53*	*15.28*
Plastics	Plastic Sheet	6.38	4.45	9.13	1.84	0.95	0.40	1.63	0.00	3.04
	Recyclable Plastics	1.66	5.32	2.03	6.72	2.85	2.69	2.00	1.08	3.51
	PET Bottles	1.10	0.09	0.54	2.87	1.65	1.88	4.89	0.27	4.28
	Other Plastics	0.32	0.48	0.00	3.72	0.33	0.04	0.00	0.12	0.09
	Subtotal-Plastics	*9.46*	*10.34*	*11.70*	*15.14*	*5.77*	*5.01*	*8.52*	*1.48*	*10.91*
Rubber & Leather		0.20	0.58	1.11	0.00	0.00	0.00	0.00	0.23	0.00
Textiles		1.27	0.65	2.29	0.81	0.00	0.00	0.00	2.96	0.34
Yard Waste		2.68	0.00	0.00	0.67	0.22	1.13	0.20	0.00	17.20
Lumber & Logs		1.50	0.00	1.03	0.00	0.00	0.00	0.00	0.00	0.30
Other Org. Waste		1.42	0.71	0.00	2.69	0.70	2.57	4.08	0.67	6.68
Organic Waste - Subtotal		**94.86**	**95.22**	**87.49**	**84.23**	**97.24**	**95.03**	**87.30**	**98.97**	**67.33**
Glass	Returnable Bottles	0.45	0.62	0.06	3.67	0.98	2.76	0.00	0.00	0.17
	Other Live Bottles	0.84	0.39	1.40	0.90	0.19	0.00	0.00	0.07	0.00
	Glass bins	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30
	Broken Glass	0.19	0.56	0.00	3.72	0.31	0.00	5.04	0.43	0.47
	Glass-Subtotal	*1.48*	*1.57*	*1.46*	*8.29*	*1.48*	*2.76*	*5.04*	*0.50*	*0.94*
Metals	Tin Cans (steel cans)	0.32	0.16	0.00	1.48	0.39	0.48	4.63	0.04	0.00
	Aluminum cans	0.23	0.04	0.00	1.88	0.82	1.50	1.52	0.00	0.09
	Copper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other Metals	0.75	0.65	0.52	0.09	0.00	0.00	0.49	0.14	0.87
	Metals-Subtotal	*1.30*	*0.85*	*0.52*	*3.45*	*1.20*	*1.97*	*6.64*	*0.18*	*0.96*
Dirt, Ash, Stone, Sand		***2.12***	***1.77***	***10.12***	2.51	0.00	0.06	1.02	0.21	29.62
Inorganic Waste - Subtotal		**4.90**	**4.18**	**12.11**	**14.25**	**2.69**	**4.79**	**12.70**	**0.90**	**31.52**
Unclassified Residual Waste		0.10	0.18	0.40	1.43	0.07	0.18	0.00	0.14	0.90
Domestic Hazardous Waste		0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.26
Batteries - Dry Cells		0.05	0.09	0.00	0.09	0.00	0.00	0.00	0.00	0.26
Other Domestic Hazardous Waste		0.10	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

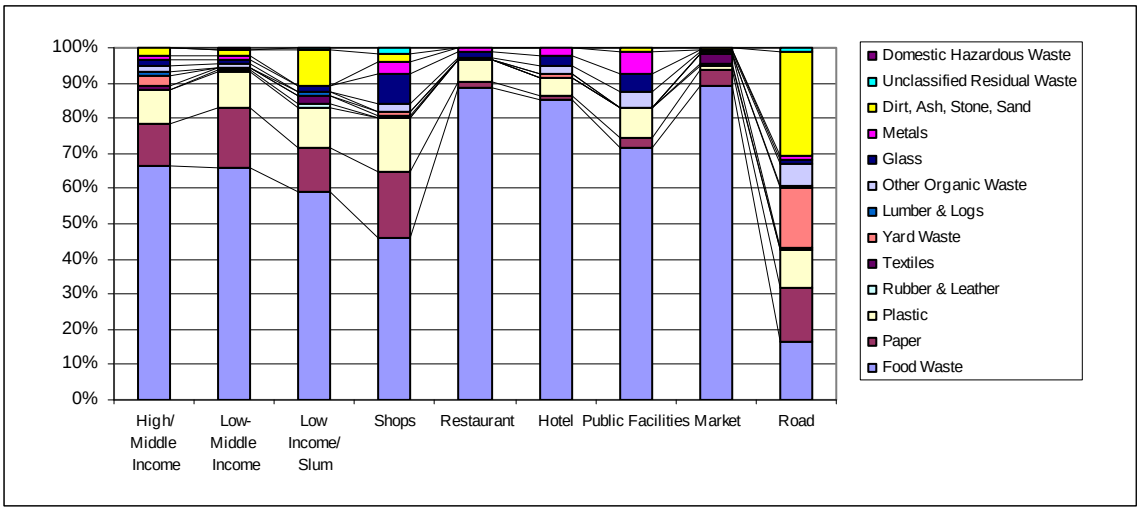


Figure 2.2.2 Physical Composition of Each Generation Source

From the above table and figure, the highest percentage of waste composition is food waste from market waste, followed by paper then plastics, both of which came from shop waste. Fourth is the mixture of dirt, ash, sand and stone as expected from road waste, and fifth is glass which came from shops.

In comparison with the 1998 JICA Master Plan Study[3], food waste, paper and plastics are the topmost compositions of waste, respectively.

The weight and weighted ratio of each composition from the total waste generation in Nairobi City have been calculated as shown in **Table 2.2.4**. The characteristics are as follows:

- The rate of food waste is 69%, paper is 9.43% and almost the same with plastics, about 9.42%.
- The rate of recyclable material such as paper, plastic, metal and glass is 15.61%.
- The ratio of organic material is 91.62%. Non-organic material has an extremely low ratio of 7.94%, unclassified residual has the ratio of 0.34% and domestic hazardous waste such as battery-dry cell has the ratio of 0.1%.

Table 2.2.4 Weight and Weighted Ratio of Total Waste Generation

Waste Composition		Total Weight (t/day)	Weighted Ratio (%)
Food Waste		1,154	68.99
Paper	Recyclable Paper	70	4.18
	Recyclable Cardboard	14	0.82
	Mixed Paper	19	1.12
	Diapers	55	3.31
	Subtotal-Paper	*158*	*9.43*
Plastics	Plastic Sheet	59	3.54
	Recyclable Plastics	56	3.32
	PET Bottles	31	1.86
	Other Plastics	12	0.70
	Subtotal-Plastics	*158*	*9.42*
Rubber & Leather		5	0.27
Textiles		12	0.72
Yard Waste		12	0.70
Lumber & Logs		6	0.36

Waste Composition		Total Weight (t/day)	Weighted Ratio (%)
Other Org. Waste		29	1.74
Organic Waste - Subtotal		**1,533**	**91.62**
Glass	Returnable Bottles	20	1.22
	Other Live Bottles	9	0.53
	Glass bins	0	0.00
	Broken Glass	23	1.40
	Glass-Subtotal	*53*	*3.15*
Metals	Tin Cans (steel cans)	18	1.06
	Aluminum cans	14	0.85
	Copper	0	0.00
	Other Metals	6	0.36
	Metal-subtotal	*38*	*2.28*
Dirt, Ash, Stone, Sand		42	***2.51***
Inorganic Waste - Subtotal		**133**	**7.94**
Unclassified residual waste		6	0.34
Domestic Hazardous Waste		2	0.09
Batteries - Dry Cells		1	0.03
Other Domestic Hazardous Waste		1	0.06
Total		**1,673**	**100.00**

Note: Total weight is calculated by subtracting self-disposal waste amount from the total waste generation amount i.e., 1,884 – 175 (self-disposal amount) = 1,673 t/day.

2.2.3 Comparison of Waste Composition of Domestic Waste

The domestic waste composition of Nairobi City compared to those of developed countries is different. This has been discussed further in the Supporting Report for WACS. However, waste composition in under-developed countries like Dhaka, Bangladesh, is almost the same as in Nairobi City[4]. Comparisons of waste composition in Nairobi City in 1998 and 2009 and also in Dhaka in 2004 are shown in **Table 2.2.5** and **Figure 2.2.3**.

Table 2.2.5 Domestic Waste Composition in Nairobi and Dhaka

(Unit: %)

Domestic Waste Composition			Nairobi-1998*1	Nairobi-2009*2	Dhaka-2004*3
Organic Waste					
1	Food Waste		54.6	63.8	68.3
2	Paper	Recyclable Paper	14.6	4.0	2.7
3		Recyclable Cardboard	-	0.5	0.0
4		Mixed Paper	1.8	1.8	3.8
5		Diapers	-	7.5	-
	Paper-Total		**16.5**	**13.8**	**6.5**
6	Plastics	Plastic Sheet	-	6.7	0.7
7		Recyclable Plastics	5.0	3.0	0.4
8		PET Bottles	-	0.6	0.6
9		Other Plastics	7.0	0.3	2.3
	Plastics-Total		**12.0**	**10.5**	**4.1**
10	Rubber and Leather		1.9	0.6	0.5
11	Textiles		2.4	1.4	1.9
12	Yard Waste		5.5	0.9	5.2
13	Lumber and Logs		-	0.8	0.8
14	Other Organic Wastes		-	0.7	0.0
Organic Waste-Total			**92.9**	**92.5**	**87.2**

Domestic Waste Composition			Nairobi-1998*1	Nairobi-2009*2	Dhaka-2004*3
Inorganic Waste					
15	Glass	Returnable Bottles	-	0.4	0.0
16		Other Live Bottles	-	0.9	0.8
17		Glass bins	1.4	0.0	-
18		Broken Glass	0.6	0.2	1.1
	Glass-Total		**2.0**	**1.5**	**1.9**
19	Metals	Tin Cans (steel cans)	1.7	0.2	0.3
20		Aluminum cans	-	0.1	0.1
21		Copper	-	0.0	0.0
22		Other Metals	1.0	0.6	0.6
	Metals-Total		**2.7**	**0.9**	**1.0**
23	Dirt, Ash, Stone, Sand		-	4.7	8.5
24	Unclassified Residual Waste		2.4	0.2	1.4
25	Batteries - Dry Cells		-	0.0	-
26	Other Domestic Hazardous Wastes		-	0.1	-
Inorganic Waste Total			**7.1**	**7.5**	**12.8**
Total			**100.0**	**100.0**	**100.0**

Source: *1 Waste Amount and Composition Survey by JICA Survey Team, 1998
*2 Waste Amount and Composition Survey by JICA Survey Team, 2009
*3 The Study on Solid Waste Management in Dhaka City in the People's Republic of Bangladesh-2004, JICA

On the whole view of the comparison table and graph, organic waste accounts for about 90% while inorganic waste accounts for 10% in waste composition for both Nairobi City and Dhaka City. In addition, the similarity is observed for food waste taking the highest ratio among other wastes and accounting for more or less 60% in each city. However, observing in detail for the recyclable waste especially for paper and plastics, the ratio in Nairobi City (paper 13.8% and plastics 10.5% in 2009) is higher than that of Dhaka City (paper 6.5% and plastics 4.1 % in 2004)[5].

The waste composition survey in each city was conducted for the waste samples generated at sources and the waste generators were instructed to discharge all wastes including recyclable wastes for the survey. However, practically, waste generators in Dhaka City tend not to discharge recyclable waste since the recycling industry in Dhaka City is active and recyclables are easily sold to the junkshops. Considering the situation of recycling activities, it can be concluded that the waste composition in Nairobi City and Dhaka City are similar. In other words, the higher ratio of recyclables in Nairobi City means that more activities are expected for resource recovery at waste generation sources.

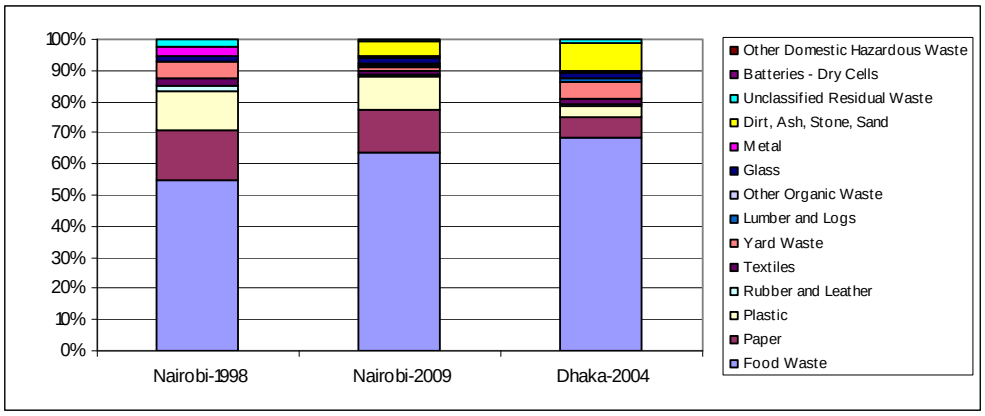


Figure 2.2.3 Domestic Waste Composition in Nairobi and Dhaka

2.2.4 Apparent Specific Gravity

The Apparent Specific Gravity (hereinafter referred to as "ASG") of solid waste in kg/litre is an important tool required to assess the total mass and volume of waste. The average ASG calculation results for each generation source survey in the wet and dry seasons are shown in **Figure 2.2.4**.

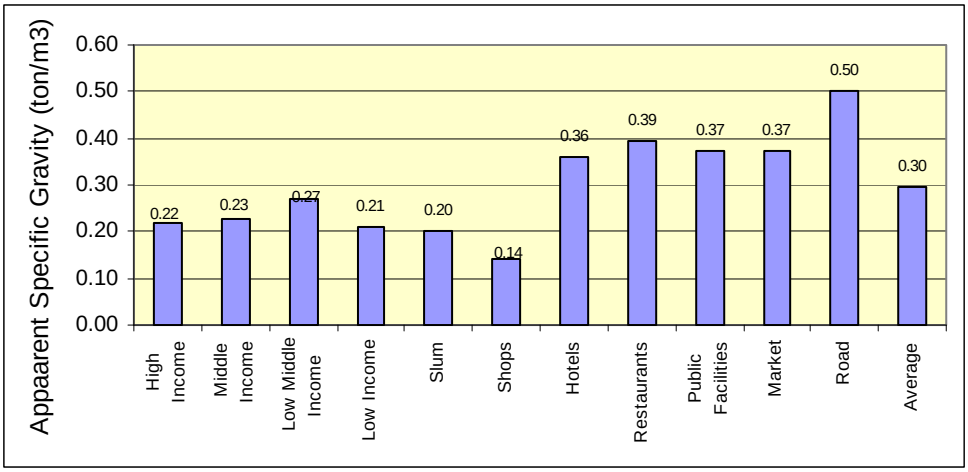


Figure 2.2.4 Apparent Specific Gravity

As shown in the above figure, road wastes have the highest apparent specific gravity while shop wastes have the lowest. The average ASG of the waste in Nairobi City is 0.30.

2.2.5 Three-Content Analysis

For this study, the chemical analysis considered was the chemical property analysis of the three contents, namely; moisture, ash and combustible. The average results of the three-content analysis for each generation source during the wet and dry seasons are shown in **Table 2.2.6** and **Figure 2.2.5**. Since road waste was not chemically analysed, the average is considered to be the weighted value of total waste generated in Nairobi City. The highest value of moisture content was the waste from the high income groups in residential areas, while the highest percentages of ash content and combustible content were from the shop waste.

Table 2.2.6 Three-Content Analysis of Each Generation Source

(Unit: %)

Waste Source Generators	Moisture	Ash	Combustible
High Income	79.27	7.80	12.94
Middle Income	73.41	4.63	21.97
Low-Middle Income	73.37	2.47	24.17
Low Income	67.80	4.15	28.05
Slum	59.36	2.23	38.42
Shop	7.61	33.18	59.22
Restaurant	72.63	13.64	13.74
Hotel	77.63	19.13	3.25
Public Facilities	25.57	20.30	54.44
Market	83.75	6.97	9.28

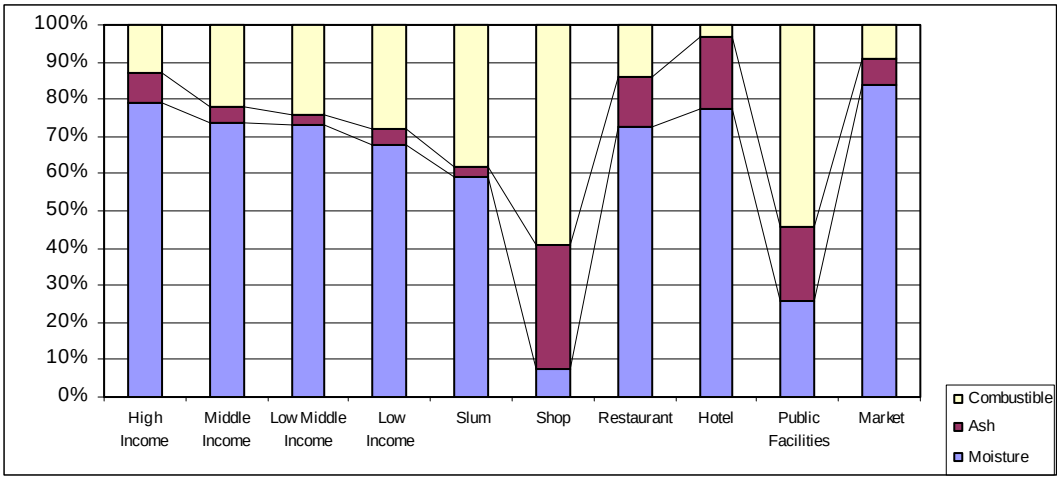


Figure 2.2.5 Three-Content Analysis Results

2.2.6 Estimation of Total Amount of Solid Waste

The assumptions used for the estimation of total amount of solid waste being generated in Nairobi City are based on the actual waste amount survey and the data gathered from different government agencies.

(1) Residential

Nairobi's population by area based on the 1999 Census stands at 2,143,254 people. It is projected that in 2009 the population of Nairobi stands at 3,040,000 (JICA Survey Team, 2010). The population ratios of high income (high and middle income groups), middle income (low-middle income group) and low income (including slum) are 13.07%, 35.08% and 51.85%, respectively.

(2) Commercial

The different establishments included in the estimation of commercial wastes are shops; restaurants; hotels and guest houses; public facilities and schools; industrial plant and other establishments. Industrial plants, guest houses and other establishments are not included in the waste amount survey but have to be considered in the estimation to have a more accurate computation of commercial waste. The estimate was done by direct interview with the person in-charge of management in the establishment. The number of establishments for year 2009 was obtained from the Department of Computer of the City Council of Nairobi.

The number of shops, restaurants, hotels and guest houses, public facilities and schools, industrial plants, and other establishments are 47,941, 1,582, 726, 3,347, 501 and 27,077 respectively.

(3) Market

Currently, there are 44 markets in Nairobi City. The actual number and distribution of markets in each zone were gathered from the Department of Social Services of the City Council of Nairobi, namely; 4 in Zone 1, 3 in Zone 2, 5 in Zone 4, 2 in Zone 6, 1 in Zone 7, 8 in Zone 8, 10 in Zone 9, and 11 in the CCN/SWMPC Zone. (Location of Zones 1 to 9 and CCN/SWMPC are shown in **Figure 4.2.2**, Page 4-4.)

(4) Road

The length of roads currently being swept is 563.3 km. However, the amount of waste generation in roads is not added to the estimation of total waste generation considering that the waste generators

are also from the residential and commercial areas. The figure only shows the estimated amount being swept from the roads everyday.

Based on the above assumptions, the total waste amount generated in Nairobi City at present is estimated at 1,848 tons per day (t/day), as shown in **Table 2.2.7**.

Table 2.2.7 Total Amount of Waste Generation

Generation Sources	Quantity	Unit	Unit Generation (kg/day)	Total (kg/day)
1. Residential Waste				
a. High Income	397,362	person	0.621	246,635.00
b. Middle Income	1,066,393	person	0.474	505,076.00
c. Low Income	1,576,245	person	0.360	566,670.00
2. Commercial Waste				
a. Shops	47,941	establishment	0.5	23,970.50
b. Restaurants	1,582	establishment	38	60,116.00
c. Hotels & Guest Houses				
Standard Hotels (D Class)	140	establishment	350	49,000.00
Lodging House (B & C Class)	586	establishment	100	58,600.00
d. Public Facilities/Schools				
Public Facilities	500	establishment	137	68,500.00
School	2,847	establishment	32	91,104.00
e. Industrial Plant	501	establishment	150	75,150.00
f. Other Establishments	27,077	establishment	0.5	13,538.50
Sub-Total of Commercial Waste				439,979.00
3. Market Waste	44	market	2045	90,000.00
4. Street Waste	563.3	km	106	(60,000.00)
Total				**1,848 t/day**

Note: Street Waste is already included in residential and commercial wastes.

2.2.7 Diverted Waste

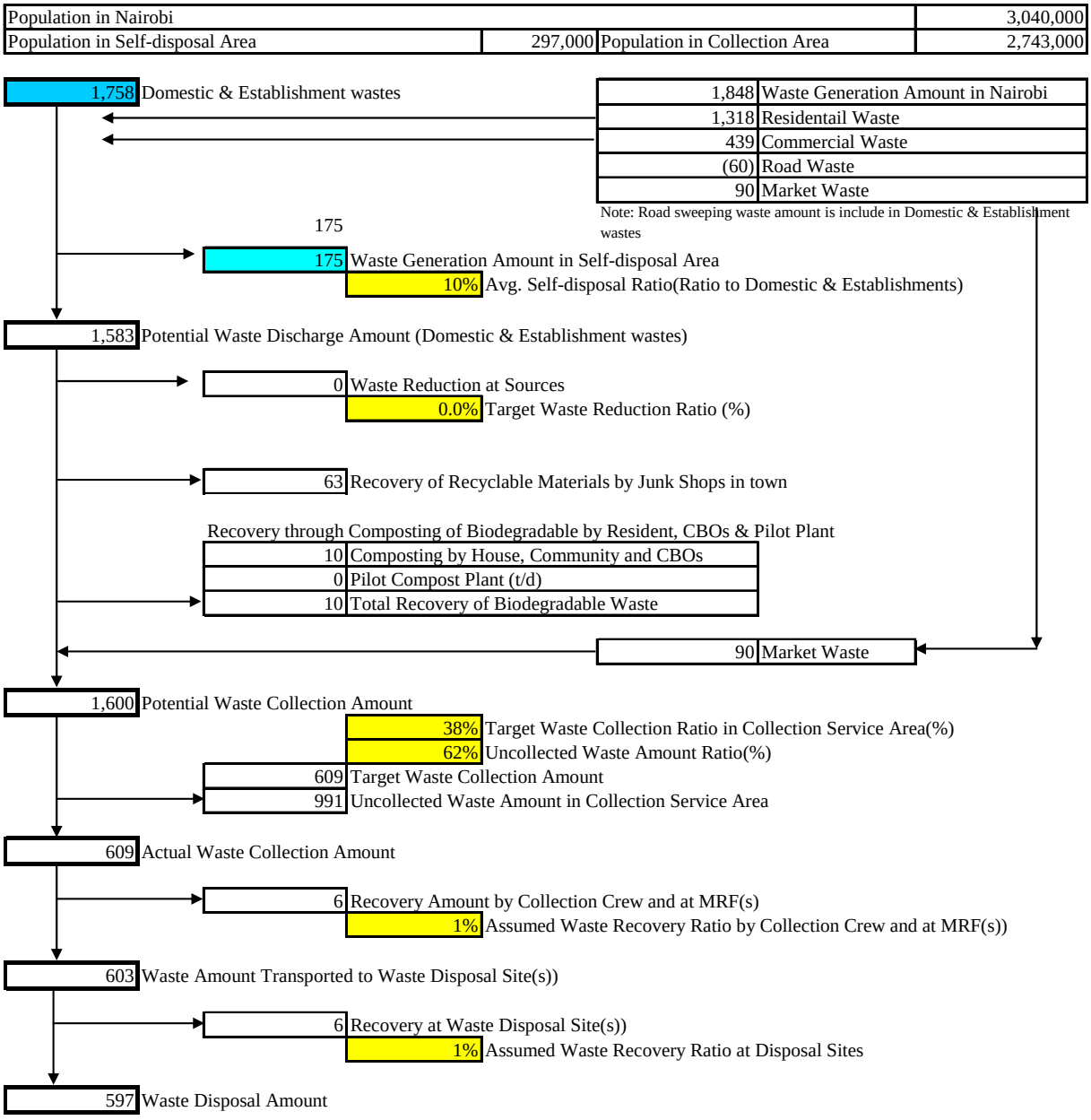
The total amount of diverted waste includes the amount of waste reduced at the source; the recyclable materials recovered from junkshops; the materials recovered through composting of biodegradable wastes by residents, CBOs and pilot plants; the amount recovered by the collection crew at the Material Recovery Facility (hereinafter referred to as "MRF"); and the wastes recovered at the waste disposal site. **Table 2.2.8** shows the amount of diverted waste estimated based on the survey results on junk dealers, recyclers (factories), etc., and the waste amount prediction conducted in accordance with the waste flow shown in **Figure 2.2.6**. As a result, the total recovery amount of recyclable materials is estimated at 86 tons per day which is equivalent to 5.3% of the potential waste collection amount. Information on the activities of junkshops, dealers and the recyclers are lacking and all the resource recovery amounts were not always recorded. However, the resource recovery amount obtained from the major junk dealers as stated above can portray the current status of recycling activities in Nairobi City in comparison with the survey results of material utilisation amount of the recycling industries obtained from the major factories.

Table 2.2.8 Summary of Waste Reduction, Recovery and Diversion

Item	Amount (t/day)
Waste Reduction Amount at Sources	0
Recovery Amount of Recyclable Materials by Junkshops	63
Recovery through Composting of Biodegradables by Residents, CBOs and Pilot Plants	10
Recovery Amount by Collection Crew and at MRF(s)	6
Recovery Amount at Waste Disposal Site(s)	6
Total Diversion Amount	**86**

2.2.8 Current Waste Flow

The current waste flow in Nairobi City is as shown in **Figure 2.2.6**.



Summary of Waste Reduction, Recovery and Diversion (t/day)

Material Recovery Amount	75	4.7%
Biodegradable Recovery Amount	10	0.6%
Total Waste Recovery Amount	86	5.3%
Waste Reduction Amount at Sources	0	0.0%
Waste Diversion Amount	86	5.3%

Figure 2.2.6 Current Waste Flow in Nairobi City (Year 2009)

2.3 Institutional, Organisational and Human Resources Development Study

2.3.1 Current Status and Problems of Institutional, Organisational and Human Resources Development for SMW in Nairobi

(1) Inefficient Structure and Improper Management of Organisation

After the formulation of the previous Master Plan, the National Environment Management Authority (hereinafter referred to as "NEMA") was established under the Environmental Management and Coordination Act (hereinafter referred to as "EMCA") No. 8 of 1999 as the principal instrument in the implementation of all policies relating to the environment. The enactment of EMCA 1999 was a milestone in promoting the sustainable environmental management. The EMCA 1999 provides the institutional framework and procedures for the management of environment. In accordance with EMCA 1999, the Environmental Management and Coordination (Waste Management) Regulations of 2006, as well as the CCN (Solid Waste Management) By-laws of 2007, detailedly stipulates the mandates of the Department of Environment (hereinafter referred to as "DoE") in the legal provisions to regulate the waste management activities.

Under the basic policy directions and the supervision by the Ministry of Local Government, CCN is primarily responsible for providing and regulating solid waste management services in the City of Nairobi, and CCN delivers the said services through the DoE. The DoE is divided into the Administration Section and three operational sections (SWM Section, Parks/Open Spaces Section and Environmental Management Planning Section). The Department of Environment is headed by the Director of Environment, assisted by two Deputy Directors. **Figures 2.3.1 and 2.3.2** show the outline of the organisational structure of the DoE and the SWM Section.

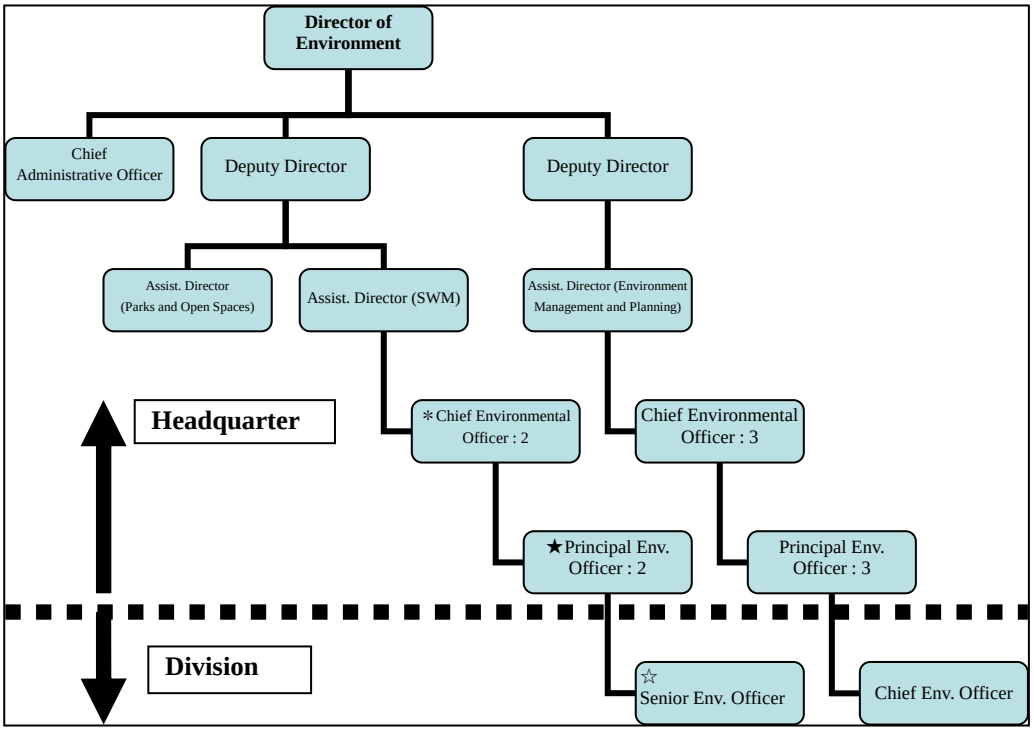


Figure 2.3.1 Organisational Chart of the Department of Environment (1)

Source: Human Resources Department, City Council of Nairobi

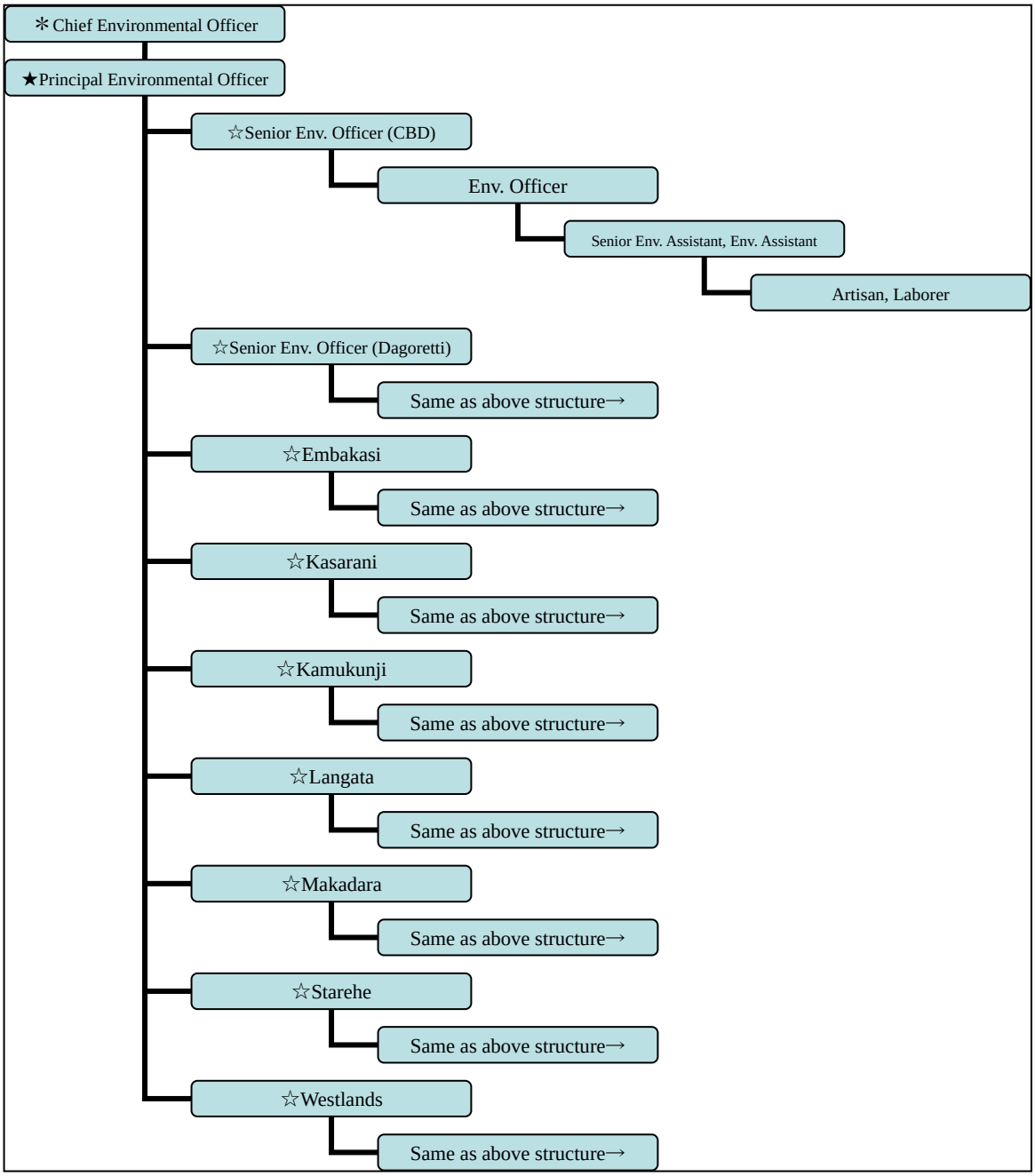


Figure 2.3.2 Outline of the Organisational Chart of the Department of Environment (2)

Source: Human Resources Department, City Council of Nairobi

The main responsibilities of the Department of Environment (DoE) on solid waste management are summarised below:

- To implement CCN's SWM policies formulated by the Council's Environmental Committee.
- To maintain public cleanliness, protect public health and the environment, and keep public places aesthetically acceptable by providing services for the collection, transportation, treatment and disposal of solid wastes.
- To regulate and monitor the activities of all generators of solid wastes.

- To regulate and monitor private companies engaged in solid waste activities.
- To enforce all laws and regulations relating to SWM.

The SWM Section is divided into nine (9) operation districts. Each district is headed by a Senior Environmental Officer and provides both collection/transportation and street cleansing services to a designated area of the city.

The major functions of the SWM Section are:

- Waste collection and transportation
- Medical wastes collection from hospitals, maternity homes, medical and veterinary clinics
- Street cleansing
- Cleaning and recovery of solid wastes from road gullies
- Road side and estates drain cleaning
- Night soil collection
- Dead animal collection
- Refuse disposal
- Supply of refuse bins to households

In the previous Master Plan, the following organisational restructuring was proposed. However, although some organisational restructuring had been carried out in line with the proposal, the number of scales of personnel remains unchanged.

- The Department of Environment should be reorganised to constitute the Division of Solid Waste Management, the Division of Environmental Planning and Management, the Division of Financial Affairs, and the Division of Parks.
- The Cleaning Section of the newly proposed Division of Solid Waste Management should be reorganised. More concretely, sections for community development and contracting affairs should be formed. At the same time, daily collection and road cleaning should be divided clearly, and the number of vertical organisations should be reduced.
- The new Division of Financial Affairs should be in charge of administering human resources development, financial affairs, general affairs and information management in the Department of Environment.
- The new Division of Environmental Planning and Management should be in charge of environmental planning, environmental management, and environmental impact assessment.

Currently, the City of Nairobi is divided into nine (9) operation zones based on constitutional boundaries including the Central Business District (hereinafter referred to as “CBD”). The zones are CBD, Dagoretti, Embakasi, Kasarani, Kamukunji, Langata, Makadara, Starehe and Westlands. The following table shows the number of staff and workers of the Department of Environment. The total number of staff and workers of the Department of Environment is 860, while that of the SWM Section is 495 as of the end of April 2010.

The Department of Environment has difficulties in efficiently providing SWM services because of chronic constraints on organisational and human resources development matters. This inefficient operation in the solid waste management services is attributed to the following management-related constraints:

(a) Over-staffing and Overlapping under Vertical Structure associated with Duplicated Responsibilities of Staff

Among the officials, there is a considerable overlapping of responsibilities making daily operations and performances extremely slow and inefficient. This is due to a series of reporting and approval chains with little value added in the organisation. For example, there are three different positions for environmental supervisors with similar tasks in each division. In addition to the overlapping of responsibilities, the over-staffing in the same scales and positions, especially in the lower positions, is another constraint. Furthermore, there are 18 levels in the vertical structure from the director down to manual workers, making the personnel management ineffective and the decision-making extremely slow.

(b) Poor Intra-departmental and Inter-departmental Coordination and Communication

Both intra-departmental and inter-departmental coordination and communication are rather poor. Lack of coordination and communication makes the organisation inefficient. Especially, there is little sharing of information and knowledge among the related officials. Currently information is not systematically shared but day-by-day, on-demand, or spot basis.

(c) Unclear Individual Mandates and Job Descriptions

Although there are departmental performance contracts, there are no clear-cut individual mandates or job descriptions. Tasks are set but there is no formal procedure to monitor individual performance. Mandates and responsibilities are not clearly assigned, thereby making the organisation more inefficient.

(d) Unaccountable and Slow Decision-making of Managers

The decision making capacity of managers and supervisors lacks effectiveness. This is not due to individual deficiencies but is a direct result of the weak management culture. Managers and supervisors need more training to develop their management skills.

(e) Insufficient Monitoring of Individual Work Performance

Although there are annual reviews on work performance as an organisation, there is almost no periodical performance monitoring on the individual work results. Therefore, there is no substantial feedback to the continuous improvement of individual work performances.

(f) No Standardised and Planned Working Procedures

The working procedures in solid waste management are not on a planned basis but on ad-hoc or day-by-day basis. For example, the collection and transport of wastes are on the weekly basis and not sufficiently planned.

(2) Improper Zoning for SWM Services

The current zoning for waste collection and transportation services is basically constituency boundaries, and there is currently no concept on the internal cross-subsidising system where the revenues from better-off zones are transferred to a fund to provide solid waste management services in poorer zones. One of the possible ways for the internal cross-subsidy is to differentiate the tariff-setting between better-off zones and poorer zones, thereby making it possible to internally cross-subsidise poorer zones in Nairobi City. At present, licensed private waste collectors are charging various levels of collection fees in different zones, and, furthermore, there is no proper zoning system for the cross-subsidisation.

(3) Lack of Information on Costing for SWM Services by Private Operators

The proper tariff setting for private contractors is also essential for the sustainable provision of solid waste management services by private contractors. It is generally recognised that in order to accurately calculate the actual cost of collecting, transporting and disposing wastes, financial information such as variable cost, fixed cost, total cost and break-even point for providing services should be clearly identified. Another institutional barrier against the sustainable provision of solid waste management services is the lack of information on costing for solid waste management services by private contractors, such as breakdown of unit costs for fuel, vehicle insurance and other expenses as well as the required cost for tendering and contracting. The chart below illustrates the image of variable cost, fixed cost, total cost and break-even point per unit waste, and the following table shows the breakdown of unit cost by private contractors. It is obvious that the costing for private contractors does not sufficiently consider the overhead cost and the depreciation of capital investment cost.

Figure 2.3.3 illustrates the image of variable cost, fixed cost, total cost and break-even point for the solid waste management. It was revealed that the majority of the staff of the SWM Section has difficulty in explaining this cost structure based on the existing data. The lack of these information leads to the improper contracting-out unit prices for waste collection by contractors, thereby hampering the sustainable provision of waste collection services.

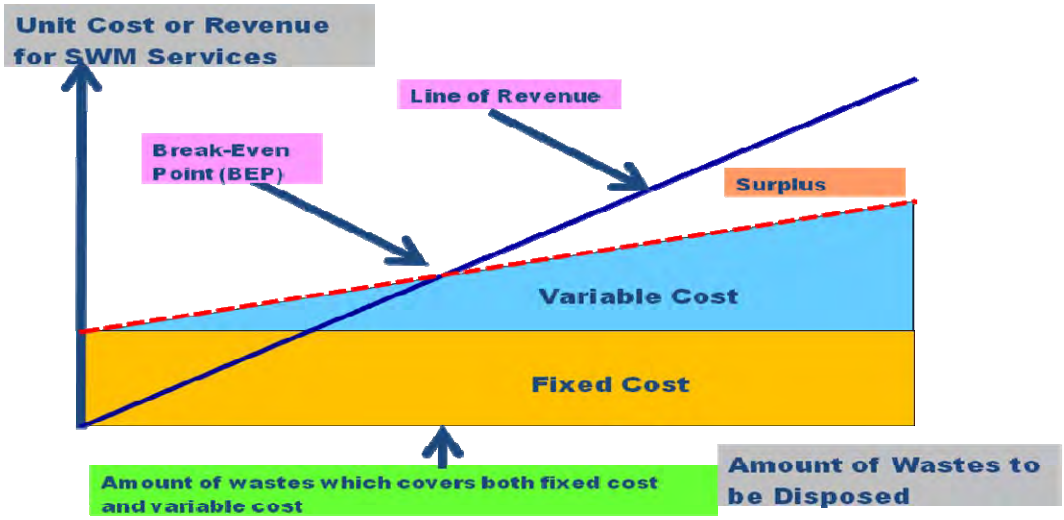


Figure 2.3.3 Image of Variable Cost, Fixed Cost, Total Cost and Break-Even Point
Source: JICA Survey Team

(4) Vulnerable Private Sector

Under the status quo, there are a significant number of private contractors and licensed private waste collectors that provide waste collection services in Nairobi City. CCN has contracted-out part of waste collection and street cleansing services, and, at the same time, waste collection services are also delivered by approximately 50 private licensed waste collectors under open and completely unregulated competition. Private companies are free to provide services to whom and to where they like and collect tariff directly from their customers. There are also around 140 community-based organisations (hereinafter referred to as "CBOs") that handle wastes especially in informal settlements, but many are badly equipped. The contracted private waste collectors operate in designated zones as stipulated in their contracts with CCN. These private stakeholders have vulnerabilities in the sustainable provision of waste collection services as outlined below. The current status of waste collection and transport in Nairobi City is described in detail in **Section 2.4**.

- Many of the private contractors and licensed private companies do not have offices and they keep their vehicles in gas stations due to financial difficulty.
- They also have difficulty in renewing and increasing the number of vehicles due to lack of financial sources to improve their collection services.
- The overhead costs and depreciation costs for the investment on vehicles are not completely included in the contracts.
- The payment to private contractors is frequently delayed due to the slow accounting process of CCN.

(5) Complicated Procedures for Procurement of Spare Parts and Maintenance

Due to the complicated procurement procedure of CCN, it takes a long time to execute the repair the grounded vehicles. Therefore, the insufficient and complicated procedure for procuring spare parts is a critical institutional barrier for the sustainable provision of solid waste management services. The main reason for a lot of vehicles not in operation is that the Treasurers Department takes a long time to provide the necessary budget for the procurement of spare parts.

More specifically, the reason for the complicated procurement procedure is that CCN must comply with the tendering procedure stipulated by the complicated contracting threshold under the current Procurement and Disposal Act, as below.

- International Open Tender under Section 71 of the Procurement and Disposal Act, 2005
- National Open Tender under Section 54(2) of the Act
- Restricted Tender under Section 73(2)-a of the Act
- Restricted Tender under Section 73(2)-b of the Act
- Restricted Tender under Section 73(2)-c of the Act
- Request for Proposal under Section 76(1) of the Act
- Request for Proposal under Section 74(2) and 74(3) of the Act

(6) Insufficient Budget for SWM Services

There are chronic financial constraints of CCN in terms of scale of budget. The revenue of CCN is basically supported by several transfer funds from the central government such as the Contribution in Lieu of Rates (CILOR), the Road Maintenance Levy Fund (RMLF) and the Local Authority Transfer Fund (LATF), and the financial base of CCN is rather fragile. **Table 2.3.1** indicates the CCN Revenue for Financial Year 2009/2010, and **Table 2.3.2** indicates the CCN Expenditure for Financial Year 2009/2010.

The major findings are as below.

- The total receipt from the Central Government occupies 34.2% of the total revenue, which implies that there is a chronic shortage of revenue for the budget of CCN.
- The budget for capital investment on SWM is only 13.2% of the total expenditure of the Department of Environment, which is not enough to improve the level of SWM services.
- The budget for outsourcing to private contractors is limited.
- The budget for maintenance such as the procurement of spare parts and repair of vehicles is only 6.9% of the total expenditure of the Department of Environment.

Table 2.3.1 CCN Revenues for Financial Year 2009/2010

No.	Total	2009/2010 Budget (1000 KSh)
1	Contribution in Lieu of Rates (CILOR)	103,318
2	Road Maintenance Levy Fund (RMLF)	883,800
3	Local Authorities Transfer Fund (LATF): Service Component	1,174.044
4	Local Authorities Transfer Fund (LATF): Performance Component	782,696
5	Other Government Funds	0
6=1+2+3+4+5	Total Receipt from Central Government	2,943,858
7	Land Rates	1,849,950
8	Plot Rates	55,900
9	Single Business Permits	860,000
10	Total Cess Receipts	208,640
11	Game Parks	7,329
12	Market and Slaughterhouse Fees	97,310
13	Vehicle Parking Receipts	714,428
14	House and Stall Rents	250,260
15	Water Supply and Sewerage Charges or Royalties	0
16	Conservancy Fees and Charges	5,031
17	Other Receipts	1,620,222
18=7~17	Total Receipt from Local Sources	5,669,070
19=6+18	Total Revenue	8,612,928

Source: Department of Treasurers, City Council of Nairobi

Table 2.3.2 CCN Expenditures for Financial Year 2009/2010

No.	Budget Item	CCN Total		Department of Environment		Solid Waste Management	
		(1000 KSh)	%	(1000 KSh)	%	(1000 KSh)	%
1	Personnel	4,051,948	40.7	175,167	32.2	59,881	16.8
2	Operation	1,892,924	19.0	249,800	45.9	204,010	57.3
3	Maintenance	996,778	10.0	37,350	6.9	22,200	6.2
4	Debt Repayment	1,700,000	17.1	0	0.0	0	0.0
5	Capital Expenditure	1,309,352	13.2	81,900	15.0	70,000	19.7
6	Total Expenditure	9,951,002	100.0	544,217	100.0	356,091	100.0

Source: Department of Treasurers, City Council of Nairobi

(7) Insufficient On-the-Job Training for SWM-Related Personnel

In the previous Master Plan, it is pointed out that there is no ample policy for human resources development. However, the Human Resource Department recently tried to improve this situation through a number of trials as below.

- The performance contract between the town clerk and each department of CCN is entered annually to clarify the target. The contract includes, vision, mission, objective of each department, commitments and responsibilities of each department and CCN, and frequency of monitoring and information flow together with quantitative indicators.
- Based on the staff performance appraisal report, it is intended to manage and improve the performance of the staff in providing public services by enabling a higher level of staff participation and involvement in planning.
- The Results-Based Management (RBM) is being prepared by each department of CCN to assess the performance results of the annual operations together with performance indicators for the purpose of improving the performance of the public services.

- Currently, the Human Resource Department is trying to obtain a certificate from the International Standard Organisation to improve the working procedures as well as the quality of works.
- The Human Resources Department recently embarked on the implementation of a baseline survey for skills, and competency needs assessment to establish critical skills and competencies for performance of the staff.
- Consultancy works for the rationalisation of the organisational structure are being outsourced to external consultants for the establishment of efficient utilisation of human resources.

Nevertheless, due to the insufficient budget the human resources development and training programme is not sufficient. Regarding the budget for human resources development in the Department of Environment, it is almost used for sending DoE's staff to overseas academic institutions as well as to attend international conferences, and is not allocated to on-the-job training programmes for the solid waste management sector.

(8) Insufficient Enforcement of Legal Framework

(a) Policy Levels

There are several policy documents which include the basic nationwide policy framework of solid waste management. Although priorities are being put on the improvement of solid waste management in these policy documents, these policies are general conceptual frameworks for the solid waste management. Therefore, the contents of these policy documents should be transformed into more detailed, tailor-made actions for the solid waste management in each local government.

(i) National Solid Waste Management Strategy

The National Solid Waste Management Strategy was prepared by the Office of Deputy Prime Minister and the Ministry of Local Government in 2008. The strategies provide a framework for the transformation of the waste management sector from being disposal-oriented to recovery-oriented. Further, these strategies are to guide all local authorities in setting a proper solid waste management.

- Strategy: To help meet Kenya Vision 2030 and the Millennium Development Goals in health poverty reduction and protection of the environment.
- Guiding principles: Zero Waste Principle (Waste is a resource that can be harnessed to create wealth, employment and reduce pollution of the environment.)
- Long-term goals: Achieve 50% waste recovery
- Short- and mid-term goals: Achieve 30% waste recovery
- Priorities: Capacity building at local authority level
- Performance indicators: Amount of waste recovered through recycling and composting programmes
- Instrument: Specific action programmes

(ii) Kenya Vision 2030

Kenya Vision 2030 is the country's new development blueprint covering the period 2008 to 2030. It aims to transform Kenya into a newly industrialised, "middle-income country providing a high quality life to all its citizens by the year 2030." The Vision was developed through an all-inclusive and participatory stakeholder consultative process, involving Kenyans from all parts of the country. It also benefited from suggestions by

some of the leading local and international experts on how the newly industrialising countries around the world have made the leap from poverty to widely-shared prosperity and equity. Kenya Vision 2030 is divided into three fundamental pillars: the Economic, Social and Political pillars. The social pillar aims at realising a just and cohesive society enjoying equitable social development in a clean and secure environment.

Under the Social Strategy, paragraph 5.4 envisions Kenya becoming a nation that has a clean, secure and sustainable environment by 2030. So as to realise this strategy, the document explains that one of the specific strategies is to improve pollution and waste management through the design and application of economic incentives, and the commissioning of public-private partnerships (PPPs) for improved efficiency in water and sanitation delivery. Some of the flagship projects earmarked for this strategy are the development of tight regulations on plastic bags to limit production and usage of environmentally-detrimental plastic bags, and the solid waste management initiative that is to be characterised by the relocation of the Dandora dumpsite, and the development of a solid waste management in five leading municipalities as well as in the economic zones planned under Vision 2030.

(iii) Nairobi Metro 2030

Nairobi Metro 2030 is part and parcel of the overall national development agenda. This agenda is encapsulated in Vision 2030 and, these two documents are the country's response to dealing with five key development issues, namely; rapid economic growth, employment and balanced wealth creation, poverty alleviation, meaningful youth engagement and a vigorous pursuit of regional equity in all its manifestations. In this connection, the Nairobi Metro 2030 aims at optimising the role of the Nairobi Metropolitan Region in the national development effort. It will be targeted at ensuring that it facilitates the effective and efficient utilisation of the Nairobi Metropolitan Region's resource endowments as well as effectively integrating the region into the national fabric. Most importantly it will be applied as an instrument for developing the other regions of the country through effective economic and other structural linkages to the rest of the country.

(b) Act and Regulation Levels

The enforcement of the provisions governing the management of solid waste is done mainly by NEMA and the CCN. However, it is found that the enforcement and monitoring is weak to implement the Acts and Regulations. It is absolutely necessary to establish and implement a system of monitoring, inspections and enforcement of the Acts and Regulations although there are many Acts and Regulations related to solid waste management, as listed below.

- Environmental Management and Co-ordination Act (EMCA) No. 8 of 1999
- City Council of Nairobi (Solid Waste Management) By-laws of 2007
- The Factories Act (Caption 514 of the Laws of Kenya): Section 13
- The Occupational Safety and Health Act of 2007: Section 55
- The Building Code of 1987: Section 239(1)
- The Traffic Act (Caption 403 Laws of Kenya): Section 55(1) and Section 56(1)
- The Transport Licensing Act (Caption 404 Laws of Kenya)
- The Scrap Metal Act (Caption 503 Laws of Kenya): Section 22(2)
- The Environmental Management and Co-ordination (Waste Management) Regulations of 2006
- The Registered Land Act of 1963

(c) Guidelines

(i) Guidelines on Private Sector Involvement in Solid Waste Management

The Guidelines on Private Sector Involvement in Solid Waste Management was prepared by CCN in 2001 to define a systematic approach and framework within which the private sector provides solid waste management services. It formalises and regulates solid waste management services so as to provide an enabling environment to waste operators, and, at the same time, the operators are expected to comply with the Environmental Management and Co-ordination Act, and other laws and regulations.

The Guidelines include:

- The policy on private sector involvement in solid waste management;
- The licensing policy and regulations; and
- The guidelines on vehicles/equipment, clothing, collection frequency, charges, cleansing and financial qualifications.

(ii) Guidelines on Public-Private Partnerships

The Guidelines on Public-Private Partnership issued by the Public-Private Partnership Steering Committee under the Ministry of Finance in 2006 is the basic policy framework for PPP projects. The Guidelines specify 13 general steps to be required for the promotion of PPP projects.

Based on the understanding of the PPP Guidelines, the Department of Environment of CCN recently prepared the document named **"Towards an Integrated Solid Waste Management System for Nairobi through Private Public Partnership (PPP) Framework."** However, both the PPP guidelines and this policy document do not specify the detailed requirements and procedures for the long-term PPP schemes such as concession and BOT projects. Hence, the Guidelines are not being used for the formation of the specific PPP projects, especially long-term concessions, BOT projects and its variations. Although the Ministry of Finance and CCN are willing to formally legalise the Guidelines, it is required to overcome the following constraints for the implementation of successful PPP projects in order to legalise the Guidelines.

- Lack of clause on risk allocations
- Lack of clause on termination of projects
- Lack of clause on reasonable concession terms
- Lack of clause on detailed methodologies of value for money analysis

(iii) NEMA General Guidelines for License Application to Own/Operate a Waste Treatment or Disposal Site

As a regulatory agency, under the Waste Management Regulations of 2006, NEMA classifies various types of waste and recommends appropriate disposal methods for each waste type. Under the Waste Management Regulations, NEMA licenses transporters, incinerators, landfills, composers, recyclers and transfer stations. Facilities to be licensed include local authorities, transporters and handlers of various types of waste. The licensing employs a risk-based approach by concentrating on facilities considered to pose a high risk to the environment. On the other hand, NEMA has the **"General Guidelines for License Application to Own/Operate a Waste Treatment or Disposal Site."** Section A of the Guidelines requires the obligatory documents that the waste transporters must submit, as below.

- Serial Number: Each tracking document to have a serial number starting with 001
- Registered Name of Transporter: As per license
- Usual Municipality/District of Operation: As per license
- License number: As per waste transportation license issued by NEMA
- Issuing Authority: NEMA

The procedures under the Guidelines are duplicated for CCN's licensing procedures required of transporters. This is due to the fact that NEMA requires the license in terms of overall environmental regulations while CCN requires the license in terms of individual solid waste management practices.

2.3.2 Results of Detailed Capacity Assessment

Capacity assessment is defined as the process through which the gaps between available capacities and those needed to meet their goals are identified. The qualitative degree of the gap between the required capacity and the present capacity at individual and organisational levels is comprehensively assessed by using 5-grade score sheets. **Table 2.3.3** tabulates the results of the outline of the capacity assessment.

Table 2.3.3 Summary of Capacity Assessment

Area	Detailed Evaluation Items	5-Grade Score (Low ◄——► High)				
		1	2	3	4	5
Individual Capacity of Staff of the Department of Environment (DoE)	● Level of Knowledge and Technologies on Solid Waste Management (Operation and Maintenance, etc.)			●		
	● Level of Awareness and Responsibilities of Staff		●			
	● Communication Skills			●		
	● Overall Management and Governance Level		●			
Organisational Capacity of the DoE* *Items of "Financial Affairs" and "Financing Capacity for Facilities and Equipment" are related to the Department of Treasurers in addition to the DoE.	● Organisational Structure (Organisation Chart, Decision-making Mechanism, Coordination Capacity, Number and Category of Staff, Personnel Management)			●		
	● Financial Affairs (Level of Financial Management, Cost Structure, Revenue Structure, etc.)		●			
	● Financing Capacity for Facilities and Equipment		●			
	● Appropriateness on Current Tariff System and Fee Collection System		●			
	● Physical Assets (Landfill Sites, Equipment, Materials, etc.)		●			
	● Intellectual Assets (Maintenance and Management Manuals, Database, etc.)		●			
	● Level of Computerised Management	●				
	● Level of Information Sharing and Cooperation among Organisations		●			
	● Level of Labour Management for Workers	●				
	● Level of Management, Disposal Capacities and Methods etc. of Transported Solid Wastes		●			
	● Current Status on Improvement of Collection Efficiency of Solid Wastes		●			
Other Organisational Issues of the DoE	● Level of Know-how of Solid Waste Management System		●			
	● Arrangement of Statistics on Solid Waste Management		●			
	● Arrangement of Manuals for Operational Efficiency		●			

Area	Detailed Evaluation Items	5-Grade Score (Low ◄——► High)				
		1	2	3	4	5
	● Level of Document Filing System	●				
Partnership with Private Sector of the DoE	● Current Function of PPP (Public-Private Partnership)		●			
	● Efficiency of Licensing Procedures for Private Companies		●			
	● Efficiency of Contract Procedures for Private Companies		●			
	● Appropriateness of Methodologies for Estimating Costs for Contracting-out		●			
	● Appropriateness of Management Indicators for Contracting-out	●				
	● Supervising and Monitoring Measures on Contracting-out	●				
	● Legal Regulatory Measures on Illegal and Open Dumping		●			
Partnership with People of the DoE	● Level of People's Understanding and Awareness on Solid Waste Management Issues		●			
	● Level of Consideration on Gender Factors for Solid Waste Management Issues		●			
	● Level of Partnership with Communities		●			
	● Operational Rule on Waste Pickers		●			
Legal and Other Institutional Issues of the DoE	● Level of Current Legal and Institutional Status (Law, By-law, Regulation and Standard on Solid Waste Management)			●		
	● Level of Legal Framework on PPP		●			
	● Appropriateness of Definition on Solid Wastes		●			
	● Degree of Clarification of Administrative Responsibilities		●			
	● Categorisation and Coding of Solid Wastes	●				
	● Formulation of Database on Solid Wastes	●				

Source: JICA Survey Team Analysis

Based on the assessment, the major findings are as described below.

(1) Individual Capacity of Staff of CCN

- "Level of Knowledge and Technologies on Solid Waste Management" and "Communication Skills" are estimated at medium level although the institutional incentive is not enough to keep the staff and workers highly-motivated.
- Although the academic background for management skills of individual staff is relatively high, practical experiences are lacking.

(2) Organisational Capacities of CCN

- "Organisational Structure" is set up while the vertical structure in association with staffing is too much complicated and many duplicated responsibilities in DoE can be seen.
- The scale of the budget for procurement of the necessary spare parts for vehicles and contracting out of waste collection is not enough.

- "Level of Computerised Management" and "Level of Labour Management for Workers" are relatively low because of no comprehensive computer network and insufficient enforcement of labour safety regulations.

(3) Other Organisational Issues

- There is no systematic document filing system. Document filing is carried out individually by each officer.

(4) Partnership with Private Sector

- There is no sufficient management indicator for private contractors, and the depreciation for vehicle investment is not sufficiently included in the costing for private contractors.
- Although there is a legal system to regulate illegal and open dumping, the enforcement capacity is still relatively weak.

(5) Partnership with People

- Although some CBOs and NGOs assist waste pickers in the dumping site, there is no systematic rule on waste pickers.

(6) Legal and Other Institutional Issues

- Coding system of collected waste including hazardous waste is insufficient in actual operation, and the database on solid wastes is not effectively utilised.
- Although there is a PPP guideline, its actual enforcement is rather weak.

2.3.3 Assistance by Other Donors and Situation in Other Cities

(1) UNEP (United Nations Environment Programme)

The current programme of Integrated Solid Waste Management was initiated as a result of the Nairobi River Basin Programme when it was realised that the problem on waste dumping in river courses has become more serious due to lack of organised and planned waste disposal arrangement of solid waste management in Nairobi City. According to the draft final report, the following gaps as well as proposed interventions have been identified and need to be complemented.

Table 2.3.4 Gaps and Interventions Suggested by UNEP/ISWM Programme

Issues	Gaps	Proposed Interventions
Prevention	● NEMA is yet to develop a law governing e-waste management in Kenya ● Country lacks appropriate technologies/know-how to handle e-waste ● Lack of policy for handling toxic and hazardous wastes such as radioactive materials and clinical wastes.	● Develop policy/law on e-waste ● Develop technologies on e-waste ● Develop policies on handling toxic and hazardous wastes
Minimisation (Reduce)	● Excess packaging ● Weak enforcement of policy on minimum thickness of plastic bags ● No active policy on establishment of eco-industrial parks built around waste exchange and/or industrial symbiosis	● Discourage through levies ● Enforce minimum thickness of plastic bags ● Promote industrial production of recyclable material, e.g., plastics

Issues	Gaps	Proposed Interventions
Reuse	● Limited access to suitable technology, e.g., for re-use of construction and demolition wastes ● Limited access to finance to fund acquisition of such technology ● Unhelpful attitude that "poor people reuse"	● Promote safe re-use of construction and demolition wastes by small operators ● Change awareness and attitude on re-use
Recycling	● Insufficient infrastructure, and no active land-use planning for such infrastructure ● Insufficient incentives ● Too many grades/types of plastic on the market ● No technology incubation (this is also relevant to the next heading	● Provide infrastructure and space for recycling ● Provide incentives ● Enforce law and regulations on plastics ● Develop incubation centres for recycling
Recovery	● A significant gap exists around recovery of carbon-bound energy from the organic fraction (OF). It seems that composters currently handle in a year the amount of material that arises in 2-5 days. Can composters scale up significantly? Would (decentralised) biogas generation be a key technology to fill this gap? ● No policy in place to encourage/regulate	● Introduce technology and know-how on composting and biogas production ● Promote the use of compost and biogas ● Enact by-laws to regulate composting and biogas generation and use
Disposal	● New landfill project not proceeding with required urgency due to conflicting interests. ● Limited financial and technical capacity	● Consultations to ensure speedy implementation ● PPP and requisite technology transfer

Source: UNEP, Integrated Solid Waste Management Programme Draft Final Report, 2010

In addition, the "Project Formulation of Reduction of Greenhouse Gas applied by the Global Environment Facility (GEF)," which is related to solid waste, is being carried out with UNEP funds at the cost of around 1.5 to 5 million US dollars. The project was started in August and the completion date is December 2010. UNEP had hired a consultant to prepare the project documents for submission and presentation in a round table conference to be held in 2011; however there is no detailed information except that this project is concerned with solid waste management in Nairobi City and the reduction of greenhouse gas.

(2) UN-HABITAT

The Kibera Integrated Water, Sanitation and Waste Management Project (WATSAN) aims at contributing towards improving the livelihood of the urban poor by supporting small-scale community-based initiatives in water, sanitation and waste management. The project contributes to the ongoing Kenya Slum Upgrading Programme (KENSUP) which is a collaborative initiative between the Government of Kenya and the UN-HABITAT with the following objectives:

- To support improved accessibility to water, sanitation and credit facilities;
- To support improvements to the drainage system;
- To initiate small-scale door-to-door waste collection and recycling initiatives; and
- To establish and strengthen governance frameworks to regulate distribution and accessibility to water and sanitation.

(3) The World Bank, AFD and SIDA

In May 2009, the World Bank (WB), in cooperation with AFD (Agence Française de Développement: French Development Agency) and SIDA (Swedish International Development Cooperation Agency), dispatched a joint mission to discuss the comprehensive strategy for

engaging in a systematic transformation of the urban and local government sectors in the country. In the aide memoire of the joint mission, the following three programmes were proposed to be carried out:

- Kenya Municipal Programme (KMP): USD100 million was already pledged.
- Kenya Slum Upgrading Programme (KENSUP): A mission will be dispatched in October 2010.
- Nairobi Metropolitan Services Project (NMSP): The Project is now being formulated.

Out of these three programmes, the major objective of the NMSP is to improve two key public services in the Nairobi Metropolitan Area, namely; Transport and Solid Waste Management, and the strengthening of institutions responsible for these services. Integrated Solid Waste Management is the Component 2 of NMSP. This component includes:

- Establishment of a new sanitary disposal site;
- Construction of recycling and composting facilities at Dandora;
- Construction of solid waste transfer stations; and
- Support of activities.

The mission proposed to create a financially independent solid waste company to be in charge of solid waste collection, disposal of solid waste, and collection of solid waste fees. The WB is currently considering the possibility of support for SWM in the Nairobi Metropolitan Areas except Nairobi City. NMSP and KENSUP will include the same ideas, such as the establishment of a new solid waste company and waste collection improvement in slum areas.

(4) Request for Proposal on Strategic Partner

CCN prepared the request for proposals to select a strategic partner for providing solid waste management services in Nairobi City. The objective of this RFP is to procure a reliable strategic partner that is capable of implementing an Integrated Solid Waste Management (ISWM) by providing reliable and sustainable services in Solid Waste Management that includes street sweeping, waste separation from the source, waste collection, transportation, intermediate treatment, decommissioning Dandora Dumpsite and commissioning a new sanitary landfill. The strategic partner will work closely with CCN to accommodate the existing staff, all other interested groups including the private strategic partners, youth and women groups. This will be done in the context of integrated solid waste management system which involves waste minimisation, reuse, recycling, material recovery, composting and final disposal at the sanitary landfill.

(5) Case of Municipal Council of Nakuru (MCN)

The private sector involved in SWM in the Municipal Council of Nakuru (MCN) consists of five small companies that charge KSh 100 per household per month in high density residential areas, KSh 150 per household per month in medium density residential areas, and KSh 200 per household per month in low density residential areas. These fees are controlled by MCN although the payments are sent directly to the private sector company.

MCN registers the private companies after advertising for the services and consequently chooses the most qualified bidder from each zone. Some of the prequalification factors looked at include financial and equipment/transport access capability. MCN also partners with CBOs in neighborhood clean-ups and general environment management. Specific areas have been zoned out and assigned for specific CBOs and private companies to engage in SWM. The MCN levies a franchise fee of 15% of gross income for the private sector companies while it is 7.5% of gross income for CBOs involved in SWM.

2.4 Collection and Transportation Study

2.4.1 Present Condition of the SWM Collection and Transportation System

(1) Actual Operation of Collectors and Transporters

The collection and transportation of municipal solid waste are carried out by four organisations, as follows:

- CCN
- Contractors subcontracted by CCN
- Private Service Providers
- CBOs

The following subsections describe how each organisation conducts waste collection and transportation. The detailed information is shown in **Section C of Volume 3, Supporting Report.**

(a) CCN

(i) Organisation

The Collection and Street Cleansing Section is in charge of the management of collection and transportation of municipal solid waste in the whole city of Nairobi and is headed by the Chief Environmental Officer. There are 9 division officers in each Division who head their staff including loaders, road sweepers and drivers.

The functions of the Collection and Street Cleansing Section are as follows:

- Waste collection and transportation;
- Street cleansing;
- Roadside and estates drain cleaning (partially);
- Dead animal collection;
- Refuse disposal;
- Grass cutting along roadsides; and
- Destruction of condemned foods and other goods, with the issuance of destruction certificates.

(ii) Operation Method

The station type of collection is common and door-to-door collection is very rare. One operation team is composed of 1 supervisor, 3 loading crew and 1 driver. There are 5 collection points currently designated by CCN. However, according to the Time and Motion Survey, 2 to 12 collection points for the areas of CBD, Langata, Makadara and Kamkunji divisions were identified in CCN's actual operation. Also in the Time and Motion survey, a higher percentage of loading time to total operation time was identified in CCN's vehicles compared to contractors and private collectors. This seems to be caused by the CCN's inefficient collection methods or time-consuming manual loading. There are no remarkable differences on trip number among the three types of collectors. However, CCN vehicles show a comparatively higher trip number compared to the contractors and transporters.

(b) Contractors Subcontracted by CCN

(i) Number and List of Contractors

There are 21 contractors engaging in the collection and transportation of waste in the areas designated by CCN under the station collection system. According to the Environmental Management and Coordination (Waste Management) Act (EMCA) of 2006, no person shall be granted a license to transport garbage without any permission from NEMA.

(ii) Operation Method

Most of the collection work is done by the station type of collection. An operation team is composed of 1 CCN supervisor, 5 crew members and 1 driver in most cases. According to the Time and Motion Survey, 2 to 22 collection points were identified in the collection areas of Kasarani, Milimani and Makadara. Also in the survey the contractor's vehicles showed the highest efficiency of collected amount of waste compared to the other types of CCN and private collectors, i.e., 120% to 225% of the average collected waste amount per trip. This higher efficiency of contractor's vehicles seems to be caused by several reasons such as 1) their collection area is not time-consuming, or 2) the vehicles used are of large capacity, or 3) their vehicles are equipped with a tipping function.

(c) Private Service Providers

(i) Number of Private Service Providers

There were 44 registered and 26 non-registered private service providers (hereinafter referred to as "PSPs") as of 2009. As for the subcontractors of CCN, the PSPs require a business license from NEMA for the transportation of waste and they have to be registered with CCN. The detailed information is given in **Section C of Volume 3, Supporting Report.** The operation of non-registered private collectors is basically illegal. However, they can do the business of collection and transportation of wastes due to the lack of enforcement capacity of CCN.

(ii) Operation Method

The PSPs operate through the door-to-door collection system in areas they have contracted for the collection and transportation of waste generated by customers in middle to high income residential or commercial areas. According to the Time and Motion Survey, the collection points of PSPs range from 1 to 36. In the survey, it was identified that private collectors showed the most inefficient operation of collection and transportation, especially in unloading work. This seems to be due to the fact that they are still using very old vehicles without a tipping function such as the old Bedoford trucks.

(d) CBOs (Community-Based Organisations)

(i) Number of CBOs

CBOs conduct their collection activities with license to collect from CCN, mainly in slum and low income areas. There are 140 CBOs in Nairobi City including the local youth groups. They conduct their collection activities occasionally with the support of NGOs, including the solicitation of funds for the purpose.

(ii) Operation Method

CBOs sell plastic bags to the residents of low income and slum areas (8 bags/household/month: 200 KSh/household/month), then collect the plastic bags containing garbage and bring them to the collection points using handcarts. The wastes at the collection points are then transported by the vehicles of CCN or the subcontractors to the Dandora Dumpsite, as gathered from the interview with one CBO on the 4th of December, 2009. The residents who can afford to buy plastic bags are actually below 20% of the total number of residents, which is presumed to be one of the causes of illegal dumping of waste everywhere in those areas.

Several unlicensed CBOs also operate in those areas and the collection frequency of CCN or its subcontractors is very low (usually, once a month). These facts are also presumed to have caused the illegal dumping activities. A workshop targeting CBOs was held on March 24, 2010 and a questionnaire survey was conducted on the CBOs.

The analysed results of the survey are as follows:

- About 46% of all respondents are registered with CCN, while 44% are not registered.
- 68% of all respondents are operating in collection activity, while 28% are doing recycling and composting activities.
- 80% of the respondents make contracts with households.
- The most significant problem is that collection vehicles do not go to the collection points of their activities.

(2) Collected Waste

(a) Collected Waste Amount

Table 2.4.1 shows the daily collected waste amounts at the Dandora open dumping site by type of collector and transporter. The total amount of collected waste at the Dandora Dumpsite increased from 397.3 ton/day in 2006 to 608.4 ton/day in 2009. The solid waste is collected mostly by the subcontractors (70-75%) followed by the private service providers (21 to 28%). According to the "Integrated Solid Waste Management Plan", UNEP 1st Draft, 19 February 2010 (UNEP Report), the average collection amount of 830 ton/day during the period 2006-2008 in the UNEP report is larger than the figure of 497.4 ton/day which is the average figure of the collected waste amount during 2006 to 2008 in **Table 2.4.1**.

Table 2.4.1 Collected Waste Amount at Dandora Dumpsite

Unit: ton/day

Year	Daily Average Collected Waste Amount					
	CCN	Contractor	PSPs	Total	Max.	Min.
2006	7.9 (2.0)	299.6 (75.4)	90.3 (22.6)	397.3 (100)	596.5	279.2
2007	13.5 (2.6)	352.2 (68.8)	145.9 (28.6)	511.6 (100)	619.2	351.7
2008	9.4 (1.8)	398.0 (75.2)	121.9 (23.0)	529.3 (100)	602.2	440.1
2009	29.6 (4.9)	446.5 (73.4)	132.2 (21.7)	608.4 (100)	906.1	472.5

Note: Figures in parentheses indicate percentage of the total.
Source: Department of Environment, CCN

(b) Collection Ratio

Waste generation is estimated at 1,848 ton/day in 2009 (See **Table 2.2.7, page 2-11**). Based on this figure, the waste collection ratio to waste generation is roughly estimated at only 33% as of 2009, and the remaining waste is presumed to be illegally dumped or self-treated at the

generation source. This figure is almost 60% of the figure in the UNEP Report. How the collection rate in the UNEP report was computed is not clear while the collection ratio of 33% in this Master Plan was computed based on the waste amount measured by the weigh bridge at the Dandora Dumpsite. The figure in the UNEP report seems to include the waste amount from illegal dumping.

(3) Maintenance of Facilities and Equipment

(a) CCN

CCN has 13 working collection vehicles and 1 loader. The collection vehicles of CCN are dump trucks and not compactor trucks, so that the operation crew load the garbage manually. CCN purchased most of its collection vehicles recently in 2009 and has a maintenance shop at the Lagos Road cleansing depot. All major repairs are carried out at the CCN transport depot along the Garage Road, off Dar Salaam Road. Most of the collection vehicles of CCN have a tipping function with the average capacity of 7 tons. The detailed information is given in **Section C of Volume 3, Supporting Report.**

(b) Subcontractors of CCN

Most of the subcontractors of CCN have 3 to 5 collection vehicles, and only half of them have a tipping function causing the inefficient collection by manual loading and unloading. The detailed information is given in **Section C of Volume 3, Supporting Report.**

(c) Private Service Providers

There is a wide variety of operation scale in the private service providers from the smallest company with only 1 collection vehicle to the large-scaled companies such as Bins Nairobi Service Ltd. with 20 collection vehicles. Very few of the companies have vehicles with a tipping function and the operation crew has to do the loading and unloading manually, which currently causes the extremely inefficient operation.

(4) Legislation and Actual Practices on Waste Segregation, Discharge and Illegal Dumping

(a) Legislation on Waste Generation and Discharge

The Environmental Management and Coordination Act (EMCA, 2006) and the City Council of Nairobi (Solid Waste Management) By-laws (2007), contain provisions on waste segregation, discharge, legislative enforcement and monitoring.

(i) Regulations on Waste Segregation, Discharge and Generation

Section 87(1) of EMCA provides that no person shall discharge or dispose any waste, whether generated within or outside Kenya, in such manner as to cause pollution to the environment or ill health to any person. Sections 1, 2 and 3 of the general provisions of EMCA also stipulate the responsibilities of waste generators in the provisions prohibiting any person from disposing any waste on public places.

On one hand, Section 8(9) of the By-law states that occupiers of domestic and trade premises shall separate waste that can be recycled and place it in a different container provided by the council or the waste operator.

(ii) Enforcement, inspection and monitoring system

The enforcement of provisions on solid waste management is done mainly by NEMA and the City Council of Nairobi. The monitoring of rivers including illegal dumping is the mandate of NEMA. Section 11(1) of the By-law mandates the CCN to establish and implement a system of monitoring, inspections and enforcement of waste management activities and is to inform and keep the public informed of steps it is taking to implement and improve waste management within the City Council of Nairobi.

The City Inspectorate Department of the CCN has the mandate on the inspection and monitoring of actual practices of the waste generators.

(b) Definitions of Illegal Dumping

Based on Sections 1, 2 and 3 of the general provisions of EMCA, waste dumping on public places such as rivers, roads and parks not designated by the authorities is prohibited. In most cases, garbage dumping in rivers and roadsides can be understood clearly to be illegal. Also, the dumping at places not designated by CCN can be defined as illegal dumping. However, even in the designated collection points, when the collection activity is done in a very low frequency such as once a month and CCN does not monitor or inspect these practices, these places also can be a problem from the viewpoint of public health, visual landscape, and lack of administrative monitoring and enforcement capability.

(c) Causes of Illegal Dumping

Various causes bring illegal dumping in a complicated relationship among the actual practice of waste generators, waste collectors and administrative capabilities. **Table 2.4.2** summarises the estimated causes of illegal dumping. As shown in **Table 2.4.2**, the lack of waste generators' awareness toward appropriate waste segregation and discharge, low affordability of waste charge and low frequency of waste collection and transportation, etc., are presumed as the causes of illegal dumping.

Table 2.4.2 Summary of Causes of Illegal Dumping

No.	Presumed Causes
1	Lack of waste generators' awareness toward appropriate waste segregation and discharge
2	Low affordability of waste generators to pay garbage fee
3	Very low frequency of waste collection and transportation
4	Lack of capability of waste collectors (Lack of collection staff and collection vehicles)
5	Weak legal enforcement in terms of weak penalty clauses
6	Lack of administrator's enforcement capability on inspection and monitoring
7	Lack of containers to accept discharged waste

(d) Actual Practice of Waste Segregation and Illegal Dumping

Currently there is no waste segregation at waste generation sources. However, waste pickers segregate recyclable wastes such as metals, PET bottles and glasses at the time the collectors collect the waste at the collection points and unload them at the Dandora Dumpsite.

Illegal dumping has been identified in various places in the city. Seventy-four (74) sites were identified, and Kasarani Division has the largest number of illegal dumping site. The detailed information is shown in **Section C of Volume 3, Supporting Report.**

(5) Relevant Projects of Other Donors in relation to Collection and Transportation (Actual Performance, Ongoing and Planning)

No support from any donor on the implementation of collection and transportation has been identified through the discussion with CCN.

(6) Necessity of Transfer Station and Current State of Candidate Sites and their Evaluation

(a) Necessity of Transfer Station

A new sanitary landfill will be an indispensible option for the appropriate solid waste management by Nairobi City when the urgent closure of the existing Dandora Dumpsite is taken into consideration. The final landfill site can be located in a long distance from the collection area. In this case, the direct haul of garbage to the new landfill site will take higher transportation cost. The transfer-transport can be a dominant alternative to the direct haul to the final landfill site. Therefore, the development of a transfer station should be studied to identify an integrated optimum system of waste collection and transportation in Nairobi City.

(b) Candidate Sites of Transfer Station

Three sites, namely, Kaliobangi South, Dandora Dumpsite and Langata were identified as candidate sites for the development of a transfer station.

The Kariobangi South Site is currently an open space with an area of 41 ha. The site is located in an area surrounded by two major roads, namely; the Outer Ring Road and the Kangundo Road, and accessed from Kangundo Road. The area is close to the existing railway line at the north edge. The land uses planned for the site are horticulture, storage facility and matatu terminal.

Dandora, on one hand, is currently an open dumping site surrounded by the Outer Ring Road and the Koma Rock Road. The site can be a facility site of a transfer station after the safe closure of the existing open dumping area.

Langata is currently a forest land with an estimated land area of 8 ha adjacent to the existing public cemetery and close to Langata Road. The site is covered with trees and located at 2 km distance from the Kibera slum area and 7 km from CBD (Central Business District). The detailed information is shown in **Section C of Volume 3, Supporting Report**.

2.4.2 Evaluation of Current Collection and Transportation System of SWM

The biggest problem in the present collection and transportation system in Nairobi City might be the low collection ratio of only 33%. The fact seems to be caused by the complicated technical, financial, legislative, institution and socio-economic factors. The issues described below are the possible factors that cause the situation.

(1) Private Sectors engaged in Collection and Transportation are beyond the Control of CCN

There are lots of actors on collection and transportation, especially, the 44 registered private companies and 21 contractors which account for about 95% of the waste collected in Nairobi City and brought to the Dandora Dumpsite. In addition, there are many other actors who illegally operate and are not managed by the CCN. CCN's lack of operation, resources and management capacity seems to make the operation of these actors disorderly. Reorganisation and government control should be mandatory for establishing an appropriate SWM.

(2) Lack of Enforcement or Inspection Capacity in Administrative Bodies

The mandate to waste generators, collectors and transporters, including the mandate to administrators regarding the inspection or monitoring of practices of waste generation and discharge, is clearly stipulated in the law which created the CCN or its By-law. However, the inspection and monitoring seems to be weak. The capacity development of administrators is required to enhance their inspection and monitoring capability.

(3) Inefficient Operation of Collectors and Transporters

It is difficult to state that the collection and transportation practices of actors are efficient because of the poor performance of their vehicles and the fact that they have no compaction tractors and very few dump trucks with a tipping function. In addition, waste pickers tend to disturb the unloading operation of transporters at the Dandora Dumpsite due to the vehicles without a tipping function. This fact also causes the extremely inefficient operation of transporters. The improvement and upgrading of collection and transportation vehicles are required.

(4) Illegal Dumping Sites scattered in a Wide Area

Several illegal dumping sites are scattered in a wide area of the city. Various reasons are presumed such as the absence of garbage containers in those places, the very low collection frequency of collection vehicles, or the residents' weak affordability to pay service collection fee to the CBOs. The installation of containers, improvement of CCN's collection system or the increase of collection frequency is required.

(5) CCN's Delayed Payment to Contractors

It was identified in the Time and Motion Survey that CCN had fallen behind its payment schedule to the subcontractors for nine (9) months with regard to the collection and transportation charges. Accordingly, the surveyor had to rearrange his survey schedule to pursue the subcontractors' claim for payment of collection and transportation charges. This fact indicates that CCN lacks the appropriate implementation capacity on SWM which may be due to the lack of appropriate contractual relationship between CCN and the subcontractors or CCN's weak financial capability which may have affected CCN's social credibility.

(6) Poor Data Management

CCN currently records the amounts of waste brought to Dandora by the incoming collection vehicles by using the existing truck scale. However, the following problems were identified in the survey:

- No data sorting of collected waste amounts by district or collection area
- Late management process in converting raw data into PC files in MS Excel format
- Lack of staff for the management and evaluation of waste collection amounts at Dandora

Therefore, the enhancement of CCN's management capability on data management of collected waste amounts will be necessary.

2.5 3R and Intermediate Treatment

2.5.1 Present Condition of 3R and Intermediate Treatment of SWM

(1) Recovery Flow of Recyclable Material

Recyclable materials in municipal waste are recovered basically in accordance with the flow chart shown in **Figure 2.5.1**. There are three major recovery flows identified in the course of the survey. First, the recyclable wastes stored by the waste generators are recovered by the waste pickers going around the town. Second, recyclable materials are recovered by the waste collection workers in the course of waste collection work. Finally, the waste pickers in the Dandora Dumpsite pick up recyclable materials. In addition to the aforementioned recovery processes, some of the large waste generators of establishments sell wastepaper or plastics through auctions or contract, but the recovered amount of recyclable materials through auction or contract are unknown. Recovery amount will be described in the following sections.

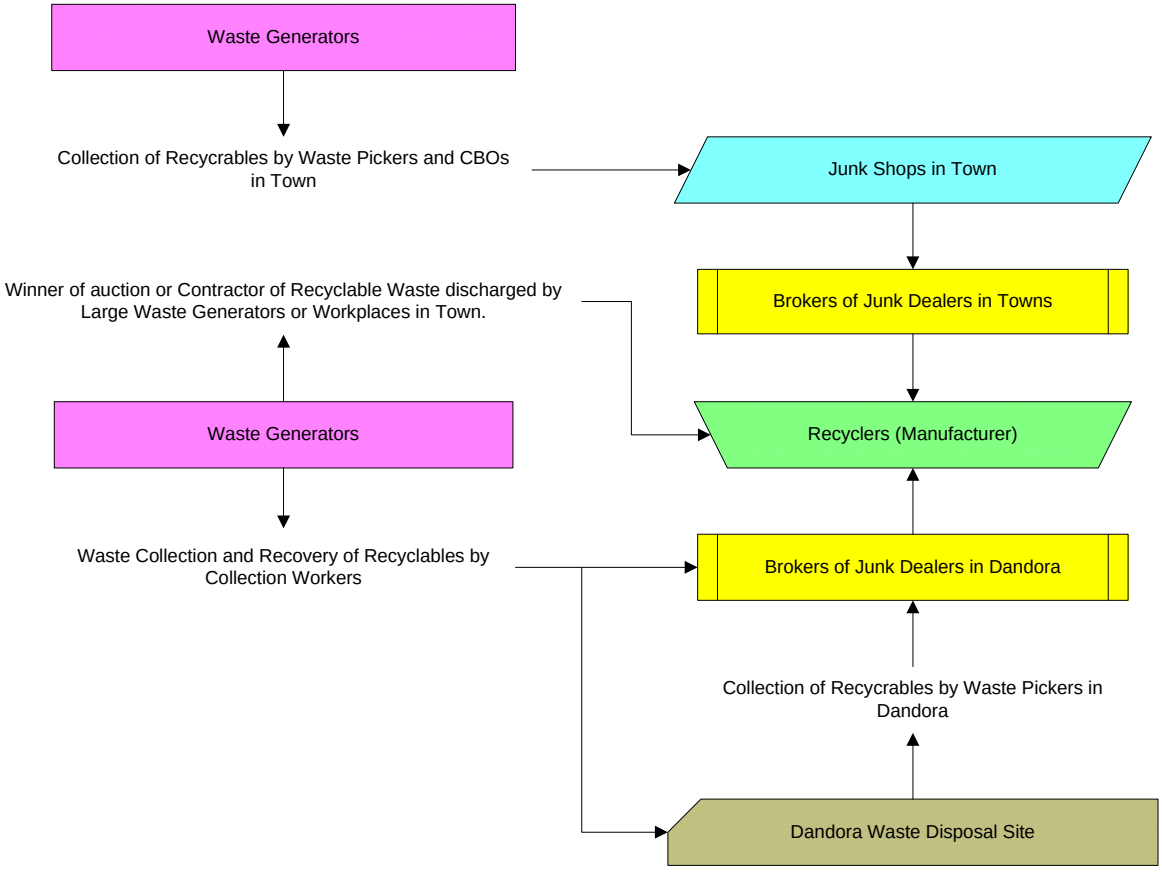


Figure 2.5.1 Recovery Flow of Recyclable Materials at Present

(2) Estimated Recovery Amount of Recyclable Materials

(a) Recovery Amount by Junkshops

The results of the junkshop survey conducted by the local consultant engaged by the JICA Survey Team in January 2010 show that the recovery of recyclable materials by the ten (10) junkshops surveyed reached 41.1 tons per month or 1.37 tons per day in 2009. The major

recyclable materials handled were scrap iron by 9 junkshops and plastics by 7 junkshops. Scrap iron recovered was 103 kg per junkshop followed by plastics at 37 kg per day per junkshop. Aluminum is handled by 3 junkshops and 2 tons per month or 23 kg per day per junkshop have been recovered. The total recovery amount increased from 19.2 tons per month in 2007 to 37.7 tons per month in 2009 excluding the amount of car batteries. Car battery is not recovered through the waste collection services. One of the major recyclable materials, wastepaper, is not handled by the ten (10) junkshops surveyed. (See **Section D of Volume 3, Supporting Report,** for the details) There are many junkshops in Nairobi and it is very difficult to grasp their current recovery activities without any registration or licensing system. Since most of the junkshops sell the recovered recyclable materials to dealers/middlemen because they do not have a channel to sell them directly to the recyclers/factories, the recovery amounts of recyclable materials by junkshops were obtained through the survey on dealers/middlemen.

(b) Recovery Amount by Dealers of Recyclable Materials

The survey was carried out from April to May 2010 on the brokers of junk dealers in the town area and the brokers handling recovered recyclable materials at the Dandora Dumpsite. The survey was made in collaboration with the solid waste supervisors/inspectors of each Division for the first survey and the manager and his staff at the Dandora Dumpsite for the second survey. **Table 2.5.1** shows the result of the survey on the brokers. The survey has not covered all the dealers in Nairobi but it covered the large dealers and most of the recyclable materials handled in Nairobi. Dealers in the town area recovered about 13 tons of recyclable materials per day while the dealers in Dandora recovered 7 tons per day from the waste collection workers and the waste pickers in the Dandora Dumpsite. The survey results show that the total amount of recyclable materials handled by the 43 brokers is approximately 20 tons per day and the actual amount of recyclable materials recovered is a little over the said amount.

Table 2.5.1 Recyclable Materials Recovered by Junk Dealers

Recyclable Materials	24 Brokers Operating in Town (ton/day)	19 Brokers Handling Recyclables from Dandora (ton/day)
Plastics	3.57	2.5
Paper	2.09	2.9
Glass	2.07	0.2
Scrap Metals	5.35	1.1
Others	0.11	0.3
Total	13.19	7.0

(c) Amount of Recyclable Materials used by Recyclers/Factories

According to the data from the Compliance & Enforcement Office, NEMA, there were 17 companies which obtained licenses for recyclers as of December 2009. Fifteen (14) out of the 17 recyclers operate in Nairobi. One company, a glass factory, is not registered but uses recovered glass for its production process. The total amount of recyclable materials reached 148 tons per day. These amounts of recyclable materials were collected from Nairobi and the neighboring provinces. Among the recyclable materials for recycling, scrap metal ranks as the first with 67 tons per day, followed by glass with 50 tons per day.

Table 2.5.2 Amounts of Recyclable Material used by Recyclers/Factories

Recyclable Materials	No. of Recyclers/ Factories in Nairobi with License from NEMA as of December 2009	No. of Recyclers/ Factories Collected Data	Amounts of Recyclable Material used by the 9 Recyclers Surveyed (ton/day)
Plastics	6	4	23
Paper	4	2	8
Glass	0	1	50
Scrap Metals	3	2	67
Others (Oil/Sludge)	1	0	-
Total	14	9	148

(3) Estimated Recovery Amounts of Biodegradable Waste

Some 30 to 50 groups including CBOs, companies and community groups are engaged in the composting of biodegradable wastes from market waste and domestic waste. **Table 2.5.3** shows the compost production amounts ranging from 1.1 to 1.5 tons per day by 15 groups. Generally, the weight of input raw materials becomes about 30% to 35% for final compost production through reduction of water content and rejection of unsuitable materials. Accordingly, input raw materials converted into compost by the 15 groups is estimated at 3.4 to 4.4 tons per day or 0.23 to 0.29 ton per group per day. Assuming that the number of composting groups is 40, the total raw material input is about 9 to 12 tons per day at present.

Table 2.5.3 Estimated Production Amount of Compost and Raw Material Input

No.	Group	Source of Waste for Compost Production	Estimated Production of Compost (kg/month)	Estimated Production (kg/day: minimum)	Estimated Production (kg/day: maximum)
1	Afya Bora Group[*1]	Kawangware Market	600	20	20
2	City Park Environmental Group[*1]	City Park Hawkers' Market	2,500	83	83
3	Mathare Mbolea[*1]	Households	1,000	33	33
4	Huruma Cisa[*1]	Households	1,000	33	33
5	Lunga Lunga[*1]	Households	500	17	17
6	Kayaba-Mwanganza[*1]	Households	600	20	20
7	Kibera Siranga[*1]	Households	300	10	10
8	Ushirika Womens' Group[*1]	Households	200	7	7
9	Kuku Womens' Group[*1]	Households	1,000	33	33
10	Nyayo Market Mbolea Group[*1]	Nyayo Market	600	20	20
11	Eco Holdings Ltd. [*2]	Market & domestic	10- 15 ton/month	333	500
12	Kenya Institute of Organic Farming[*2]	Farm waste & domestic	60-120 ton/year	164	329
13	Kayole Environmental Management Association[*2]	Market & domestic	84 ton/year	230	230
14	PENTA Flowers Ltd.[*2]	Flower waste & coffee husks	24 ton/year	66	66
15	Kibera Public Space Project: New Nairobi Dam Community Group[*2]	Market & domestic	20-24 ton/year	55	66

No.	Group	Source of Waste for Compost Production	Estimated Production of Compost (kg/month)	Estimated Production (kg/day: minimum)	Estimated Production (kg/day: maximum)
	Estimated total amount of compost produced	kg/day		1,125	1,467
	Conversion to Raw Material (Biodegradable Waste)	kg/day		3,375	4,401
	Raw material used per composting group per day	kg/day/group		225	293
	Estimated number of composting group in Nairobi	group/company		40	40
	Estimated amount of raw material used for composting in Nairobi	ton/day in Nairobi		9	12

Source: [*1] JICA, CTI Engineering Co., Ltd. and Environmental Technology Consultants Co., Ltd.: *"The Study on Solid Waste Management in Nairobi City in the Republic of Kenya, Final Report, Volume 4, Supporting Report,"* August 1998, Section G, p. G-50.
[*2] Inventory and Analysis of Users, Producers and Markets for Compost, Biogas and Livestock Feeds, pp. 94-97.

(4) Number of Waste Pickers and CBOs in Waste Management Activities

(a) Number of Waste Pickers in Dandora Dumpsite

The waste pickers survey conducted by CCN through its staff at the Dandora Dumpsite identified a total number of 611 persons (see **Section F of Volume 4, Data Book**) belonging to five self-help groups, and some of the waste pickers work independently. The identified number of waste pickers is about half of the total number of waste pickers. The total number of waste pickers in Dandora is about 1,200 to 1,500 persons and a half of them pick up recyclable materials frequently. However, the information on waste pickers is limited so that a detailed interview survey and registration will be required.

(b) Number of CBOs for Waste Collection and Recovery of Recyclable Waste

The Community Development Section of the Social Services and Housing Department, CCN, listed 64 self-help groups in Nairobi conducting social-related activities including waste collection, environmental activities, cleanup, sports, etc. (See **Section D of Volume 4, Data Book**). The Environmental Planning and Management Division, Department of Environment, CCN, had listed 140 CBOs (See **Section F of Volume 4, Data Book**) conducting solid waste management activities. Most of them do waste collection in the narrow streets and bring the wastes to the collection points for CCN/contractors' vehicles. They are also engaged in the recovery of recyclables from discharged waste. Some of the CBOs in the two lists are duplicated but approximately 200 CBOs are involved in waste management in Nairobi. The effectiveness of the activities of these CBOs should be taken into consideration in the systematic solid waste management in Nairobi.

(5) Number of Recyclers for the Composting Activity

The Compliance and Enforcement Office, NEMA, has an inventory of waste handlers licensed under the Waste Management Regulations of 2006. As of April 2010, 26 companies were registered as licensees (See **Section D of Volume 3, Supporting Report**). Among them only two companies are registered in Nairobi and the rest are registered in the provincial areas. The promotion of registration of more companies and/or groups in Nairobi may be required.

(6) Potential Amount of Recyclable Materials and Biodegradable Waste

Table 2.5.4 shows the result of weighted average of domestic waste in the composition survey conducted by the local consultant engaged by the JICA Survey Team. Domestic waste in Nairobi consists of 91.2% organic waste, 8.4% of inorganic waste and 0.4% of domestic hazardous waste and unclassified waste.

Table 2.5.4 Results of Waste Composition Survey (Weighted Average of Domestic Waste)

Waste Composition			Weighted Average (%)
1	Food Waste		62.37
2	Paper	Recyclable Paper	4.15
3		Recyclable Cardboard	0.31
4		Mixed Paper	1.89
5		Diapers	7.61
		Subtotal-Paper	*13.96*
6	Plastics	Plastic Sheet	7.13
7		Recyclable Plastics	3.14
8		PET Bottles	0.46
9		Other Plastics	0.21
		Subtotal-Plastics	*10.93*
10	Rubber and Leather		0.81
11	Textiles		1.58
12	Yard Waste		0.35
13	Lumber and Logs		0.73
14	Other Organic Waste		0.43
	Total-Organic Waste		**91.16**
15	Glass	Returnable Bottles	0.31
16		Other Live Bottles	0.97
17		Glass Bins	0.00
18		Broken Glass	0.22
		Subtotal-Glass	*1.50*
19	Metals	Scrap Iron, Tins & Cans	0.10
20		Aluminum Cans	0.04
21		Copper	0.00
22		Other Metals	0.60
		Subtotal-Metal	*0.74*
23	Dirt, Ash, Stone, Sand		6.15
	Total-Inorganic Waste		***8.39***
24	Unclassified Residual Waste		0.29
	Domestic Hazardous Waste		0.00
25	Batteries - Dry Cells		0.04
26	Other Domestic Hazardous Waste		0.13
	Grand Total		**100.00**

From the viewpoint of recovery of recyclables in waste, the major types of recyclable materials were listed, as shown in **Table 2.5.5,** together with the data of the JICA SWM Master Plan 1998. The commingled ratio of the major recyclable materials is almost the same as the result in 1998 except for glass and metals, which are currently recovered more actively. These comingled ratios

shall be considered as the potentially available target ratio of resource recovery from the municipal waste in Nairobi.

Table 2.5.5 Comparison of Percentages of Potential Recyclable Materials in Domestic Waste

(Unit: %)

Waste Type	JICA SWM Master Plan 2010*	JICA SWM Master Plan 1998
Paper	14.0	10.5 – 19.1
Plastics	10.9	4.1 – 16.1
Glass	1.5	1.5 – 3.8
Metals	0.7	1.3 – 4.2
Food Waste	62.4	48.6 – 67.0

Note: *Percentage showing in this row is indicated as weighted average.

2.5.2 Evaluation of Current 3R and Intermediate Treatment of SWM

(1) Evaluation of Current 3R Activities

The term 3R as defined herein stands for Reduce, Reuse and Recycling. The current state of 3R in Nairobi is to be evaluated in the following subsections.

(a) Circumstance of Waste Reduction

It seems that the term "waste reduction" is misinterpreted in Nairobi as "recovery, reuse, recycling and reduction of waste amount for final disposal," which can be interpreted as waste diversion. Waste generation amount per capita is not so high in Nairobi and it may be a challenging scheme to conduct the waste reduction plan. However, there are still some spaces to reduce waste generation amount through avoiding excessive use or saving consumable goods, repairing and reuse of commodities.

(b) Circumstance of Waste Recovery

Resource recovery from the municipal solid waste is practiced by the waste pickers going around town and in the Dandora Dumpsite, the waste collection vehicle workers and the junkshops, dealers/middlemen, and finally recycled by the recyclers/factories. The current recovery ratio of recyclable materials is estimated at approximately 5% through the survey on junkshops, dealers/middlemen and recyclers/factories. However, the sorting of recyclable materials at waste generation sources, residential houses and workplaces is not taking place with the social movement. The major items of resource recovery are paper, plastics, glass and metals. In addition, other materials such as bones, shoes, onion net, etc., are recovered though the recovery amount is little. The waste composition survey shows 27% as the ratio of recyclable materials in municipal waste in the total amount of paper, plastics, glass and metals. Considering the present ratio of resource recovery and the potential amount of recyclable materials in the discharged waste, attaining the total recovery ratio of 15% will be possible through sorting of recyclable materials at generation sources and the resource recovery programmes involving all the stakeholders concerned.

(c) Circumstance of Reuse

Based on the results of the waste composition survey, the commingled ratio of reusable commodities is almost zero. People in Nairobi, especially the low income group families, are practicing reuse as a natural daily activity. Secondhand clothes and shoes are usually sold at the hawkers' markets. However, there still exist waste generation groups such as the high

income group and workplaces targeted to promote reuse or use of items over and over again, even the repaired ones, for the reduction of waste discharge amount.

(d) Circumstance of Recycling

The recycling of paper, plastics, glass and metals is being practiced in Nairobi. Some nine (9) recyclers surveyed are using four major recyclable materials of 148 tons per day for their manufacturing process. The plant capacity of these recyclers has some more room to use more recyclable materials through manufacturing depending on the demand. The Ministry of Industrialisation is promoting the plan to formulate a policy on waste utilisation in industry, which is in line with the Kenya Vision 2030. The Draft Policy on Waste Utilisation in Industry issued in February 2010 by the National Steering Committee describes mainly the introduction and situation analysis, but no policy statement is included in the report. Resource recovery and recycling plans shall be formulated as among the main programmes of 3R to save finite resources, reducing the amount of waste collection and disposal thereby reducing the cost of solid waste management. Accordingly, the resource recovery and recycling plan shall be formulated in line with the policy on waste utilisation in industry.

(2) Evaluation of Current Intermediate Treatment Activities

(a) Circumstance of Composting Activities

As mentioned in the preceding section, there are 30 to 50 groups engaged in composting. Many groups use biodegradable waste derived from market and domestic wastes and the raw material input reaches about 10 tons per day. More amounts of compost by the composting groups will reduce waste amount discharge and save on waste collection cost of CCN in the long run. In view of the higher ratio of food waste mixed in municipal waste, on-site composting by composting groups shall be promoted for the integrated solid waste management in Nairobi. However, the activities of these composting groups are not always grasped by CCN and the group companies/CBOs are not registered with NEMA for licensing as recyclers. Identification and linkage of the composting groups will be the key to involve them in the treatment of more biodegradable waste.

According to the Report "Horticulture Industry in Kenya 2005" by the Export Processing Zone Authority (EPZA) of Kenya[6], horticulture has grown in the last decade to become a major foreign exchange earner, employer and contributor to food needs in the country. Horticulture including the production of fruits, vegetables and cut flowers are the main aspects of horticulture in Kenya. The horticulture industry is the fastest growing agriculture subsector in Kenya recently ranked third in terms of foreign exchange earnings from exports or over USD300 million a year.

The horticulture farming area in the vicinity of Nairobi reported in the JICA Master Plan in 1998 indicated a little over 100,000 hectares[7]. Potential demand of compost was estimated at 1 million tons per year or 2,700 tons per day. The JICA Survey Team estimated that the maximum production amount of compost is 1.5 tons per day only from the identified 15 composting groups. In addition, no enterprise was identified to run a compost production business. Organic fertiliser derived from chicken manure and cow manure is also used together with chemical fertilisers by the farmers in Kenya. However, organic fertiliser cannot be a substitute to compost for maintaining the healthy condition of soil. In conclusion, the potential demand for compost is enormous in the vicinity of Nairobi and supply of compost will contribute to the further growth of horticulture in Kenya.

(b) Circumstance of Incineration of Hazardous Waste

Incineration facilities in Nairobi are listed up in **Subsection 2.10.2**. Five incinerators have been identified doing combustion of hazardous waste from hospital waste, pharmacy companies, and factories generating hazardous waste. The total incineration capacity of the five companies is about 4.5 tons per hour and about 90-150 tons are treated per month. Currently, hazardous waste treatment relies on the services provided by the private companies. After the combustion of hazardous waste, residuals or ashes are disposed at the Dandora Dumpsite. CCN is responsible for the treatment and disposal of hazardous waste generated by the medical facilities and the factories. However, considering the present situation, the new sanitary landfill site shall have a separate cell to accept residuals from the hazardous waste incinerators and a special tipping fee shall be charged until the time the central hazardous waste disposal facility is constructed by the agency concerned.

(3) Issues on the Implementation of 3R and Intermediate Treatment Plan

The issues under this item are the matters for CCN to conquer for taking initiatives to implement the 3R and intermediate plan through obtaining support/cooperation of the stakeholders. The relevant issues are as summarised below.

(a) Issues on the Initiation of 3R Activities by CCN

The issues under this item are related to the institutional setup of CCN and the raising of awareness or cooperation of waste generators towards enhancement of the 3R activities.

- Clear policies, purpose and strategies of 3R by CCN and the government agencies
- Outlook on the future potential/activities of recycling by the government agencies
- Determination of target resources and target level of recovery and recycling
- Involvement of waste generators, junkshops, dealers and recyclers to increase recovery of recyclable materials in waste
- Raising awareness of waste generators to reduce waste generation amount against the tendency of consumption in daily life.

(b) Issues on Recovery of Recyclable Materials and Biodegradable Waste

- Activation of current inactive status of source segregation by the waste generators including residents, commercial shops, institutional buildings, etc.
- Promotion of separate collection of segregated recyclable waste by CBOs, junkshops and/or junk dealers, and/or the support of CCN to transportation on demand and minimum charges.
- Promotion of segregation of food waste and garden waste for on-site composting.

(c) Issues on the Setup of Waste Bank/Buy-Back Centre for Waste Recovery

The current situation of recovery of recyclable materials by waste generators is not always active due to the lack of recovery system attracting or giving benefits to the people. The waste bank system which is considered as one of the solutions to activate the waste recovery implicates the following issues to initiate the programme:

- Possibilities for CCN or CBOs/NGOs/NPOs or other organisations to be the owner and/or operator of the waste banks or buy-back centres or a similar system where junkshop activities are relatively low.

- Support of CCN or the government agency(s) concerned to stabilise the buying/selling price of recyclable materials.

(d) Issues on the Development of Intermediate Facilities

Development of intermediate facilities will bring about the stabilisation of disposed waste and the reduction of health risks and/or environmental deterioration caused by solid waste. However, the financial burden will become a bottleneck on construction, operation and management. To establish the intermediate treatment system, the following issues shall be resolved by CCN:

- Alternative methods of intermediate treatment including waste to energy concept and composting.
- Technical and financial capability of CCN to implement the project for development of intermediate treatment facilities.
- Possibilities of private sector, CBOs, NGOs or other organisations to be by-players and/or the primary players in the development project of intermediate treatment facilities.
- Financing agency to offer loan for the project and the borrowing capacity of CCN.

(e) Issues on the Implementation of Composting

Composting of biodegradable waste is considered as the most practical way for intermediate treatment in view of the characteristics of municipal waste in Nairobi. However, implementing the project for composting requires the following actions:

- Formulation of practical implementation plan of CCN to promote home composting, community level composting and central composting.
- Provision of sufficient information on home composting, community level composting, and central composting activities by the residents, CBOs/NGOs/NPOs, CCN, etc.
- Promotion of home composting in residential houses.
- Involvement of CBOs, NGOs or other groups in the implementation of community composting.
- Implementation of a pilot project for central composting.
- Possibilities of segregation of biodegradable wastes by tenants of city markets.
- Possibilities of full-scale central composting using market waste and biodegradable wastes from the entire city.
- Preparation of database on cultivation area by type of crop, cropping pattern, vegetable farm, orchard, coffee farm, tea farm, pastures, horticulture farms, city park, reserved forests, national park in Nairobi and neighboring areas.
- Estimation of demand/consumption/supply of organic fertiliser, compost, chemical fertiliser in Nairobi and neighboring areas.
- Benefits for using compost for farming.

2.6 Final Disposal

2.6.1 Present Condition of Final Disposal in SWM

The Dandora Dumpsite is the only official dumpsite currently operating in Nairobi and waste collected in the city is dumped there. However, there are also approximately 70 illegal dumpsites scattered throughout the city and wastes collected by private collectors are dumped at those sites. Also, in slum

areas and low income residential districts, waste is dumped by the roadsides and in vacant spaces. The Kayole temporary dumpsite serves as a temporary site for disposing waste picked up from Nairobi River, etc. The Kayole temporary dumpsite is managed by NEMA and city waste from Nairobi is not supposed to be dumped there. In reality, however, waste is dumped there by private collectors.

In this subsection, the current condition of the Dandora Dumpsite and the Kayole temporary dumpsite is gauged with a view to identifying the problems and issues that confront final disposal in Nairobi. Details regarding the condition of illegal dumpsites are given in the section on collection and transportation.

(1) Present Condition of Dandora Dumpsite

(a) Outline of the Situation

The Dandora Dumpsite is located in the northeast side at about 7.5 km away from the central part of Nairobi. The geographical feature before the use of Dandora Dumpsite Area presents a quarry (Area: Approximately 2 ha) in the north-western part. The depth of the quarry was about 20~30m. Other ranges consist of grounds inclining gently toward the Nairobi River.

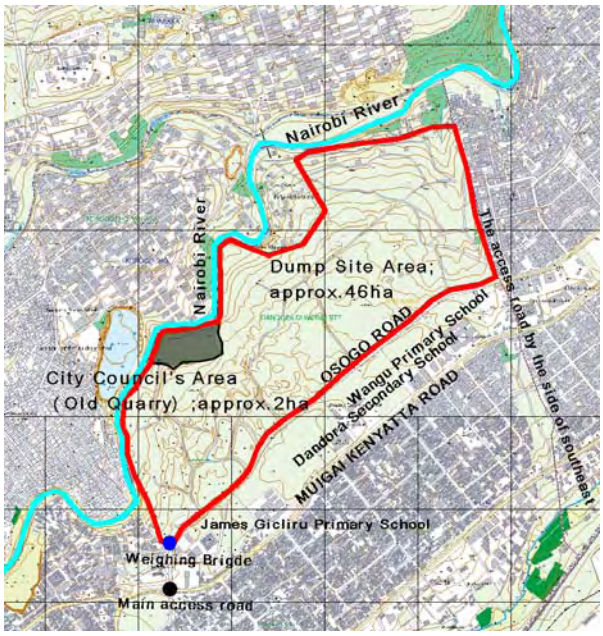


Figure 2.6.1 Location of Dandora Dumpsite

The landfill at the Dandora Dumpsite began in 1981, and is still currently being used. The total area covered by waste in Dandora is about 46 ha. Approximately 2 ha of the quarry in the western part of the total area is part of the City Council's disposal site, while the rest of the land is private land. The overall area of Dandora is as shown in **Figure 2.6.1**.

(b) Description of Current Condition

(i) Waste Amount

Since 2006 the amount of waste brought into Dandora has been weighed by the weighing bridge, as shown in **Figure 2.6.1**. The total amount of waste brought in 2009 was about 220,000 tons/year. (For details, refer to **Section A of Volume 3, Supporting Report**)

From the analysis on the actual measurement of weight from 2006 to 2009, the total amount of reclaimed waste was estimated with respect to the population transition from 1981 to 2009. Approximately 3,550,000 tons of waste were reclaimed from 1981 to 2009, a total of 29 years. Estimated results are shown in **Table 2.6.1**.

The total area of the Dandora Dumpsite is 46 ha. Additionally, according to the measurements undertaken during the present study, the average height of waste landfill is around 3 m. Also, part of the Dandora Dumpsite was an old quarry and the average height of landfill in that area is estimated to be around 20 to 30 m.

Making an estimation based on the characteristics of the Dandora Dumpsite (total area and average height of the landfill) the total waste amount in the dumpsite is assumed around 1,800,000 m^3 (20,000m^2 × 25m + 440,000m^2 × 3m = 1,820,000m^3).

Table 2.6.1 Total Waste Amount at Dandora Dumpsite

Year	Waste Amount (ton)	Remarks
1981 to 2005	2,800,000	Estimated*
2006	145,000	Actual
2007	187,000	Actual
2008	193,000	Actual
2009	222,000	Actual
TOTAL	**3,547,000**	

Note: * The waste amount at Dandora Dumpsite between 1981 and 2005 is estimated based on the population data of Nairobi (Table 4.2.1) and measurement records of waste carried in the Dumpsite after 2006 to 2009.

(ii) Waste Composition

Different types of waste have been transported to the Dandora Dumpsite. Almost half of the waste generated in Nairobi City is food waste according to the WACS; hence, it is safe to say that around half of the waste transported to the Dandora Dumpsite will be composed of Food Waste. The other half of the waste will be composed of paper, plastics etc., and a small amount of medical waste with some degree of Intermediate Treatment. For details of waste composition, refer to **Section A of Volume 3, Supporting Report (Waste Generation and Composition Analysis)**.

(iii) Landfill Method

At the Dandora Dumpsite, after weighing by the weighing bridge which is located at the entrance to the landfill, dumping is done at any possible location. After dumping, no action to flatten the waste by bulldozer is carried out and no covering of soil is done. Moreover, no gas exhaust equipment and leachate drain is installed in the landfill area. From the above description, the landfill method at the Dandora Dumpsite is said to be the open dumping system.

The present situations of landfill at the Dandora Dumpsite are as shown in **Photo 2.6.1**.

Photo 2.6.1 Situations at the Dandora Dumpsite

(iv) Management Organisation and Administrative Staff

The management of Dandora Dumpsite is done under the Solid Waste Management Section of the Department of Environment (DoE). The list of management staff is given in **Table 2.6.2**. As the table shows, there are 12 management staffs including the Dumpsite Manager of the Dandora Dumpsite. According to the field survey findings, the weighing of waste is carried out and the records are consolidated in the Dumpsite Manager's Office. Moreover, waste dumping positions are instructed at the entrance gate. However, no evidence of waste compacting and so on could be confirmed.

Table 2.6.2 Staff Allocation of Dandora Dumpsite

Scales	Position	Work Description	Number
8	Env. Officer I	Dumpsite Manager	1
9	Env. Officer II	Deputy Dumpsite Manager	1
13	Env. Assistant III	Clerk (Computer Operation)	2
16	Artisan III	Supervisior of machine operating at the site	4
17	Ungraded Artisan	- Washing weighbridge, cleaning of the office that control trucks - Control of illegal dumping along access roads	1 2
18	Labourer II	Messenger Dandora-Kaloleni-City Hall	1

(v) Machinery for Landfill Operation

The city council owns 4 units of bulldozer. However, since 2007, these have been grounded and only 1 unit was repaired in 2010. The present landfill activity is being managed by two subcontracted corporations. Operation is carried out using 2 bulldozers and 1 excavator.

(vi) Annual Administrative and Maintenance Expenditures

For the maintenance and management of the Dandora Dumpsite, the expenses shown below are necessary:

- Salary of administrative staff
- Heavy machine fuel and maintenance
- Machine hiring fee
- Weighing bridge maintenance fee
- Road maintenance fee

Annual maintenance expenses were incurred for the city's machinery used in the landfill operations up to the year 2006. Since landfill operations were subcontracted to private enterprises starting in 2007, two sorts of annual maintenance expenses were prepared, as shown in **Tables 2.6.3 and 2.6.4.** In the first case, two units of the city's heavy machinery were operational while in the other case, two heavy machinery of the private subcontractor were operational.

On comparing the costs of heavy equipment between 2006, when CCN equipment was used, and 2009, when equipment was leased from the private sector, the latter cases were around three times more expensive at KSh 35 million. Furthermore, looking at monthly payments to the private sector in 2009, the ability to pay is thought to be inadequate because there were months when zero payments were made (See **Section E of Volume 3, Supporting Report** for details on private sector consignment costs in 2009). Concerning the reason for this, since the cost of maintaining heavy machinery accounts for roughly one-tenth of the DoE SWM budget, it is impossible to pay any more. Accordingly, in

order to properly operate heavy machinery without causing budget pressure, it will be necessary to repair the four heavy machines owned by the CCN and to stop leasing machinery from the private sector as quickly as possible.

Table 2.6.3 Annual Expenditures for Dandora Dumpsite Operation (2006)

No.	Expenditure	Amount (KSh)
1	Total Salary	3,100,000
2	Heavy Machine Fuel And Maintenance	8,600,000
3	Weighing Bridge Maintenance Fee	3,000,000
4	Road Maintenance Fee	10,000,000
5	Heavy Machine Repair Fee	1,600,000
	Total Expenditures	26,300,000

Source: Department of Environment and City Council of Nairobi

Table 2.6.4 Annual Expenditures for Dandora Dumpsite Operation (2009 Machine Hiring)

No.	Expenditure	Amount (KSh)
1	Total Salary	3,100,000
2	Machine Hiring Fee	35,000,000
3	Weighing Bridge Maintenance Fee	3,000,000
4	Road Maintenance Fee	10,000,000
	Total Expenditures	51,100,000

Source: Department of Environment and City Council of Nairobi

(vii) Environmental Situation of Dumpsite and Surrounding Area

The landfill gases produced by waste decomposition cause an ill effect on the workers as well as the residents nearby the dumpsite. The leachate water from the dumpsite is estimated to be one of the causes of water pollution of the Nairobi River. With regard to the environmental condition of the final disposal site and the surrounding area, reference should be made to **Section G of Volume 3, Supporting Report**.

(viii) Current Situation of Waste Pickers

As shown in **Photo 2.6.1,** approximately 1,500 waste pickers active in Dandora Dumpsite extract "valuables" from the waste. As for the current situation of waste pickers, reference should be made to **Section G of Volume 3, Supporting Report**.

(2) Present Condition of Kayole Temporary Dumpsite

(a) Outline of the Situation

The Kayole temporary dumpsite is located in the east side at about 13 km from the central area of Nairobi and south of the Dandora Dumpsite. On the southern reaches of the Ngong River there are 9 quarries located along the river and one of these quarries is currently being used as a dumpsite. The landfill at the dumpsite began in 2009. For this project it was planned to use the 3 pre-established quarries located in that area as temporary dumpsites. However, during the site inspection, it was noted that 2 of those quarries had accumulated a great amount of water, rendering the area not suitable for waste disposal. There are some residential areas located in the northern side of the Ngong River, and to the south of the Quarry Area the Embakasi Garrison is located. **Figure 2.6.2** and **Photos 2.6.2 and 2.6.3** show the current situation of the temporary dumpsite at Kayole.

(b) Description of Current Condition

The quarry being used as landfill covers an area of 4 hectares. With a depth of 23m, the volume of the pocket is estimated to be around 92 million cubic m^3. The on-site investigation revealed that the bedrock is exposed and there was no water filtration on the walls. The bedrock has a low permeability, based on the site observation. The presence of water filtration through some fissures in the bedrock was not confirmed because only a partial part of the water pond could be inspected.

At the Kayole temporary dumpsite, after measurement by the temporary weighbridge, the waste is carried and dumped into the bottom of the quarry. The total amount of waste carried into the dumpsite in a day is approximately 400 tons, and waste is composed of river cleansing waste and municipal solid waste. In the landfill area, no gas exhaust equipment and leachate drain facilities have been installed. There are 10 to 20 waste pickers at the site and some people do stonecutting work.

In addition, although the information gathered point to the existence of three quarries at the temporary dumpsite, landfill operation is actually performed in only one place. The other two quarries are in a state where water has accumulated at the bottom, and in one of them is being used for dumping surplus soil from construction works.

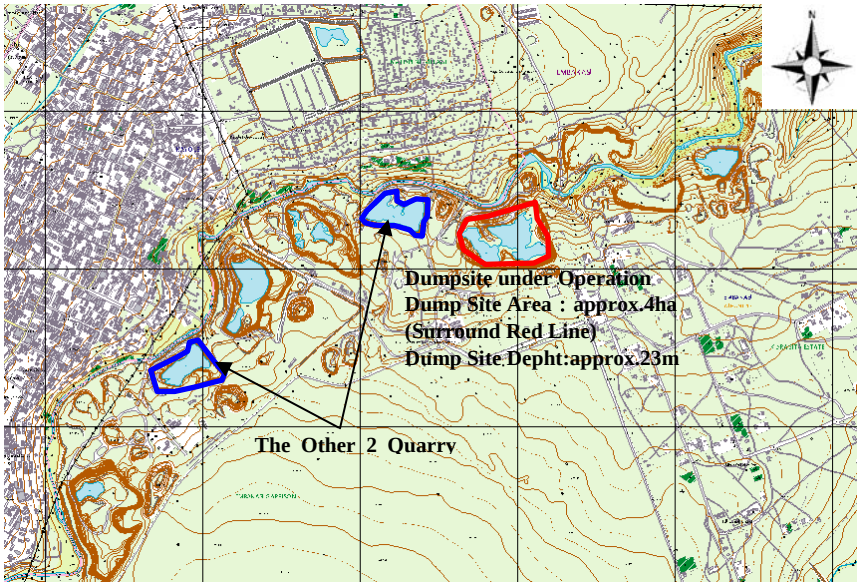
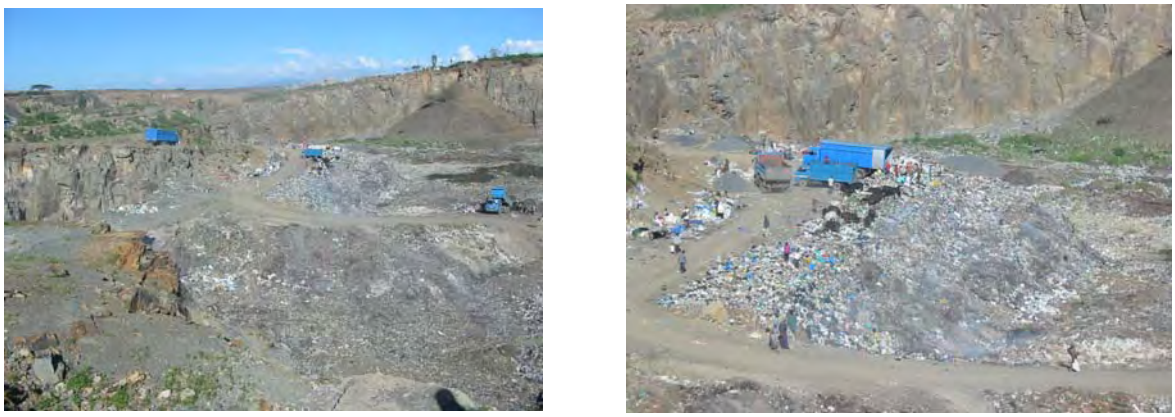


Figure 2.6.2 Location of Kayole Temporary Dumpsite



Temporary Dumpsite at Quarry

Photo 2.6.2 The Kayole Temporary Dumpsite (1)

The other 2 quarry sites

Photo 2.6.3 The Kayole Temporary Dumpsite (2)

2.6.2 Evaluation of Final Disposal Sites

(1) Evaluation of Dandora Dumpsite

The following problems were identified in the survey at the Dandora Dumpsite:

- Covering of soil to maintain the dumpsite in a sanitary condition was not made.
- Large amounts of landfill gas are generated in some parts of the dumpsite because no gas exhaust equipment or leachate drain was installed.

In addition, the following maintenance issues were also identified:

- The contractors hired for landfilling work because of the breakdown of CCN's heavy rquipment were not paid adequately.
- Accordingly, sufficient landfill work was not made.

Therefore, measures such as soil covering, provision of heavy equipment for landfilling work and protection from gas emission will be required, urgently.

(2) Evaluation of Kayole Temporary Dumpsite

No adverse impact on the surrounding environment such as the generation of landfill gas was identified in the Kayole temporary dumpsite. However, its landfill is in the same situation as that of the Dandora Dumpsite and it cannot be said that enough maintenance has been carried out. Therefore, the same measures such as soil covering and installation of gas exhaust equipment will be required as in Dandora. Also there is the possibility that there are fissures in the bottom of the quarry, allowing the flow of contaminants that might affect underground water deposits.

2.7 Public and Establishments' Awareness on SWM

2.7.1 Present Condition of Public and Establishments' Awareness on SWM

(1) Public and Establishments' Awareness Survey

The Public and Establishments' Awareness Survey was conducted by a local consultant, the Environmental Cost Management (EMC) Centre Limited. The purpose of the survey was to obtain the following features in relation to the awareness of the public and establishments on solid waste management in Nairobi City:

- General and detailed information on solid waste management and cleansing practices and services in Nairobi City
- Actual practices on solid waste management at the households and establishment level
- Behaviour of households and establishments toward solid waste management
- Affordability and willingness to pay for solid waste management services
- Current perception of the public and establishments toward solid waste

(a) Household Survey

To grasp the level of awareness among the households, a sample size of 250 respondents from the five (5) income group areas of Nairobi City, namely; (i) High income group area; (ii) Middle income group area; (iii) Low-Middle income group area; (iv) Low income group area; and (v) Slum area, were used. The main results are shown in the table below.

Table 2.7.1 General Findings of the Public Awareness Survey

Questions	High Income	Middle Income	Low-middle Income	Low Income	Slum
Existence of waste collection service	Yes: 88% No: 12%	Yes: 78% No: 12% Not known: 10%	Yes: 62% No: 30% Not known: 8%	Yes: 34% No: 54% Not known: 12%	Yes: 24% No: 64% Not known: 12%
Methods of collecting discharged waste					
(a) Door-to-door :by vehicles	(a) 67 %	(a) 63 %	(a) 13%	(a) 0%	(a) 0%
(b) Door-to-door by workers	(b) 23 %	(b) 29 %	(b) 39 %	(b) 11%	(b) 0%
(c) Residents carry to collection point	(c) 8%	(c) 6%	(c) 48%	(c) 78%	(c) 100%
(d) Collection from building dust chute	(d) 0%	(d) 3%	(d) 0%	(d) 0%	(d) 0%
(e) I do not know	(e) 3%	(e) 0%	(e) 0%	(e) 11%	(e) 0%
Point of waste discharge from the house:					
(a) Into containers to be collected by workers	(a) 54%	(a) 76%	(a) 52%	(a) 52%	(a) 6%
(b) Around the premises without container	(b) 12%	(b) 2%	(b) 16%	(b) 4%	(b) 12%
(c) Communal container	(c) 4%	(c) 4%	(c) 8%	(c) 4%	(c) 22%
(d) Discharge point	(d) 4%	(d) 12%	(d) 2%	(d) 2%	(d) 2%
(e) Compartment fixed in the house	(e) 20%	(e) 0%	(e) 10%	(e) 30%	(e) 54%
(f) Others	(f) 6%	(f) 6%	(f) 12%	(f) 8%	(f) 4%
Person responsible for waste discharge from the house:					
(a) Housewife	(a) 54%	(a) 42%	(a) 46%	(a) 38%	(a) 40%
(b) The master	(b) 4%	(b) 10%	(b) 10%	(b) 34%	(b) 32%
(c) Children	(c) 2%	(c) 8%	(c) 16%	(c) 12%	(c) 4%

Questions	High Income	Middle Income	Low-middle Income	Low Income	Slum
(d) Other house member (e) Housekeeper (f) Others	(d) 0% (e) 36% (f) 4%	(d) 4% (e) 30% (f) 6%	(d) 0% (e) 24% (f) 4%	(d) 0% (e) 10% (f) 6%	(d) 0% (e) 8% (f) 16%
Satisfaction with the waste collection service	Yes: 80% No: % Average: 11% Not known: 2%	Yes: 56% No: 18% Average: 26% Not known: 0%	Yes: 35% No: 35% Average: 29% Not known: 0%	Yes: 18% No: 24% Average: 59% Not known: 0%	Yes: 8% No: 75% Average: 17% Not known: 0%
Reasons why not satisfied with the collection service: (a) Frequency of collection is low (b) Collection time is irregular (c) Collection time early or late (d) Behavior of worker is very bad (e) Collection work is very crude (f) Collection fee is very expensive	 (a) 0% (b) 67% (c) 33% (d) 0% (e) 0% (f) 0%	 (a) 0% (b) 67% (c) 33% (d) 0% (e) 0% (f) 0%	 (a) 9% (b) 36% (c) 18% (d) 27% (e) 9% (f) 0%	 (a) 20% (b) 10% (c) 20% (d) 40% (e) 0% (f) 10%	 (a) 22% (b) 11% (c) 0% (d) 1% (e) 22% (f) 33%
Guidance received on proper waste discharge	Yes: 56% No: 44%	Yes: 36% No: 64%	Yes: 16% No: 84%	Yes: 10% No: 90%	Yes: 16% No: 84%
Willingness to participate in cleaning campaign	Yes: 82% No: 14% Not known: 4%	Yes: 54% No: 44% Not known: 2%	Yes:42% No: 54% Not known: 4%	Yes: 48 % No: 52% Not known: 0%	Yes:18% No: 80% Not known 2%
Participation in public education programme on SWM	Yes: 34% No: 66%	Yes: 20% No: 80%	Yes: 36% No: 64%	Yes: 28% No: 72%	Yes: 38% No: 62%
Awareness on whether insects breed in the solid waste	Yes: 56% No: 44%	Yes: 36% No: 64%	Yes: 42% No: 58%	Yes: 52% No: 48%	Yes: 72% No: 28%
Awareness on recyclable materials	Yes: 86% No: 14%	Yes: 90% No: 10%	Yes: 84% No: 16%	Yes: 78% No: 22%	Yes: 64% No: 36%

The main findings of the household survey are as follows:

(i) Eighty-eight percent (88%) of the respondents from the high income area manifested that they have collection services followed by 78% from the middle and 62% from the low-middle income area. As for the respondents from the low income and slum areas, the figures are 34% and 24% respectively.

(ii) Sixty-seven percent (67%) of the respondents from the high income and 63% from the middle income area manifested that they receive door-to-door collection by vehicles. As for the respondents from the low-middle income, low income and slum areas, 48%, 78% and 100%, respectively, manifested that they carry these waste to the collection point by themselves.

(iii) When questioned on the point of waste discharge from their houses, most respondents from the high income area (54%), middle income area (76%), low-middle and low income areas (52%) manifested that they deposit their waste into containers that are later collected by workers. As for the respondents from the slum area, most of them answered that they put their garbage into a compartment fixed in their houses.

(iv) The housewives are the main persons responsible for waste discharge from houses, with 54% from the high income, 42% from the middle income, 46% from the low-middle, 38% from the low income and 40% from the slum area, respectively.

(v) Eighty percent (80%) of the respondents from the high income and 56% from the middle income areas are satisfied with the collection service. However, only 18% and 8% of respondents from the low income and slum areas are satisfied with the service, respectively. Most of the unsatisfied respondents from the low income area mentioned as the main reasons of dissatisfaction are the bad behaviour of workers (44%), followed by the low frequency of collection (20%). Thirty-three percent (33%) of the dissatisfied respondents from the slum area indicated that the collection fee is expensive followed by 22% who said that the collection frequency is low.

(vi) Most of the respondents who receive guidance on proper discharge are from the high income area (56%), however, this figure is as low as 16% from the slum area.

(vii) Eighty-two percent (82%) of the respondents from the high income, 54% from the middle income area and 48% from the low income area are willing to participate in cleaning campaigns but only 18% from the slum area want to participate.

(viii) A high number of the respondents in all areas had not participated in any public education programme, where the highest figure occurs in the middle income with 80% of the respondents and 72% in the low income.

(ix) The highest number of respondents who said that there are insects breeding in their domestic waste areas come from the slum area with 72% and the lowest is from the middle income area with 36%.

(b) Establishment Awareness Survey

A total of 67 samples were selected, from which 57 are commercial establishments and institutions and 10 are hospitals. The results are summarised in the tables below.

Table 2.7.2 General Findings of the Commercial Establishment and Institution Survey

Questions	Answers
Point of waste discharge from the establishments: (a) Into containers to be collected by worker (b) Around the premises without container (c) Communal container (d) Discharge point (e) Compartment fixed in the company (f) Others (chute system, etc.)	 (a) 26% (b) 4% (c) 16% (d) 21% (e) 23% (f) 11%
Contract with entity for waste collection (a) CCN (b) Private company	 (a) 49% (b) 51%
Guidance received on proper waste discharge	Yes: 14%; No: 86%
Degree of satisfaction with the waste collection service	Yes: 58%; No: 18%; Average: 25% Do not know: 0%
Reasons why not satisfied with the collection service: (a) Frequency of collection is low (b) Collection time is irregular (c) Collection time is very early or late (d) Behavior of worker is very bad (e) Collection work is very crude (f) Collection fee is very expensive	 (a) 30% (b) 10% (c) 10% (d) 20% (e) 10% (f) 20%
Willingness to participate in cleaning campaign	Yes: 22.8%; No: 73.7%; Do not know: 3.5%

The main findings of the commercial establishment and institution survey are as follows:

(i) Majority of the respondents place their waste into containers that are later collected by workers (26%) followed by those who deposit waste in the compartment fixed in the company building (23%).

(ii) Fifty-one percent (51%) of the respondents have a contract for waste collection with a private company while 49% is with CCN.

(iii) A high rate (86%) of the respondents had never received instruction on proper waste discharge.

(iv) Fifty-eight percent (58%) of the respondents are satisfied with the collection service. Most of the respondents indicated that the main reason of their dissatisfaction is related to the low frequency of collection (30%).

(v) A high number of the respondents (74%) are not willing to participate in a cleaning campaign.

Table 2.7.3 General Findings of the Hospital Survey

Questions	Answers
Category of Facility (a) Primary (b) Secondary (c) Health Centre	 (a) 50% (b) 30% (c) 20%
Ownership of Facility (a) Government (b) CCN (c) Private company	 (a) 20% (b) 10% (c) 70%
Services contracted out on SWM (a) Collection of general waste (b) Collection of general & medical wastes (c) not contracting any services	 (a) 20% (b) 70% (c) 10%
Existence of Hospital Waste Classification	Yes: 100%, No: 0%
How pathological waste are treated (a) Incineration & chemical treatment (b) Incineration (c) Burning in premises	 (a) 30% (b) 50% (c) 20%
Frequency of collection (a) everyday; (b) every two days	 (a) 70%; (b) 30%
Existence of in-house education programme on SWM	Yes: 100%; No: 0%
Main diseases in facilities (a) Malaria, waterborne diseases, heart diseases, diabetes and cancer (b) Malaria and waterborne diseases	 (a) Primary & secondary (80% of respondents) (b) Health Centres (20% of respondents)

The main findings of the hospital survey are as follows:

(i) Fifty percent (50%) of the surveyed facilities are categorised as primary facility; 30% as secondary and 20% as health centre. Primary hospitals provide services of consultancy, diagnostics, pharmacy and theatre; the secondary ones provide services of in-patient, diagnostics, out-patient, and pharmacy; and the health centres provide only diagnostics and pharmacy.

(ii) Seventy percent (70%) of the facilities surveyed are private companies.

(iii) Seventy percent (70%) of the respondents contract-out the collection of general and medical wastes.

(iv) All hospitals surveyed classify their wastes.

(v) Fifty percent (50%) of the hospitals treat their pathological waste through incineration. Others combine incineration with chemical treatment (30%) and the remaining (20%) burn waste in their premises.

(vi) Seventy percent (70%) of the hospitals receive daily collection services.

(vii) All hospitals surveyed have in-house education programmes on SWM. The programmes are developed by them or they follow the guidelines of the Ministry of Public Health.

(viii) Eighty percent (80%) of the respondents (primary and secondary hospitals) manifested that the main diseases they treat are malaria, waterborne diseases, heart diseases, diabetes and cancer, while within the health centres that occupy 20% of the surveyed facilities, malaria and waterborne diseases are the more widely treated disease.

(2) Waste Pickers Awareness Survey

The survey was carried out on ten (10) waste pickers to broadly analyse the current situation of their work at the Dandora Dumpsite. The main findings are as summarised below:

- The CCN has no record on the number of waste pickers working at the site; however, some CCN personnel estimated that the number is around 600 persons. These workers include men and women who collect valuable things from incoming wastes such as paper, glass, metal, plastics, etc. The recovered valuable things are sold at the site to brokers or directly to recyclers who finally bring them to recycling plants.
- The number of brokers at the site is more than 5. Waste pickers sell valuables mainly on the monthly basis. Waste pickers prefer the brokers or the recyclers because they have vehicles for the transportation of recovered materials to recycling plants.
- Waste pickers work 7 days a week, 12 hours a day, mostly from 6 am to 6 pm.
- Half of those interviewed mentioned that they would like to continue waste picking at the site and would protest if the site is closed.
- All of those interviewed are willing to have a job if a recycling plant is built.
- Monthly income of the respondents ranges between KSh 5,000 and KSh 10,000.
- The major problem facing the waste pickers is the marketing of recovered materials.

(3) Classification of Income Group

The Public Awareness Survey for households was conducted for the five income groups. This five income groups were firstly divided into three income levels, high, middle and low, then added two more income levels, low-middle and slum income groups, in consideration of the specific features of the large number of lower income population in Nairobi City. The income range of each income group was estimated based on the average monthly income of each income group of respondents.

Table 2.7.4 shows the results of computation to determine the monthly income range of each income group. As shown in this Table, the monthly income of the five income groups is divided in the range of less than KSh 8,000 in the slum area and more than KSh 84,000 in the high income group area.

Based on the results of the survey on affordability to pay by income level (see **Table H.2.2, Estimation of Affordability to Pay, in Section H of Volume 3, Supporting Report**), in order to prepare the zoning plan for privatisation of waste collection, the five income group areas were categorised into 3 classes of zones, Class A, Class B and Class C, based on the Poverty Rate Data surveyed by the World Bank**.** The classification of income group areas by zone is as follows:

- High Income Group and Middle Income Group Areas: Class A
- Low-Middle Income Group Area: Class B

- Low Income Group and Slum Areas: Class C

For reference, the monthly income range of each class quoted from the results of the Public Awareness Survey shown in **Table 2.7.4** are as indicated below.

- Class A : More than KSh 41,000 per month
- Class B : From KSh 23,001 to 41,000 per month
- Class C : Less than KSh 23,000 per month

Table 2.7.4 Monthly Income Range of Five Income Groups in Nairobi City

(Unit: KSh/month)

Item	Income Groups				
	High	Middle	Low-Middle	Low	Slum
Estimated Minimum Income	45,000	28,000	14,000	8,000	4,000
Average Income Level obtained from PAS	90,000	56,000	27,000	15,000	8,000
Estimated Maximum Income	135,000	84,000	41,000	23,000	12,000
Determined Income Range					
Income less than	-	-	-	-	8,000
Income from	-	41,001	23,001	8,001	-
Income to	-	84,000	41,000	23,000	-
Income more than	84,000	-	--	-	-

Source: JICA Survey Team

(4) Affordability to Pay for SWM Services

For households, in case that waste charges are included not in the group of obligatory expenditure but in the group of disposable income, the disposable income is used to estimate the affordability to pay for waste charges, because the estimates of affordability to pay for waste charges seem to be double-counted if the expenditure forwaste charges is included not in the disposable income but in the obligatory expenditure. In this survey, the affordability to pay for waste charges is applied to the disposable income with waste charges as shown in **Table 2.7.4**.

For business establishments, the highest amount of waste charges paid is more than KSh 51,000 which is assumed to be paid by establishments such as hotels, big markets and so on for the discharge of large amounts of wastes. Around 60% of the establishments have paid from KSh 18,000 to KSh 50,000.

Table 2.7.5 Affordability to Pay of Households

(Unit: KSh/month)

Income Group	ATP	
	Without Waste Charges in Disposable Income	With Waste Charges in Disposable Income
High Income	994.5	1,017.4
Middle income	758.6	768.8
Low-Middle Income	326.7	328.6
Low Income	152.2	152.9
Slum Area	89.4	89.7

Source: JICA Survey Team

(5) Willingness to Pay for SWM Services

The average willingness to pay of households is estimated by area classification. The average willingness to pay of all households per month is KSh 72.8. The average willingness to pay by area classification is totally reasonable because the willingness to pay is completely proportional to the area classification. The willingness to pay in high income areas is KSh 193.0, which is more than twenty-five times that of slum areas which is KSh 7.7.

For business establishments, only 1 out of 57 establishments responded that it is not willing to pay more for the improvement of waste services. Sixty percent (60%) said they are willing to pay between KSh 100 and KSh 500 per month.

(6) Current Situation of Public Awareness Raising and Environmental Education

The promotion and implementation of environmental education programmes are essential to raise the public awareness of residents and get them involved in solid waste management. In this sense, the JICA Survey Team carried out the field investigation through analysing relevant documents and direct interviews with the officials of organisations related to SWM to assess the current situation on this sector. The results are as described below.

(a) Environmental Education

(i) Formal Education

In this survey, analysed was the present situation of environmental education in the primary education only recognising that it is the starting point where the students may learn and develop awareness of the environment. The Kenya Institute of Education is responsible for the development of the curricula to be used by the students of primary schools. At present, the curricula focuses on the general environment under the subject of Geography and no specific theme is developed in the sector of SWM. Besides, the teachers do not have instruction materials such as textbooks, videos, etc., to help the students understand and be aware of the issues involving SWM. As of 2008, 1,409 primary schools were operating in Nairobi City. The Ministry of Education had established non-formal education institutions for children of school age that could not attend formal education.

(ii) Informal Education

Some activities were promoted especially by CCN, NEMA and NGOs through organising clean-up campaigns.

(b) Organisations dealing with Public Awareness and Environmental Education on SWM in Nairobi City

(i) Department of Environment of CCN (DoE)

This Department has no specific unit that deals with public awareness and environmental education on SWM. However, some activities of awareness creation had been conducted by the Section of Environmental Planning and Management aiming to sensitise the people through the provision of information materials on SW issues. DoE had been involved with other institutions such as the Ministry of Environment and Mineral Resources and NEMA in many activities to create public awareness through environmental education programmes or cleaning campaigns.

(ii) NEMA (National Environment Management Authority)

This institution through its Department of Environmental Education, Information and Public Participation develops and implements programmes intended to enhance environmental education and public awareness of the people on environmental issues. Among the activities conducted by this Department is the development of environmental education and awareness materials to sensitise various stakeholders including learning institutions, policy makers, media, civil society organisations and the general public.

(iii) NGOs

The role of NGOs is very important in the creation of awareness through the implementation of environmental education programmes and small projects targeted to improve the social and environmental condition of the communities. The NGOs frequently work with one another and with CBOs.

(iv) Community-Based Organisations (CBOs)

The CBOs provide waste collection service to the communities that they represent. The CBOs assist their members through the implementation of capacity building activities to get them ready to provide the services. They work closely with the NGOs and CCN during both the initial establishment and the implementation phases of self-help initiatives. They are well aware of the issues of concern of the communities they represent and the approaches to mobilising community resources. In **Section F of Volume 4, Data Book** can be found the list of registered CBOs dealing with SWM in Nairobi City.

2.7.2 Evaluation of Current Public and Establishment Awareness for SWM

(1) Public Awareness for SWM

From the survey on households, the evaluations and conclusions on the main findings are as follows:

(a) The high and middle income areas are well serviced with waste collection. However, the lowest rate of collection is given in the slum areas where solid wastes are disposed by the residents along roads, river banks, open spaces, etc.

(b) Most of the households of high and middle income areas receive collection services by door-to-door vehicles. As for the low income and slum areas, most of the respondents manifested that they carry their solid waste to the collection point.

(c) A significant percentage of respondents discharge their waste in premises without containers.

(d) According to the survey, most of the respondents are housewives. This is expected because most of the interviews were conducted during daytime when most men as the main income earners are in their respective workplaces. In cases where both the wife and husband are working, the households are in most cases left under the care of a female housekeeper. In most surveyed households, it is the housewife or the house helper (maid) who disposes waste from the house.

(e) The highest level of satisfaction with the collection service was given from the high income area. However, it is very low in the low income and slum areas. Among the main reasons of respondents' dissatisfaction with the service are (a) the collection frequency is low; and

(b) the collection time is very irregular or it is very early or late. Dissatisfied respondents from the slum areas (33%) indicated that the collection fee is expensive.

(f) More than 70% of all respondents have not received any guidance or instruction on methods of proper waste discharge.

(g) The willingness of respondents to participate in cleaning campaigns was found to be highest in the high income areas and the lowest in the slum areas. This can be attributable to the low level of awareness of the people on SWM issues.

(h) Almost 70% of the respondents have not participated in any public education programme on SWM.

(i) More than half of the respondents said that there are insects breeding in their domestic waste areas. The highest number of respondents was from the slum areas.

(j) From the survey result, it can be concluded that there is a necessity of implementation of educational programmes for citizens in order to raise or create awareness on proper waste management in Nairobi City.

(2) Establishment, Institution and Hospital Awareness on SWM

From the survey, the main findings are as follows:

(a) Commercial Establishment and Institutions

(i) Most of the respondents indicated that they place their waste in a container to be collected later by workers or in the compartment fixed at the company premises, or bring them to the communal container.

(ii) All of the establishments surveyed confirmed that they have a contract with either CCN or a private collector.

(iii) Eight percent (8%) out of 14% have received specific guidance on proper waste segregation, storage and discharge. However, a high rate (86%) had never received instruction on proper waste discharge.

(iv) The level of satisfaction with the current collection service was found to be 57.8% of the establishments sampled. However, respondents that are not satisfied indicated that the main reasons are: (a) the low frequency of collection; and (b) the very bad behaviour of workers.

(v) Most of the respondents are not willing to participate in cleaning campaigns.

(vi) From the survey, it can be concluded that all of the establishments sampled are covered with collection services and more than half of them are satisfied with the service. However, a high rate had never received guidance on SWM, resulting in a low awareness on proper waste management.

(b) Hospitals

(i) Nine of the ten hospitals interviewed contract-out SWM services for the collection of general and medical waste.

(ii) All hospitals have a waste classification set by the hospital management or by using the waste classification given by the Ministry of Public Health.

(iii) All hospitals give special treatment to their pathological waste including sterilisation of potential infectious waste before discharging them to designated areas.

(iv) Seven (7) hospitals have contracts with service providers to transport medical waste off their premises.

(v) All hospitals stated that they have in-house education programmes on SWM.

(vi) As for health centres, it was found that malaria and waterborne diseases are the more widely treated diseases.

(3) Waste Pickers Awareness on SWM

From the survey on waste pickers, the following evaluation and conclusions are made:

(a) No official registry on the number of waste pickers at the Dandora Dumpsite exists although the number of waste pickers at the Dumpsite is estimated from 1,200 to 1,500. On the other hand, some CCN officials estimated that about 600 waste pickers work at the site, collecting valuable things from incoming wastes such as paper, glass, metal, plastics, etc.

(b) Half of those interviewed mentioned that they would like to continue waste picking at the site and would protest if the site is closed.

(c) All of those interviewed are willing to have a job if a recovery plant is built.

(d) It is necessary to conduct a survey on waste pickers in order to know their current number, housing, working habit, etc. in order to prepare a realistic and applicable plan for them.

(4) Affordability to Pay for SWM Services

For households, the contents of household income by category are very useful data to estimate the affordability to pay. The disposable income is closely related to the income level. This result suggests that the waste charge level should take account of the income level, especially, for lower income level areas including slum areas.

For business establishments, the affordability to pay is considered to be more than that of households because the income level of business establishments is more than that of households. However, there are small-scale business establishments such as kiosks, so that the waste charge level for business establishments should also take account of the income level.

(5) Willingness to Pay for SWM Service

It has become clear that the willingness to pay (WTP) is also closely related to the income level. The WTP is not only a kind of criteria for the level of waste charge but also provides the amount of benefit to be generated from the SWM service. It is already pointed out that the benefits from SWM projects have some difficulty to be quantified because SWM services do not completely belong to the market economy and the price of the service as waste charges is not always decided by the market in which the price is decided by the relationship between demand and supply for the SWM service. In this context, the WTP is a very useful indicator to quantify the benefits of the SWM service for the economic evaluation of the Master Plan.

(6) Public Awareness Raising and Environmental Education

From the survey on households, the following evaluation is made:

(a) The current curricula of primary education focus on the general environment and no specific theme is developed in the sector of SWM.

(b) The teachers assigned to primary schools do not have instructive materials such as textbooks, videos, etc., to help them understand and be aware of the issues involving SWM

and teach these properly to their students. The development of these educational materials is considered of great importance to create proper awareness inside the educational community starting with primary education.

(c) The DoE of CCN does not have at present a unit to implement a regular programme oriented to educate the people on solid waste aspects. The establishment of a section inside the DoE is considered indispensable to deal with Public Awareness, Environmental Education and Community Participation and to obtain more involvement of the communities in the SWM.

(d) The DoE of CCN is conducting an awareness campaign addressed to CBOs that operate along the Nairobi river banks in the frame of the Rehabilitation and Restoration Programme for Nairobi Rivers. Through this campaign, the CBOs are requested to bring the wastes to a designated point from where the CCN could transport them to the disposal site. This good experience could be replicated in other areas of Nairobi.

(e) NEMA conjointly with the DoE has developed good initiatives for raising awareness of the general public. The implementation of these types of initiative should be sustainable to keep the level of environmental awareness of the people.

(f) The NGOs are well recognised for their assistance to the communities in the implementation of small projects aside from giving training on environmental education for awareness creation. NGOs frequently work with one another and with CBOs. The joint-venture initiative between an NGO and a private organisation to produce plastic poles from recycled plastic employing for the process of collection of recovered plastics thousands of youths is a good example on how these organisations are working in favour of the environment and at the same time creating job opportunities for many people.

(g) CBOs are playing an important role in providing collection services and the recycling of garbage especially in the low and slum areas. These organisations should be assisted by CCN to develop practical strategies for the improvement of their activities.

2.8 Environmental and Social Considerations

2.8.1 Present Environmental and Social Conditions

Analysed in the following subsections are the current situations of environment and the social aspects related to solid waste management in Nairobi City. The current condition of four components of the environment, namely; water, sewage, air quality and solid waste that are considered relevant to SWM, were studied utilising available information in the institutions of the sector and through field observations.

(1) Water

(a) Surface Water

The City of Nairobi is traversed by three main rivers that compose the Nairobi River Basin, namely; Nairobi River, Ngong River and Mathare River. These rivers join east of Nairobi to discharge finally into the Athi River.

These rivers are highly polluted by domestic and industrial wastewater and solid waste. In 2008, it was detected that about 56 % of the city residents live in 46 slums[8] along the banks of rivers in Nairobi without having proper sanitary facilities, occasioning great pollution to these rivers. Slums are informal settlements, with Kibera, Mathare and Kawangware as the biggest ones. The estimated density in the slums of 300,000 people per square kilometre and the lack

of proper sanitation facilities put the slums in an uncompromising situation as the major sources of water pollution[9].

In this JICA survey, the water quality of Nairobi River in four (4) points of its course was analysed. The highest concentration of BOD was found to be 150 mg/l in spite of the fact that the samplings were made after a rainy day. Therefore, higher levels of pollution could be expected when the survey is conducted in the dry season.

(b) Groundwater

Groundwater in Nairobi is used mainly by industries and hotels to supplement the water supplied by the Nairobi Water and Sewerage Company (NWSC). Besides, some parts of the city such as Langata and Karen also use the water from wells. Groundwater quality is generally satisfactory for all domestic purposes from the chemical point of view, except the fluoride content which exceeds the Kenyan Standard of 1.5 mg/litre for drinking water.

In the period 1997-2002, a total of 290 wells were drilled within Nairobi City, with concentrations of fluoride increasing with depth. Thirty percent (30%) of the drilled wells presented fluoride of about 2 ppm[10].

(c) Water Supply

The provision of water services to Nairobi City has been privatised to the Nairobi Water and Sewerage Company (NWSC). This company is fully owned by the City Council of Nairobi and is licensed to operate by the Athi Water Services Board (AWSB). The privatisation was made to improve the quality of the service.

The current coverage of water services is over 80% and the consumption per capita in the informal settlements is 40 ltrs/day while it is 300 ltrs/day for the more affluent consumers. The company adopts the WHO standard for drinking water[11]. Only 42% t of the households in Nairobi City have proper water connection and water losses exceed 50% due to leakage and illegal connections[12]. The residents of slums suffer most due to the lack of piped-water supply in these areas. According to the Study on Ngong River, 85% of the households in the Kibera slum get water from kiosks located at approximately 40 meters on average at an average price of KSh 2 per 20 litres[13]. The water source for water supply is, mainly, the surface water.

(d) Waterborne Diseases

At the national level, in 1999, 4.7% of all outpatients reported cases of diarrheal diseases which were more prevalent in Nairobi, Rift Valley, Nyanza and the western provinces[14]. The diarrheal diseases may be attributable to poor or inadequate sanitary facilities and hygienic practices. In Nairobi City, the population living in informal settlements is the most vulnerable group to waterborne diseases due to the inadequate sanitary condition of these places.

The Study on Ngong River revealed through interview with some residents of informal settlements the high prevalence of environmental-related diseases such as malaria, diarrhea, eye diseases and typhoid. According to this Study, in 2000, between 85% and 95% of all patients that visited the Langata Clinic (mainly serving Kibera residents) suffered from environmentally related diseases like malaria, diarrhea, intestinal worms, diseases of the respiratory system, diseases of the skin and eye infections[15].

Water pollution due to municipal, industrial, mining and agricultural sources continues deteriorating the water supply, causing waterborne diseases[16].

(e) Water Pollution Control

The rivers in Nairobi City are polluted mainly by domestic wastewater, industrial wastewater and solid waste. The Department of Water Resource Management of the Ministry of Water and Irrigation is in charge of the protection, conservation and management of water resources, control and apportionment, as well as water quality and pollution control; whereas, the National Environment Management Authority (NEMA) is in charge of implementing programmes for controlling pollution of the environment. NEMA is the institution in charge of EIA studies. On the other hand, the Nairobi Water and Sewerage Company Limited also have the responsibility of monitoring industrial effluents before discharge into the sewers. Standards for drinking water and for effluent discharge into the environment and public sewers are presented in **Section G of Volume 3, Supporting Report.**

(2) Sewage

The sewerage system of Nairobi City is of combined type where sewers receive both storm water and sewage. The sewerage service is provided by the Nairobi Water and Sewerage Company Limited.

Sewer sizes range between 225mm in diameter to 2m in diameter with manholes provided at intervals for inspection purposes. The sewerage network in the city is not sufficient, resulting in the illegal discharge of sewage into the rivers[17].

According to the officials of Nairobi Water and Sewerage Company Limited, many people block or puncture the sewers to get sewage for urban agriculture[18]. The current coverage of sewerage in Nairobi City is approximately 40%.

(3) Air Quality

The previous study carried out for Nairobi City shows that the level of particulates in most parts of the city is above the level recommended by WHO (mean value: 90 $\mu g/m^3$). Most of the affected parts of the city with the highest concentration of particulates are the residential areas located in the eastern zone and the city centre[19].

During the present JICA survey, it was observed that burning of waste is very common at the collection points and disposal sites. According to CBOs or waste pickers, they burn the waste at the collection points to reduce the amount of waste at the site, because the collection service is very irregular. At the disposal site, the burning of waste could happen intentionally by waste pickers, or naturally due to the decomposition of waste and not the existence of gas treatment system.

On the other hand, it was noted during the survey that many mal-maintained vehicles in the daily traffic pollute the air of Nairobi City. In addition, NEMA also reported that industries are also responsible for air pollution[20].

(4) Solid Waste

The JICA Survey Team carried out a field observation conjointly with the Kenyan counterparts on the following sites: (a) Dandora designated disposal site and Kayole Orbit temporary disposal site; (b) major illegal disposal sites (large and medium/small scales); (c) some collection points operated by CBOs/CCN; and (d) some collection points operated by CCN.

(a) Overview of Major Findings during the Field Observation

(i) Disposal Sites

Designated and Temporary Disposal Sites

Currently, the Dandora Dumpsite is the only designated disposal site in Nairobi City. CCN waited for the resultd of the present JICA Survey before taking a decision on the closure of Dandora open dumping site and the construction of a new landfill in the Ruai site. However, until the construction is implemented, a temporary disposal site is needed, and this could be at Dandora or the Kayole Orbit Quarry.

Illegal Disposal Sites

It was estimated roughly that in Nairobi City there are three (3) sizes of illegal disposal sites, namely; the large-scale (used mainly by private contractors); and the medium and small scale ones located along the roads or river banks where residents mainly dispose their solid wastes.

Identified in the present survey were four (4) large-scale illegal disposal sites: (a) Gathundeki; (b) Zimerman; (c) Eastleigh Air Force; and (d) Mathare North.

As for the medium/small scale illegal disposal sites, they consist of several sites located along the roads and river banks where people discharge their wastes contributing to the degradation of the environment. These sites can be seen in the low income and slum areas.

(ii) Designated Collection Points

There are many collection points designated by CCN where the residents are allowed to bring their waste by themselves. On the other hand, the CBOs provide garbage collection services to households especially those located in the low income and slum areas. The CBOs also are allowed to bring their collected waste to the designated collection points where they usually separate valuables, and the remaining waste is left for CCN to collect and transport to the Dandora Dumpsite.

2.8.2 Evaluation of Current Environmental and Social Conditions

(1) General Condition

(a) Water

It is concluded that the quality of rivers in Nairobi is being deteriorated by pollutants from the domestic sector (sewage and solid waste), agricultural sector (agrochemicals) and industrial sector (wastewater). Using sewage for irrigation of agriculture is the most serious and unhealthy practice that needs attention because it might involve hazard to human health. This practice was observed in the vicinity of Kariobangi South where the sewage running through open channels is diverted by individuals to irrigate maize and other crops.

(b) Sewage

The main problem affecting public health is the lack of proper sewage disposal, because the area of Nairobi is partially served by sewer lines leading to increased river pollution due to the domestic water channeled nearby. It was noted that sewage in the slum areas is diverted to open channels, finally reaching the watercourses and deteriorating river water quality.

(c) Air Quality

Main sources of air pollution that affect the City of Nairobi are the vehicles, industries, emissions from the use of charcoal or firewood, open burning of waste, and the unsanitary waste disposal sites.

Previous studies indicate that the level of particulates in the air of Nairobi City exceeds the WHO standard of 90 $\mu g/m^3$. The areas most affected by this pollutant are the eastern residential areas and the city centre.

(2) Environmental Problems due to Solid Waste

(a) Water Pollution

It was observed by the JICA Survey Team that wastes are not collected regularly at many collection points. Delays in waste collection for a long time generate the smell of a black liquid called leachate which is considered as a high polluter when it reaches watercourses due to its high concentration in BOD, COD and chemicals. It was noted that the leachates generated in these collection points and in the illegal disposal sites pollute the rivers of Nairobi.

It was observed also that solid wastes are dumped intentionally along the roads or river banks by the residents. This fact brings as a consequence the transfer of uncollected wastes to rivers, drains, streams and lowland areas when Nairobi experiences intensive rains. It was observed also that the rivers are polluted by the existing disposal sites.

(b) Air Pollution

From the results of the survey, it is concluded that the air quality of Nairobi City is also being deteriorated from the current practice of burning waste. Besides, the existing unsanitary disposal sites (legal or illegal) cause the emission of offensive gases hazardous to the health of people living in the vicinity.

Actually the sources of air pollution in Nairobi City are vehicular emission, factory emission and the haphazard generalised burning of wastes.

(c) Landscape

In the City of Nairobi could be observed the proliferation of illegal disposal sites along the roads, beside the rivers and in open spaces. This fact brings about the degradation of city environment, presenting an unhealthy landscape to residents and visitors alike.

(d) Soil Contamination

The designated disposal site at Dandora had received in the past not only domestic waste but also dangerous waste due to the lack of control on the public sector. By 1998, the JICA Study Team already had detected the presence of some elements that lead to soil contamination, especially heavy metals. Since up to the present there are no remedial actions to restore the place, it is assumed that the soil is still contaminated with some heavy metals.

(3) Social Problems due to Solid Waste

(a) Situation of Waste Pickers

Waste pickers interviewed by the JICA Survey Team pointed out that their daily income depends on what they obtain from waste, because they have no other option or opportunity to earn money for subsistence.

Generally, waste pickers work at the disposal sites without using any kind of equipment and materials to protect them from the unsanitary condition of the site. In addition, these people live next to the disposal site, so that they are vulnerable to diseases due to the unhealthy environmental conditions.

(b) Public Health

Many of the observed solid waste collection points in the city became open temporary disposal sites, because CCN could not provide regular collection services. Besides, Nairobi City does not have a sanitary disposal site for solid waste.

Noted during the survey in most of the solid waste collection points and disposal sites is the presence of offensive odour, smoke and disease vectors such as cockroaches, rats, flies and mosquitoes that have negative impacts on public health. In the MP Study in 1998, the people interviewed mentioned cases of respiratory and stomach problems among children and adults due to the smoke and smell coming from the Dandora Dumpsite. At present, the Dandora Dumpsite still presents the same unsanitary condition and it is assumed that the health of operators, waste pickers and people living in the vicinity are still affected by the wastes dumped at the site. According to the officials of CCN, residents living in and around the dumpsite would like to receive relief from air pollution due to the burning of wastes.

2.8.3 Initial Environmental Examination (IEE)

(1) Ruai Candidate Site for Final Landfill

(a) Natural Environmental Condition

(i) General Information

The site is located in Embakasi Division at about 30 km east of Nairobi City on flat land adjacent to the Nairobi River. The place available for disposal site is grassland of about 80 hectares owned by CCN and currently used for the pasture of livestock. There are no trees in the site except the riverine vegetation (forests) on the left bank of the Nairobi River. At the entrance to the site, there is the Dandora Estate Sewage Treatment Works operated by the Nairobi Water and Sewerage Company. The presence of many varieties of birds which feed on the insects and fishes from the ponds of the sewage works has been observed.

(ii) Water

The only existing river in the area is the Nairobi River which is located adjacent to the site. During this JICA Survey, water sampling was conducted after a rainy day on the Nairobi River upstream of the candidate site and noted the presence of solid waste in both river banks brought by the river during the rain. The results indicate that the river is loaded with organic substances from sewage and solid waste. According to some people living in the surrounding areas, the water of Nairobi River is used for animal consumption and even for domestic use.

(iii) Flora and Fauna

The site is open grassland with some shrubs especially in the riverine zone. The grassland is used for the pasture of animals like cattle, goats and sheep. Livestock was the main animal activity observed. A few birds were observed especially in the riverine community. According to the local people, crocodiles and hippopotamus can be found in the Nairobi River at the site.

(iv) Landscape

The place is located on a huge flat land adjacent to the right bank of Nairobi River. The cover soil of the site comprises surface black cotton soil developed over the poorly drained flat surface of the land.

(v) Air and Noise

During the survey at the site, no air pollution or generation of noise was noted.

(b) Socio-Environmental Condition

(i) Socio-economy

There is no population living near the site although it is important to mention that the Ruai area corresponds mainly to the low income area of subsistence cultivators, pasture keepers and small-scale traders. Far away from the site were observed some houses where displaced people lived after the Kenya election in 2007 and the Maasai population mostly living in temporary houses and dedicated to goat and cattle breeding. Most of the problems they mentioned is the lack of water as well as educational and health facilities near their places of abode.

(ii) Sanitation

No water supply facility exists at the site; and the people who live nearest to the site buy water at 1 KSh/litre for their consumption. Pit latrine is used for excreta disposal and garbage is disposed by burying or burning.

(iii) Health Condition

Malaria is the most common disease in the area.

(c) Conclusion

The site could be used for developing the new sanitary landfill site with the necessary mitigation measures. The site is one of the most suitable due to the limited settlements in the vicinity and the large extent of the area. In addition, there is no significant socioeconomic activity at the site

(2) Juja Candidate Site for Final Landfill

(a) Natural Environmental Condition

(i) General Information

The site is located within the jurisdiction of Thika County Council, in the north-eastern side of Nairobi City, at 39 km from the Nairobi Central Business District. The site is composed of many quarries, some of them still active, located at the right side of Ndarugu River. The area available for the landfill site is about 40 hectares. Next to the site is found the railway that could be used for solid waste transportation from Nairobi City. The vast land belongs to one owner who is willing to participate as a partner in the project.

(ii) Water

The site is located at the right bank of Ndarugu River which is the water source for water supply to Juja town, for irrigation of coffee plantations and for the coffee industry located near the site. The water intake for water supply is located upstream of the candidate site.

(iii) Flora and Fauna

Only a few shrubs were noted especially in the riverside area. A few cattle grazing around the site were observed. A vast plantation of coffee located between the quarries and the railway track was also observed.

(iv) Landscape

The site is a vast, disturbed land composed by quarries of different depths ranging from 5m to 30m, some of them abandoned and some still active.

(v) Air and Noise

Noise and dust are produced from the operation of the active quarries.

(b) Socio-Environmental Condition

(i) Socio-economy

About 100 people work at the active quarries which provide much of machine-cut stones for Nairobi's building industry. Plantations of coffee and horticulture in minor scale exist around the quarries. A flower plant garden could be observed also in the vicinity.

(ii) Sanitation

At the upstream of the site, the river water is treated and pumped to Juja Town located at about 5 km from the site. The Ruiru-Juja Water and Sewerage Company Ltd. is in-charge of the water supply service, but it does not provide sewerage services so that septic tanks are used commonly for sewage disposal. The company also operates two bore holes of 150 feet in depth, but the production of water is very low and the fluoride content is high. In Juja area some houses own wells 20-30 m in depth to supplement the water supply from the treatment plant; however, these shallow wells already present signs of pollution especially by sewage according to the local consultants. Around the site were observed very few houses occupied mainly by workers at the quarries. Opposite to the site was observed the Thika Road Girls High School with 93 students. As for garbage, people dispose them by burying or burning.

(iii) Health Condition

The main diseases in the area are malaria, diarrheal diseases, typhoid, and intestinal worms/amoebiasis, some of them attributable to the consumption of polluted water.

(c) Conclusion

The site could be used for waste disposal taking into account mitigation measures. The proximity of the site to Nairobi City and Thika County Council means that the site could be used by both urban centres with a view to sharing the costs.

(3) Mavoko Candidate Site for Final Landfill

(a) Natural Environmental Condition

(i) General Information

The site is located within the jurisdiction of the Municipality of Mavoko, in the south-eastern direction from the city centre toward Mombasa. The total area of about 4000 ha which include the proposed site, belong to the East African Portland Cement Co., Ltd. which is a parastatal organisation (major shareholder is the Government of Kenya).

The proposed site is a vast, open grassland area and near to it could be observed the railway, which could be used for the transportation of solid waste from Nairobi City.

(ii) Water

Two seasonal water courses exist at the site, the River Stonyathi and its tributary which join downstream.

(iii) Fauna and Flora

The site is typical savannah vegetation mainly inhabited by wild animals. Currently the plains have huge savannah grass due to the rains. At the site could be observed wild animals such as giraffe, ostrich, zebra, and antelope, living in the natural habitation. However, these animals keep moving all the time.

(iv) Landscape

The site has a gentle slope towards a seasonal stream. The cover soil is black cotton to depths of 0.5m to 2 m; further depths may present gypsum or laterite soils. The railway track that connects Nairobi to Mombasa runs next to the site.

(v) Air and Noise

No noise or air pollution was noted at the site.

(b) Socio-Environmental Condition

(i) Socio-economy

The site has little economic activity. Some parts are leased by the Kenya Meat Commission for cattle grazing. Before entrance to the site is an industrial zone where some firms are located, such as the Kenya Meat Association, the Steel Mills Ltd., etc. In the vicinity is the Athi River EPZ (Export Processing Zone).

(ii) Sanitation

The nearest community named Kitengela is located behind the railway track. This place is being developed and the houses are of permanent and temporary types. Some houses are supplied with water from the Athi River Company and others buy it from tankers. It was observed during the survey that a borehole is being constructed to serve a new condominium site composed by many high class houses. Available information shows that some boreholes constructed in the Kitengela area present a high degree of alkaline and fluoride. Excreta are disposed in septic tanks. Garbage is disposed by burning or burying; other residents contract private collectors.

(iii) Health Condition

Main diseases in Kitengela area are malaria, influenza, and chest problems.

(c) Conclusion

The site could be used for developing the sanitary landfill site with necessary mitigation measures. The site is one of the most suitable due to its huge extent and far location from human settlements. The site could be shared by CCN and Mavoko Municipality.

(4) Dandora Candidate Site for Transfer Station

(a) Natural Environmental Condition

(i) General Information

The site with an area of about twenty-six (26) ha is located in the Embakasi Division. It was a quarry along the Nairobi River, used for stone extraction for the building industry in Nairobi City. The site is used currently for garbage disposal, operated by CCN and owned by CCN and private individuals.

(ii) Water

The only existing river in the area is the Nairobi River which is located adjacent to the site. During this JICA Survey, water sampling was conducted in the Nairobi River upstream and downstream of the candidate site. The results indicate that the river is loaded with organic substances and not suitable as the source of domestic water. It was confirmed that Nairobi River receives leachate without any treatment from the Dandora Dumpsite, leading to water pollution.

(iii) Fauna and Flora

At the site could be observed the presence of animal scavengers such as pigs, birds, goats, sheep and cattle that feed on the waste. Few shrubs could be observed especially in the riverine vegetation.

(iv) Landscape

The site is an ex-quarry filled with waste. It slopes steeply before reaching the Nairobi River.

(v) Air and Noise

Smoke, dust and exhaust gases pollute the air at the place. Offensive odour also could be noted due to the unsanitary condition of the place. Offensive odour and smoke are the major complaints of people living around the site. Noise production also could be noted due to the machines and vehicles operating at the site.

(b) Socio-Environmental Condition

(i) Socio-economy

Dandora dump is surrounded by populated villages such as Kogorocho Slum, Lucky Summer, the Kariobangi and Dandora estates, and by a number of educational and religious facilities such as the Dandora Secondary School, the Jiran Education Center, the Tortola Rescue and Educational Centre, and the Monica Church.

Many waste pickers from the surrounding villages work at the place for material recovery or recycling. No official record exists on the number of waste pickers at the site although the number of waste pickers at the Dumpsite is estimated from 1,200 to 1,500. On the other hand, it was estimated to be about six hundred (600) by the CCN officials.

During the survey, the presence of one group identified as the Mukuru Recycling Centre was noted, performing paper recycling with its own equipment. Other people of the surrounding villages are the stone miners working near the site.

(ii) Sanitation

The surrounding population is provided with piped water and excreta disposal is made through sewers in some cases or pit latrines. As for garbage disposal, some are carried by collectors and some are burned.

(iii) Health Condition

The place is an open dumping site where solid waste poses a risk from the sanitary point of view, which could affect the operators of the landfill site, the waste pickers and the residents living around the site directly. The site constitutes a breeding ground for different organisms which are carriers of diseases such as malaria, typhoid, dysentery, etc. Interviewed persons expressed that the main diseases in the area are upper respiratory tract infections, gastro-intestinal diseases, allergies, tetanus, chest infections, etc.

(c) Conclusion

The site could be used with mitigation measures for developing the transfer station and recovery facilities after the sanitary closure of the existing disposal site. The public health of a vast population living around the site will be improved through closing the existing disposal site.

(5) Langata Candidate Site for Transfer Station

(a) Natural Environmental Condition

(i) General Information

The site is located next to the Langata Cemetery limiting with the Langata Road with an area of approximately eight (8) hectares that form part of the Ngong Road Forest. The site is located in-front of the National Nairobi Park at approximately ten (10) km south-west from the city centre. The land is owned by the private sector.

(ii) Water

The Mokoyeti stream is in the lowest part of the land. It goes through the Nairobi National Park and is currently polluted by leakage of sewers that pass through the site. A newly constructed borehole was identified at the Wildlife Clubs of Kenya; however, it is not operated yet and no data was available about the water quality and other features.

(iii) Fauna and Flora

Presence of some birds was noted. Shrubs are dominant while few species of trees were observed at the site.

(iv) Landscape

The site has a gentle slope towards the stream. The cover soil is red soil that goes down until approximately 50 cm. Under this soil, a rocky layer is found.

(v) Air and Noise

No significant noise or air pollution was noted at the site. The existing ones come from the traffic on Langata Road.

(b) Socio-Environmental Condition

(i) Socio-economy

No residential area was found in the vicinity, but next to the site is the Wildlife Clubs of Kenya which promotes environmental education and tourism courses. Next to this facility exists the Bomas of Kenya Limited, a government corporation with many facilities for tourists, entertainment, and social activity.

(ii) Sanitation

Water supply in the area of Langata is provided by CCN in some parts and the other parts use bore holes. Sewage is disposed by sewerage or septic tanks. In front of the candidate site is a sewerage pipeline. The garbage is usually collected by private collectors.

(iii) Health Condition

Main diseases in the area are respiratory diseases and malaria.

(c) Conclusion

The site could be used with mitigation measures for developing the transfer station. The site is a sensitive area due to its proximity to tourist areas and recreational facilities; therefore, strict monitoring of the operation should be implemented to avoid any negative impact.

(6) Kibera Candidate Site for Transfer Station

(a) Natural Environmental Condition

(i) General Information

The site is about six (6) km south-west from the Nairobi centre, next to the railway track and in-front of the Kibera Station. The site is owned by the Kenya Railways Corporation (a parastatal institution).

(ii) Water

There is a stream in the vicinity originating in springs. The stream feeds 3 dams which supply water for the population of Kibera and for livestock consumption.

(iii) Fauna and Flora

Grass, shrubs, maize and vegetable plantation could be observed at the site. The presence of animals could be noted.

(iv) Landscape

The site has a steep slope towards the access road to the site. The cover soil is red soil and rock.

(v) Air and Noise

No noise or air pollution could be noted at the site.

(b) Socio-Environmental Condition

(i) Socio-economy

In front of the site could be observed the Unga Farm Care (EA) Limited, a parastatal institution with an area of 109 hectares where the exhibition of Kenyan products (including livestock, agricultural and commercial) is organised every year. Also noted were the three (3) schools located very near to the site and in the land belonging to the Kenya Railways Corporation.

(ii) Sanitation

Some houses have piped water from CCN. Others buy it at KSh 4 for each container of 20 litres. Sewage is disposed using pit latrines or septic tanks. As for garbage, the common system used is burning, composting or dumping anywhere.

(iii) Health Condition

Interviewed persons informed that the main diseases in the area are influenza, coughs and malaria.

(c) Conclusion

The site could be used with mitigation measures for developing the transfer station. The health of the vast population living in Kibera could be improved through the improvement of collection and transportation of garbage from the area using the transfer station. An additional area of land needs to be acquired to meet the requirement of the proposed transfer station.

2.9 Financial and Economic Aspect

2.9.1 Financial Conditions

(1) City Council of Nairobi (CCN)

(a) Revenues and Expenditures

The total revenue of CCN increased by 17.6%, i.e., from KSh 6,781 million to 7,944 million for the period 2007-2008. Revenues come from CCN's own sources, the central government and other sources. The former decreased by 8.6% and the latter increased by 16.1%. This indicates that CCN had slightly strengthened its financial independence against the other sources of revenue. On the other hand, the operating expenses increased by 31.7% from KSh 5,374 million to 7,079 million. Then net surplus from operating activities decreased by 38.5% from KSh 1,407 million to 865 million. By taking account of non-operating revenues (Expenses), the net surplus from ordinary activities indicates the increase by 9.0% from KSh 490 million to 534 million. Ultimately the net surplus for the year carried to the

consolidated general rate reserve fund is recorded as a decrease of 47.2% from KSh 390 million to 184 million.

(b) Cash Flow Statement

The cash flows from operating activities are composed of the cash receipts and the cash payments. The total cash receipts show increase by 20.9% from KSh 6,677 million to 8,068 million from 2007 to 2008 and the total cash payments increased by 16.1% from KSh 5,787 million to 6,721 million. The net cash flows from operating activities indicate increase by 51.5% from KSh 890 million to 1,348 million. On the other hand, the cash flows from investing activities are the purchase of plant and equipment which increased by 36.4% from KSh 859 million to 1,173 million. The cash flows from financing activities composed the proceeds from loans and repayment of loans. The net cash flows of them indicate the decrease by 89.0% from KSh 218 million to 24 million. The net cash in cash and cash equivalents shows decease by 19.4% from KSh 249 million to 200 million. The cash and cash equivalents as of 30 June 2008 recorded an increase of 37.1% from KSh 541 million to 741 million.

(2) Department of Environment (DoE)

The Department of Environment (DoE) is composed of six sections and each section has its own accounts for revenue and expenditure. In 2008/2009, the total revenue and expenditure of DoE recorded KSh 18.4 million and 486.1 million, respectively, and the balance show the deficits of KSh 467.8 million in 2008/2009. In 2010/2011, the total revenue and expenditure of DoE recorded KSh 29 million and 612 million, respectively, and the balance as the deficits would increase to KSh 583 million. The total revenue and expenditure of the CCN is estimated at KSh 9,976 million and 12,047 million respectively in 2010/2011. Then the share of the total revenue and expenditure of DoE in the CCN is 0.29% and 5.1% respectively, which are low allocations in the CCN in comparison with the other fifteen departments. The share of revenue is the eighth and that of expenditure is sixth. More allocations should be considered.

Table 2.9.1 shows the financial situation of the Solid Waste Management Section of the DoE, which consists of three sections, namely; the Public Cleansing, Refuse Removal and General Cleansing sections. The total revenue is expected to increase from KSh 9.9 million to 10.3 million, and the total expenditure would also increase from KSh 385.2 million to 407.7 million. In 2009/2010, the share of revenue and expenditure in the CCN would be only 0.12% and 4.1%. It was pointed out by the CCN that the budget for the general cleansing section and public cleansing section of DoE has been on a downward trend over the financial years with the exception of financial year 2006/2007 where it increased by 41%. However, the trend has been different for the Refuse Removal Section of DoE. This particular section has incurred major fluctuations in its budget with estimates rising and falling over the five financial years. It was also pointed out by the CCN that the budget allocation for solid waste management vis-a-vis the total city council budget has been decreasing over the years. This is an indication that solid waste management in the CCN is not being given priority as compared to other cities in the world where the total allocation for solid waste compared to the total budget ranges from 10% to 50%.

These pointed out facts are the core problems of the existing budgeting system of the CCN. The way of thinking for prioritising the activities of the CCN is necessary to be reviewed and improved by taking account of the substantial welfare and benefits of the people of Nairobi City.

The DoE is not financed directly from the GoK, but there is the possibility to be directly financed through the LATF which is annually budgeted although it is not much expected by taking account of the present budgetary condition that the allocation of budget from the DoE is relatively a small share to the total budget of the CCN.

Table 2.9.1 Current Financial Situation of Solid Waste Management by CCN

(Unit : KSh 1,000)

Items	2008/2009 Approved	2009/2010 Estimates	Change (%)
1. Public Cleansing			
(1) Expenditure			
1) Personnel	0	0	0.0
2) Operations	90	0	-100.0
3) Capital Expenditure & Investment	0	0	0.0
Subtotal	90	0	-100.0
2. Refuse Removal			
(1) Revenue			
1) Local Levies			
a. TIP Charges	**6,300**	**10,320**	**63.8**
2) Public Health & Sanitation Service Fees			
a. Refuse Collection Fee	**2,903**	**0**	**-100.0**
b. Waste Disposal Services (Water Co.)	**740**	**0**	**-100.0**
Subtotal	**9,943**	**10,320**	**3.8**
(2) Expenditure			
1) Personnel	0	59,880	-
2) Operations	214,043	204,010	-4.7
3) Maintenance	22,500	22,200	-1.3
4) Capital Expenditure & Investment	0	70,000	-
Subtotal	236,543	356,090	50.5
3. General Cleansing			
(1) Revenue			
1) Miscellaneous Fees & Charges			
a. Garbage Dumping Fee	**0**	**0**	**0.0**
Subtotal	**0**	**0**	**0.0**
(2) Expenditure			
1) Personnel	136,480	44,702	-67.2
2) Operations	8,550	3,800	-55.6
3) Maintenance	3,500	3,200	-8.6
Subtotal	148,530	51,702	-65.2
Total Revenue	**9,943 (54.1)**	**10,320 (54.4)**	**3.8**
Total Expenditure	**385,163 (79.2)**	**407,792 (74.9)**	**5.9**
Balance	**-375,220 (80.2)**	**-397,472 (75.7)**	**5.9**
DOE			
Total Revenue	**18,392 (100)**	**18,982 (100)**	**3**
Total Expenditure	**486,167 (100)**	**544,216 (100)**	**12**
Balance	**-467,775 (100)**	**-525,234 (100)**	**12**

Note: Figures in parenthesis indicate the share of the total DoE budget.
Source: Department of Treasurers, CCN

2.9.2 Waste Charging System

(1) Nairobi City

(a) Business Establishment

After 2008, the new waste charging system was implemented. The business establishments are categorised into around 80 groups and the rates of charges per ton are classified into 5 classes, namely; KSh 100, 200, 320, 420 and 500. In 2009, new charges were added for supermarkets (KSh 1,000); post offices, courts (institutions), banks (institutions) as KSh 1,500; other institutions (KSh 3,000) and hotels (KSh 5,000). The waste charges are collected mostly monthly on the basis of the amounts of collected wastes which are counted by the driver by observing the loaded truck depending on the loading capacity of the truck. The charge is paid based on invoice issued by the CCN. The collection rate of charges is less than 35%. The

amounts of waste charges depend on the amounts of wastes to be collected by category of wastes and of business. Collection and transportation are suspended for defaulters.

(b) Households

When the water supply service was being implemented by the CCN, waste charges of KSh 10 per household were paid at the time the water charges were collected. After the water supply service was privatised to the Nairobi City Water and Sewerage Company Limited (NCWSC) in 2003, the collection of waste charges was suspended. Therefore, a new waste charging system is necessary to be created. Main reasons of the no-charge until now are considered to be (i) the costing for collecting charges for each household because the collection with water charge is assumed to be less cost without the need of personnel to collect; (ii) the difficulty to set up the charge level by income level; (iii) the political reason that the congressman wishes to keep the support from people by not imposing the waste charge; (iv) the increase of waste collection by private companies; (v) the difficulty of asking the slum and low income areas to pay the charges, and so on.

(2) Contractors (Outsourced Company)

The area for the collection and transportation of wastes is divided into nine (9) zones including CBD (central business district) and contracts with private companies were agreed based on the zone. The total number of contractors is around 21 according to the documents obtained from the Solid Waste Management Section of the DoE in April 2009. The procurement of contractors is done by the CCN through the open bidding system.

The contract amounts are agreed between CCN and contractors on the basis of KSh rate per ton of collected wastes. This rate is based on the transportation distance from the collection sources to the dumpsite. The number of companies is assumed to be different each month. The rate ranges from KSh 748 to 1,210 and the average is KSh 960.

Comparing the waste management cost per day between the CNN and the contractors (outsourced companies), the contractors would save the costs for solid waste management by KSh 2,080 for direct cost, KSh 1,416 for indirect cost and KSh 3,496 for total cost. The private companies are supposed to pursue effective management to make profit from their business as much as possible. These figures from the private contractors reflect their business conditions. On the contrary, the cost of CCN is not based on effective management because it is not business minded. In this context, this comparison suggests that outsourcing is one of the alternatives for the effective solid waste management by the CCN.

(3) Licensed Company

(a) Number of Licensed Companies

The licensed companies are registered with the Business Permit Office of the CCN by the time they are issued a business permit for their trucking or transportation business. The number of registered companies was 15 in 2009. The licensed companies must also pay a license fee as waste transporter to NEMA (National Environment Management Authority).

(b) Waste Charge

The following table shows an example of waste charge for the Zoa Taka Ltd. Charges are classified into corporate and household. The waste charges for corporations are categorised into six (6) on the basis of package material and truck load, while those of households are categorised into two (2) on the basis of income level. The bases of charges to decide the level of charges are mainly five factors, namely; (i) quantity of collected wastes; (ii) type of waste

such as food, industrial, construction, garden, etc.; (iii) location/distance of the client's premises; (iv) frequency of collection; and (v) income level. Waste charges for a few residential clients are paid on mostly monthly and quarterly bases. The payment method is by cash and check collected by debt collectors. Clients must deposit in advance payment for the cost of dump and skip as the containers. The amount of payment for containers is settled by taking account of the condition of the containers during the termination of contract. If the containers are damaged, the settled amount of damage will be deducted from the amount of deposit to be repaid.

In cases where the beneficiary of waste collection/transportation services fails to pay the waste charges, the contractor could suspend the waste collection/transportation.

Table 2.9.1 Rate of Charges of Zoa Taka Ltd.

1. Corporate

	Type	Charge in Kenya Shilling	Capacity	Actual Weight
1	Plastic Bag	100 - 200/- per Bag	10kg	Depending on the type of waste
2	Drum	250 - 400/- per Drum	210kg	
3	Std Skip	2000 - 2500/- per Skip	1,000kg	
4	Mega Skip	3000 - 3500/- per Skip	2,000kg	
5	4.0t Truckload	4000 - 5000/- per Load	4,000kg	
6	8.0t Truckload	8000 - 9500/- per Load	8,000kg	

2. Households

1	Low & Middle Income	200-250/month/household
2	High Income	400-550/month/household

Source: Zoa Taka Ltd.

2.9.3 Management Situation of Private Companies

(1) Licensed Company

The City Council of Nairobi allows privately-owned companies to collect, transport and dispose solid waste. CCN licenses these private garbage collectors to operate and it also runs the Dandora Dumpsite where the private garbage collectors are expected to finally dispose the collected non-hazardous solid waste. The private garbage collectors collect solid waste from residential areas, commercial entities, industries and even health care providers. The private garbage collectors handling hazardous waste are, however, expected to dispose these wastes through their own means as approved by the National Environment Management Authority (NEMA). Thus some private garbage collectors own and operate incinerators. To apply, the private garbage collectors pay the City Council of Nairobi an application fee of KSh 10,200. Once licensed, they pay KSh 8,800 per annum as license fee to operate. Furthermore, private garbage collectors need to have a license for each truck they operate for solid waste transportation. For this they pay license fees of KSh 5,000 to KSh 8,000 to NEMA and KSh 5,000 to the City Council of Nairobi. To dispose non-hazardous waste at Dandora, private garbage collectors pay a tipping charge of KSh 280 per trip.

According to the income statement of one of the licensed companies, the gross profit increased by 1.64 times from KSh 2,592 thousand to 4,244 thousand in 2007 to 2008. As for expenditure, the total expenditure increased by 1.64 times from KSh 2,540 thousand to 4,165 thousand. Therefore, the growth rate of gross profit was the same as that of total expenditure. The net profit increased by 1.52 times from KSh 51.5 thousand to 78.3 thousand. The highest growth rate recorded for bank charges was 4.37 times, followed by insurances at 3.65 times and marketing commissions at 3.18

times. It must be noted that the growth rate of salaries and wages was relatively lower than other items of expenses indicating savings on personnel costs.

The Operating Income Margin (OIM) is derived from operating income by sales and indicates the strength of profitability of the company regarding the revenues to be earned by the main business for waste collection and transportation. The operating income is the difference between the gross income and the total of sales cost and general administration cost. The OIM of this company has increased from 10.4% to 12.4% from 2007 to 2008 and shows the increase of profitability year by year.

(2) Community-Based Organisation (CBO)

The City Council of Nairobi (CCN) licenses community-based organisations (CBOs) to collect waste from generators and deposit them in a designated collection point where the CCN collects it for final disposal. However, there are some CBOs that have trucks and thus are able to transport their collected waste to the Dandora Dumpsite.

The CBOs charge the households a weekly and, in some instances, a monthly rate for the collection of waste. According to the field survey by CCN, it is considered that the CBOs are actually charging 7KSh/month~100KSh/month from the slum area and 100KSh/month~200KSh/month from the middle income area. They use these charges to finance their operations. Most CBOs also recover some reusable and recyclable materials from the waste they collect. They sell these materials to supplement their income.

The CBOs pay varying rates to the CCN as they are charged per amount of waste they have collected which the CCN transports and finally disposes. However, some of the CBOs hire private trucks to collect their waste for final disposal. There are currently 140 registered CBOs in Nairobi that are involved in solid waste management.

2.10 Hazardous Waste Management

2.10.1 Present Condition of Hazardous Waste Management

At present, there is no national legislation to guide the City Council of Nairobi (CCN) in the management of hazardous waste. CCN recognises that effective management of medical and industrial wastes is difficult under the present situation. The Environmental Management and Coordination (Waste Management) Regulations of 2006 conferred by Section 92 and 147 of the Environmental Management and Coordination Act (No. 8 of 1999) implemented by the National Environment Management Authority (NEMA) deals with almost all types of waste including biomedical, industrial wastes, etc., by setting out provisions on the responsibility of waste generators, licensing of transportation of waste, waste treatment disposal facilities and control of hazardous waste. Licenses have been issued to waste handlers and controlled under the conditions for licensing under the Environmental Management and Coordination (Waste Management) Regulations of 2006. However, no concrete policy and/or guidelines on hazardous waste management have been implemented.

The different types of hazardous wastes being considered in Nairobi City are the following:

Medical Waste such as sharp objects (needles and blades), syringes, vials, tubes, infectious wastes (cotton, diapers, gloves and clothes), chemical waste (solid, liquid and gaseous chemicals as disinfectant or solvent for cleaning process), pathological wastes (human tissues and organs), and other microbiological waste, including:

- Pharmaceutical Waste such as drugs, vaccines, sera, etc.;

- Farm Waste such as empty chemical containers;
- Packaging from agrochemical industries (pesticides);
- Seeds which are stocked with chemicals;
- Solvents dealing with metal packaging;
- Oil Sludge from motor vehicle industries;
- Feril Goods; and
- Substandard Raw Materials.

(1) Medical Waste

There are 409 health care facilities in Nairobi City**. Table 2.10.1** shows the type of health facilities and the frequency of disposing medical waste.

Table 2.10.1 Health Care Facilities in Nairobi City

Health Care Facilities	Number	Ratio (%)
Clinic	141	34.5
Dispensary	100	24.4
Health Center	76	18.6
Hospital	23	5.6
Nursing Home	27	6.6
Research Centre	1	0.2
VCT Centre	41	10.0
Total	409	100.0

Source: Ministry of Public Health and Sanitation, 2009

Healthcare facilities are being operated by government and private sectors. The distribution of ownership is shown in **Table 2.10.2**. More than half of the total number of facilities is privately-owned.

Table 2.10.2 Ownership of Healthcare Facilities

Health Care Facilities	Number	Ratio (%)
Company Clinic	6	1.5
Government of Kenya	65	15.9
Mission	55	13.4
Nairobi City Council	63	15.4
Non-Government Organisation (NGO)	11	2.7
Private	209	51.5
Total	409	100.0

Source: Ministry of Public Health and Sanitation, 2009

There are five (5) incinerators being used by the government or the city council. These are located in the following facilities:

(a) Mathare Mental Hospital;

(b) Kangemi Health Centre;

(c) Kayole II Sub-District Hospital;

(d) City Mortuary; and

(e) Westlands Health Centre.

Private healthcare facilities have arrangements with private refuse collectors licensed and accredited by NEMA, who collect periodically and take medical wastes for incineration.

(2) Industrial Waste

There are about 501 industries in Nairobi City. **Table 2.10.3** shows the location division and frequency of industrial plants that dispose hazardous waste.

Table 2.10.3 Industrial Plants in Nairobi City

Location of Industrial Plant	Number	Ratio (%)
Starehe	38	7.6
Westlands	10	2.0
Dagoretti	6	1.2
Embakasi	72	14.4
Kamkunji	6	1.2
Kasarani	25	5.0
Langata	20	4.0
Makadara	293	58.5
Non-Allocated	31	6.2
Total	501	100.0

Source: Department of Computer, City Council of Nairobi, 2009

The disposal system of the different industries to their hazardous waste is the same system as that being done by private hospitals. They contract private collectors licensed and accredited by NEMA. All of the industries have a storage area or holding area where they store their hazardous waste. Most of the hazardous wastes are collected on monthly basis. The storage area is strictly secured, and no one can enter without the permission of the manager and the visitor should be accompanied by the person-in-charge only.

2.10.2 Evaluation of Current Condition of Hazardous Waste Management

The incineration process in Nairobi City started only in year 2002, being initiated by Dr. Mwabe from the Environmental & Combustion Consultants, Ltd. The first incinerator has the capacity of about 1,000 kg/hr. Operations started with oil sludge and then pesticides to industrial waste and now even pharmaceutical and medical wastes are being incinerated.

Based on the gathered information, the disposal of hazardous wastes from private medical and industrial facilities is relying on the services provided by private contractors. There are only five (5) contractors providing incineration in Nairobi City. The lists of contractors and details of hazardous wastes being collected and incinerated are as shown in **Table 2.10.4**.

Table 2.10.4 List of Contractors with Incinerator in Nairobi City

Name of Contractors	Capacity of Incinerators (kg/hr)	Estimated Amount Hazardous Waste (ton/month)
Environmental & Combustion Consultants, Ltd.	2,000	30 – 60
Envirosafe Ltd.	1,000	18 – 40
Nairobi Incinerators	500	10 – 25
Kenya Medical Institute (KEMRI)	400	2 – 8
Ecowaste	600	20
Total	4,500	

Source: JICA Survey Team, 2010

2.10.3 General Recommendations on Hazardous Waste Management

Some of the recommendations to be considered in the improvement and development of the hazardous waste management system in Nairobi City are the following:

- Provide a separate cell at the proposed sanitary landfill for the ashes of incinerated hazardous wastes;
- The Environmental Management and Coordination Act of 1999, Section 91, should be properly implemented and enhanced with common standards to be followed;
- The Government or the City Council of Nairobi should implement policies or guidelines that will centralise the hazardous waste management system;
- Specific policies and regulations on e-waste should be developed. These should govern the handling process from collection to final disposal, and licensing of the key actors. A collection system needs to be developed, and a consumer awareness campaign launched. Waste should be sorted at source, and this should be enforced by the local authorities. Capacity development programmes should be launched in the sector, possibly funded by fees levied on importers of second-hand equipment; and
- Developing an e-waste management system should be a multi-stakeholder process, which includes the participation of civil society.

CHAPTER 3. PLANNING POLICIES OF SOLID WASTE MANAGEMENT IN NAIROBI AND FRAMEWORK OF THE MASTER PLAN

3.1 Introduction

Caption 265 of the Local Government Act and Caption 242 of the Public Health Act legally mandate the local authorities of Kenya to take reasonable and practical measures to maintain their areas of jurisdiction at all times in a clean and sanitary condition. For example, as stated in Article 11, Clause 242 of the Public Health Act, Rev. 1962, every local authority shall take all lawful, necessary and reasonably practicable measures to maintain its district in clean and sanitary condition, preventing the occurrence therein or remedying or causing to be remedied or condition liable to be injurious or dangerous to health and to take proceedings at law against any person causing or responsible for the continuance of any such nuisance or condition.

After the JICA Study in 1998, the Environmental Management and Co-ordination Act, No. 8 of 1999 was enacted to provide for the development of standards for waste and formulations of regulations for the management of solid waste. Further, the City Council of Nairobi (CCN) promulgated the Solid Waste Management By-law in 2007, stipulating that CCN has the primary duty to regulate waste and its management within the area of jurisdiction of the City of Nairobi and for this purpose all wastes generated or otherwise arising within the area of the City of Nairobi shall be subjected to these By-law and shall be regulated by the Council accordingly.

The responsibility, duty, authority, regulations, etc., of the local government mandated by legislation will be the key elements to formulate the solid waste management (SWM) plan. This chapter thus proposes the principles and guidelines for establishing the framework of SWM for Nairobi City. In particular, to establish the planning policies and general directions for the formulation of the Master Plan, *the Integrated Solid Waste Management Plan (ISWMP) for the City of Nairobi* developed under the United Nations Environment Programme (UNEP) was referred to in principle since this UNEP Project was started in March 2009 and ahead of the present survey, and it already drafted planning strategies including vision, mission, goals and targets of ISWMP covering mostly the same as the present survey scope of work.

3.2 Principles and Guidelines for Establishment of SWM Framework

Although more discussions and consensus between the JICA Survey Team and the Kenyan counterparts are required, principles and guidelines for solid waste management (SWM) for the City Council of Nairobi (CCN) are as prepared and presented in the following sections. These principles and guidelines are the basis on which the planning policy of SWM for CCN and framework of the Master Plan shall be formulated hereinafter.

3.2.1 Categories of Waste

(1) Municipal Waste

CCN is responsible for the management of municipal waste. Municipal waste is defined in the Solid Waste Management By-law of 2007 as "waste which is the responsibility of the Council whether under these By-laws or under any other law to collect, treat and otherwise dispose of, and includes refuse." It is suggested that, for practical purposes, types of municipal wastes should be much clearly defined as the same types in the JICA Master Plan Study in 1998, as follows:

(a) Household waste
(b) Business waste of small amount (less than 50 kg)
(c) Waste generated from public institutions such as schools
(d) Market waste
(e) Hospital waste that does not require any treatment
(f) Dead animals excluding domesticated animals (cows and pigs)
(g) Street waste excluding demolition waste dumped on streets
(h) Other wastes accepted by CCN as municipal waste

(2) Non-Municipal Waste

Non-municipal waste is waste that is not under CCN's responsibility but the responsibility of waste generators. Waste categories are as summarised in the table below:

Table 3.2.1 Waste Category and Management Responsibility

Kinds of Waste	Management Responsibility	Remarks
1. Municipal waste	CCN	CCN collects bulky waste upon receipt of a request from citizens by charging a special tariff.
2. Non-municipal waste 2-1 Non-hazardous industrial waste and commercial waste of large amount 2-2 Demolition waste 2-3 Discarded vehicles 2-4 Hazardous waste including infectious hospital waste	Generators of waste (CCN should monitor generators' management of non-municipal waste until they establish a proper management system for these waste.)	CCN may accept waste 2-1 and 2-2 at its disposal site on full cost recovery basis. The central government should establish hazardous waste management (treatment) facilities.

3.2.2 Responsibility of Central Government, CCN, Business Waste Generators and Residents

CCN must have the power and responsibility for organising solid waste management. As shown below, there are other organisations involved in solid waste management.

- Central Government
- CCN
- Contractors
- Business (Industrial and Commercial) Waste Generators
- Citizens

The proposed principal responsibilities of respective organisations are given in the table below.

Table 3.2.2 Parties Involved in Solid Waste Management and Their Responsibilities

Involved Parties	Responsibilities
1. Central Government	1) To formulate a national policy with respect to waste reduction, recycling and solid waste management. 2) To formulate and pass a national SWM law. 3) To set technical standards. 4) To research on solid waste management. 5) To ensure that the laws and regulations are applied. 6) To provide guidance to local governments.
2. City Council of Nairobi	1) To formulate a local policy and prepare local strategies and plans (short and long term). 2) To finance SWM. 3) To levy a waste tax. 4) To formulate regulations. 5) To formulate guidelines with respect to: a) methods of discharging waste (types of containers to be used); b) the waste reporting requirements of business waste generators; and, c) recycling (types of waste to be recycled).
3. Contractors	1) To provide waste collection, haulage and street sweeping services under contractual arrangements.
4. Business (Industrial and Commercial) Waste Generators	1) To manage (collection, treatment and disposal) their waste except those accepted by the local government as municipal waste 2) To submit reports on their waste (types, quantity, pretreatment and other information) as required by the municipal regulations.
5. Residents	1) To reduce generation of waste. 2) To recycle. 3) To comply with the local government's waste collection procedure. 4) Not to litter waste. 5) To dispose of discarded vehicles by using commercial enterprises.

3.2.3 Vision, Mission and Goals of Solid Waste Management in Nairobi City

(1) Vision of Solid Waste Management in Nairobi City

The vision of solid waste management in Nairobi City is proposed in the UNEP Integrated Solid Waste Management Plan (ISWMP), as follows:

"A healthy, safe, secure and sustainable solid waste management system fit for a world-class city"

(2) Mission of Solid Waste Management in Nairobi City

The mission of solid waste management in Nairobi City is proposed in the UNEP ISWMP, as follows:

(a) To improve and protect the public health of Nairobi residents and visitors;

(b) To protect ecological health, diversity and productivity; and

(c) To maximise resource recovery through the participatory approach.

(3) Goals of Solid Waste Management in Nairobi City

The goals of solid waste management in Nairobi City are proposed in the UNEP ISWMP, as follows:

(a) To significantly extend resource recovery, including but going beyond the creation of enabling environments and the development of markets for recyclables;

(b) To build (awareness and capacity for) source separation as essential components of sustainable waste management;

(c) To restructure and extend efficient and equitable collection of source-separated waste streams with the view of protection of public health and the environment; and

(d) To build environmentally sound infrastructure and systems for safe disposal of residual waste, replacing current disposal sites which must be rehabilitated.

3.3 Planning Strategy

3.3.1 Problem Identification on SWM in Nairobi

As stated in **Chapter 2**, due to poor waste collection services of the city authority, residents of Nairobi have been suffering environmental deterioration around their living quarters and, consequently, lodge complaints with CCN for fear of degradation of public health. In addition to the evaluation based on the result of site reconnaissance and field surveys, two stakeholders' workshops were held at the end of March 2010 to identify the current problems and establish the planning directions to solve these problems.

Based on the results of these surveys, analyses and workshops, there are many causes preventing CCN from conducting better services of waste collection and disposal. Although the major problems enumerated below, which are considered to be the key issues on master plan formulation, are still the same as those of the previous master plan in 1998 and not yet solved, low level of waste collection rate especially in low income and slum areas and lack of financial sources are identified as the two core problems that shall be solved.

- Low level of waste collection rate
- Lack of spare parts and long procedure for procurement of parts
- Few involvement of CCN on waste reduction and resource recovery
- Illegal and uncontrolled disposal
- Open dumping and no ample space available at Dandora Dumpsite
- Inefficient institutional and organisational arrangements of CCN
- Uncontrolled private sector involvement on waste collection services
- Lack of financial sources for investment and operation
- Improper budgetary system failing to secure financially sound operation
- Lack of public awareness about SWM problems facing the city

3.3.2 Planning Strategy

To solve the problems and achieve the goals, the strategic approach to formulate the SWM Master Plan for CCN are proposed with the following six items in consideration of solving the implicated constraints of the city towards improvement of technical and institutional deficiencies:

- Financial strengthening of SWM

- Institutional capacity development
- Improvement of SWM operational capacity
- Enhancement of PPPP (Public-Private-People Partnership) in SWM
- Public awareness and participation of CBOs and NGOs
- Promotion of 3R (reduce, reuse, recycle)

3.4 Planning Directions of the Master Plan

3.4.1 PCM Workshop

In order to further analyse the existing situation, the full-scale *"problem analysis"* as well as *"objective analysis"* using the PCM (Project Cycle Management) method was conducted in the occasion of the second workshop on the 24th of March 2010. *"Problem Analysis"* is a method for graphically displaying the problematic environment related to the matter of issues. The analysis lays problems out in a cause and effect tree with roots and branches showing relationships between problems. Roots represent causative factors and branches represent consequent effects. One problem in a tree is one of the causes of the problem located above as well as the effect of the problem located beneath. Participants of the workshop were from various stakeholders including CCN and central government, CBOs and NGOs.

Apart from this workshop, a workshop for CBOs was also held on the 26th of March 2010 for about 150 CBOs in Nairobi. Participants in this workshop came exclusively from the CBOs in Nairobi and they carried out *"Problem Analysis"* to identify problems encountered in their own communities.

As a result of these workshops, major constraints on SWM in Nairobi were identified and confirmed, as presented in the preceding **Subsection 3.3.1** and required actions in the master plan were developed, as presented in **Subsection 3.4.3**. More detailed information on the workshops is given in **Section B of Volume 3, Supporting Report**.

3.4.2 Formulation of Project Design Matrix (PDM) and Plan of Operations (PO)

Based on the PCM workshop, the outline of the identified project are expressed in the form of PDM (Project Design Matrix), which is a four-by-four matrix to lay out a project design, in **Section B of Volume 4, Data Book**, and each box in the PDM contains the following specific information.

- ***Narrative Summary*** refers to the hierarchy of objectives and makes the distinction between programme strategy ***(Overall Goal)***, project impacts ***(Project Purpose)***, project deliverables ***(Outputs)*** and the key activities ***(Activities)***.
- ***Objectively Verifiable Indicators*** identifies the performance indicators which define quantity, quality and time for each objective.
- ***Means of Verification*** refers to the data sources for objectively verifiable indicators.
- ***Important Assumptions*** describes the other conditions on which each project depends for its success.
- ***Pre-conditions*** indicate prerequisites for starting a project or implementing the activities.
- ***Inputs*** required for implementation of the activities are listed in the bottom box in the second column.

Activities specified in each PDM are broken down into more manageable packages of work, which is called Work Breakdown Structure (WBS). The WBS is a deliverable-oriented hierarchical decomposition which defines all the works to be accomplished during the project. Being a critical document of the project scope, the WBS serves as the basis for planning of the project. More concretely, the WBS is a very common and critical project management tool, and the full-scale WBS will be formulated and incorporated into the new Master Plan. The plan of operation (PO) of each action plan is presented in **Section 4.12**.

A full-scale PO is a detailed project implementation plan containing various project management factors including scope, time, human resource, quality, procurement and cost. The full-scale PO including the following contents will be also incorporated into the new Master Plan.

- ***Activities*** are the list of detailed activities which are equivalent to the WBS.
- ***Expected results*** are performance indicators of the activities.
- ***Time schedule*** is a calendar bar chart which provides time estimates, sequence of activities over time and the precedence relationships.
- ***Person in charge*** is a responsible person with supervisory authority over a set of activities.
- ***Implementers*** are human resources or team assignments for implementing the activities.
- ***Materials and equipment*** are resources input to implement activities and their procurement schedule.
- ***Budget and expenditure*** defines the allocation and disbursement of budget for a set of activities.

Out of these factors, ***"time schedule"***, ***"implementers"*** and ***"budget/expenditure"*** are integral parts of the PO.

Project time management, which is a subset of project management including the processes required to ensure timely completion of the project, is related to ***"time schedule"***.

Project cost management, which refers to process ensuring that a project is completed on time and within budget, is related to ***"budget and expenditure"***. In the preliminary POs, WBS-wise ***Cost Breakdown Structure (CBS)*** as well as ***Budget Breakdown Structure (BBS)*** for each project is specified.

3.4.3 Components of the Master Plan

The Master Plan of SWM Improvement in Nairobi is formulated in three stages of action plans, namely; the first implementation stage (short-term plan covered from 2011 to 2015); the second implementation stage (mid-term plan covered from 2016 to 2020); and the third implementation stage (long-term plan covered from 2021 to 2030). The action plans are formulated through two approaches: (1) technical approach, and (2) institutional and financial approach. The major planning items of the Master Plan as the result of the PCM Workshop are summarised as the following eight programmes.

Technical Approach of the Master Plan

Programme 1: Collection and Transportation Plan

Programme 2: 3R and Intermediate Treatment Plan

Programme 3: Final Disposal Plan

Institutional and Financial Approach of the Master Plan

Programme 4: Organisational Restructuring and Human Resources Development Plan

Programme 5: Legal and Institutional Reform Plan

Programme 6: Financial Management Plan

Programme 7: Private Sector Involvement Promotion Plan

Programme 8: Community Participation Promotion Plan

3.4.4 Objectives, Planning Policies and Strategies of Each Component of the Master Plan

The objectives, planning policies and strategies of each component of the Master Plan are clarified, as follows:

(1) Collection and Transportation Plan

(a) Objective

The overall objective of the Collection and Transportation Plan is to improve or expand the collection service coverage in the whole area of Nairobi City in order to maintain public health and cleanliness, and to protect the City's environment.

(b) Planning Policy

The basic policy of the Collection and Transportation Plan is to prioritise an optimum system through taking into consideration a time frame development and proper allotment of collection and transportation system synchronising with other sectors (especially transportation sector). For the issue in low income and slum areas, on the other hand, the existing problems in these areas shall be identified and reflected on the planning to eliminate the obstacles for providing appropriate collection and transportation services.

(c) Strategy

(i) Technical alternatives on collection and transportation system shall undergo evaluation by studying if they can bring the most efficient effect in terms of collection and transportation of solid waste from generation source to final disposal, as well as evaluation from the viewpoint of less impact to society and the environment.

(ii) The development plan for collection vehicles or equipment for collection and transportation shall be studied on whether or not it corresponds to the most optimum system of collection and transportation including the transfer system.

(iii) The rearrangement of private sectors shall be required to enhance the administrative leadership of CCN in controlling the current disorder of their collection and transportation services. Administrative control of their services by zone or district will be one of the solutions. More detailed approach toward better management of private sectors shall be discussed in the planning in parallel with the establishment of organisation and institutional framework.

(iv) As for the solid waste management in lower income and slum areas, the key issues shall be identified in terms of waste generation, collection and transportation through a problem analysis approach such as group discussion for CBOs who are main actors in these areas.

As a result, an optimum system of discharge and collection shall be studied in combination with the improvement of transportation system to be provided by CCN or its subcontractors to eliminate the factors causing illegal dumping at these areas.

(v) Action plans shall be prepared in a time frame of short, middle and long term to implement the most suitable development option of collection and transportation.

(vi) The capital, operation and maintenance cost for collection and transportation in the above time frame shall be studied to examine the economical and financial viability of solid waste management.

(2) 3R and Intermediate Treatment Plan

(a) Objective

The 3R and Intermediate Treatment Plan is composed of the plans for waste reduction, recovery of resources, reuse, recycling and intermediate treatment, whose objectives are as follows:

(i) The objective of the Waste Reduction Plan is to lighten the cost burden of CCN through the reduction of solid waste amount for collection and disposal.

(ii) The objective of the 3R Plan is to save finite resources and minimise landfill space as a result.

(iii) The objective of the Intermediate Treatment Plan is the stabilisation and reduction of residuals in addition to resource recovery through waste conversion.

(b) Planning Policy

(i) The Waste Reduction Plan shall be formulated under the condition to perform a role of each party, i.e., the role of the Government, local authority and the beneficiaries.

(ii) Solid waste recycling shall make use of the existing functions of the residents, junkshops, community-based organisations, NGOs and the recycling industries (recyclers) to the maximum extent.

(iii) The Intermediate Treatment Plan shall be formulated in consideration of the applicable technology in Kenya so as not to cause a financial burden on SWM.

(c) Strategy

(i) Waste reduction shall be carried out to reduce discharge of domestic, commercial and other business wastes through participation of the consumers, shops, workplaces, CCN, and the government agencies concerned.

(ii) CCN shall have the primary responsibility for promotion, guidance and assistance to the residents, community groups, enterprises, and all other stakeholders for establishing the recovery, reuse and recycling systems.

(iii) Practical and initial solid waste recycling activities shall be carried out mainly through materials recovery by the waste generators at sources and the activities of waste pickers, waste collection workers and junkshops in town.

(iv) Small-scale intermediate treatment shall be promoted through home composting and community level composting for recycling biodegradable waste.

(v) Large-scale intermediate waste treatment or waste conversion shall be introduced in the future.

(3) Final Disposal Plan

(a) Objective

In the concept of final process of solid waste management (SWM) system, the objective of Final Disposal Plan is to have the solid waste stabilised and be hygienic to prevent secondary pollution.

(b) Planning Policy

The sanitary landfill is evaluated to be the most appropriate disposal method from both economic and environmental viewpoints. Therefore, the final disposal plan shall be formulated for the construction and operation of a sanitary landfill. Altogether, the plan of closure of Dandora and the existing illegal dumpsites shall be considered as sanitarily as possible where the present reclamation is performed.

(c) Strategy

(i) The scale of sanitary landfill facilities and their operation shall take financial availability into consideration. Due to financial constraints concerning SWM financing, a phased construction of the disposal site shall be also considered.

(ii) The Closure Plan for the Dandora and the existing illegal dumpsites shall take economical efficiency into consideration as if the influence on surrounding environment is made to reduce.

(4) Organisational Restructuring and Human Resources Development Plan

(a) Objective

The Organisational Restructuring and Human Resources Development Plan have two objectives as follows:

(i) To comprehensively reorganise the functions of the Department of Environment to the ring-fenced new public organisation so that the responsibilities and services on solid waste management could be effectively and efficiently managed.

(ii) To comprehensively strengthen human resources capacities of the candidate staff and workers of the new organisation to support its functions.

(b) Planning Policy

(i) For the establishment of the new organisation in charge of solid waste management services, the function of the Department of Environment should be comprehensively reviewed in terms of organisational and individual capacity assessment;

(ii) Responsibilities and obligations of the new organisation should not be fragmented or overlapping among the staff and workers;

(iii) Linkages and coordination arrangements between different departments in the new organisation should be efficient and effective;

(iv) The organisational structure should be optimised in line with the selected structure for Public-Private Partnership;

(v) The functions of the Department of Environment should be transferred smoothly to the new organisation; and

(vi) Human resources development for providing solid waste management services shall be comprehensively designed and implemented based on the results of the capacity assessment.

(c) Strategy

(i) The organisation of the Department of Environment shall be restructured comprehensively for establishing the new organisation based on the following concepts:

- An efficient and rationalised organisational structure with clear reporting lines, reasonable spans of control and number of levels of staff and workers, and the appropriate vertical structure to attain the operational efficiency of the solid waste management;
- A clear assignment and delegation of responsibilities and adequate authority to managers and supervisors with accountability for individual performance as well as a simple workflow for a quick decision process;
- A streamlined workflow based on the practical basis to avoid the overlapping of the organisational structure;
- Clear-cut directing functions from the strategic level down to middle management and supervisors;
- Effective and appropriate management information systems and other procedures;
- Periodic assessment and feedback of managers' performance and private operators based on agreed performance targets and criteria; and
- Streamlined zoning of the service areas for the cross-subsidisation which makes the enlarged services to poorer area possible.

(ii) The following functions should be added to the new organisation:

- The new organisation should have the function of managing and regulating the proper Public-Private Partnership scheme; and
- The new organisation should have the function of raising public awareness on best practices in solid waste management such as recycling, segregation, re-use, and recovery as well as inculcating the culture of waste reduction and proper storage among producers and consumers.

(iii) More practical human resources development including on-the-job training programme based on the capacity assessment and feedback system to share job skills among staff and workers should be implemented.

(5) Legal and Institutional Reform Plan

(a) Objective

The objective of the Legal and Institutional Reform Plan is to propose the most suitable legal arrangement which will enable the new organisation to effectively and efficiently regulate solid waste management activities in Nairobi City.

(b) Planning Policy

(i) SWM-related Acts, Regulations and By-laws should be improved in terms of better enforcement.

(ii) Monitoring system should be strengthened for the better enforcement of Acts, Regulations and By-laws.

(iii) Policy documents and guidelines should be transformed into the actual enforcement.

(c) Strategy

(i) Enactment of Basic By-laws for the establishment of the new organisation in charge of the solid waste management services;

(ii) Establishment and implementation of a system of inspection, enforcement and monitoring of solid waste management activities;

(iii) Preparation of operation manuals with respect to the solid waste management services which must comply with the relevant Acts, Regulations and By-laws; and

(iv) Introduction of the regulations to set up the basic PPP structure, the proper zoning, tariff setting, and cross-subsidisation for the proposed PPP scheme.

(6) Financial Management Plan

(a) Objective

The objective of Financial Management Plan is to improve and strengthen the financial conditions of SWM services and to support sound or sustainable operations.

(b) Planning Policy

(i) Suitable revenue should be secured for the effective operation and maintenance of SWM services.

(ii) Cost effectiveness should be improved for the operation of SWM services.

(iii) Financial planning for SWM services should be improved.

(c) Strategy

(i) Establishing Financial Autonomy of SWM

Since the generation of general tax revenue by CCN is severely constrained and is likely to remain for a considerable time, the Department of Environment must secure its own revenue for the operation of SWM services by establishing a special account whose revenue is restricted to expenditures for SWM activities only. Especially, cost accounting system should be established for the effective solid waste management.

(ii) Increasing Revenue through Charges

The expansion of collection area is the first priority to increase revenue from waste charges. The existing waste charging system for business establishments is necessary to be improved, especially, the charge collection method, by raising the accuracy to measure the volume of collected wastes. The new waste charging system for households should take into account the willingness to pay, the affordability to pay and the operating and management cost of solid waste management.

(iii) Increase of Budgetary Allocation for SWM

The allocation for SWM in the DoE is given low priority and budget is not secured by direct allocation through the LATF. A thorough review of the priority of allocating the budget is indispensable to increase the allocations for SWM and the DoE.

(iv) Private Sector Involvement

Contracting a part of the SWM services to private companies is expected to improve cost performance of the services as a whole and to contribute to the decrease of shortages of funds to operate.

(7) Private Sector Involvement Promotion Plan

(a) Objective

The objective of the Private Sector Involvement Promotion Plan is to establish the optimum PPP (Public-Private Partnership) Model for the purpose of providing the best solid waste management services based on the optimum partnership between the public sector and the private sector.

(b) Planning Policy

(i) Utilisation of the past experiences of success and failure of Public-Private Partnership.

(ii) Selection of the optimum Public-Private Partnership option based on comparative analysis of the alternative options.

(iii) Further extension of concept of Public-Private Partnership (PPP) to Public-Private-People Partnership (PPPP) with involvement of the communities.

(c) Strategy

(i) Maximisation of Benefits by PPP

The extent to which the private sector can bring benefits is reflected by the level of competition in the sector. Usually private sector management brings a number of benefits including:

- a more committed and innovative management;
- better management skills and more effective decision-making;
- improved resource management of assets and human resources;
- more efficient financing and management of capital investment;
- motivated workforce;
- quick management decision;
- higher labour productivity; and
- more efficient operational procedures.

(ii) Formulation of New Public-Private Partnership based on Long-Term, Stable and Win-Win Basis

The key objective of involving the private sector is to explore a new source of capital financing. Private sector companies should be provided an incentive to make investments to improve the level of their services for the long-term, stable and win-win based PPP scheme.

(8) Community Participation Promotion Plan

(a) Objective

The objective of the Community Participation Promotion Plan is to raise awareness of residents on their cooperation in the solid waste management.

(b) Planning Policy

(i) The Plan shall be formulated to promote a better understanding of residents through public and school environmental education by establishing a workable implementation system within CCN.

(ii) The Plan shall be formulated to promote more involvement of CBOs in the provision of collection services especially in the informal settlements.

(c) Strategy

(i) New Section within the CCN

To achieve the objective, the Section of Public Awareness, Environmental Education and Community Participation should be established to raise the awareness of the people on SWM and to facilitate the involvement of more CBOs in the provision of collection of solid waste.

(ii) Communications Strategy

The CCN has to inform the public of the measures to be taken to improve SWM services in the city. A properly structured communications strategy should be proposed.

(iii) Public Environmental Education

A public environmental education and awareness programme should be carried out to raise public awareness and involve the public in the initiatives for a better SWM in the city.

(iv) Primary Environmental Education

The introduction of SWM in the current primary education curricula should be implemented to make school children more aware on solid waste issues. In addition, the development of educational material for teachers and students of primary education is considered essential as a tool to promote environmental education and create awareness among the educational community.

3.5 Goals of the Master Plan

The goals of the action plan of each sector of the master plan are as outlined below with prospective target levels to be achieved by the year 2015 for the Short-Term Plan, year 2020 for the Mid-Term Plan and year 2030 for the Long-Term Plan.

3.5.1 Collection and Transportation Plan

(1) Short-Term Plan (2011-2015)

- Increase of collection rate from the current 33% up to 50% in 2015.
- Improvement of city's sanitary environment through the cleanup of littered wastes along the roadsides and on vacant lots.
- Formation of three (3) private franchisees for implementation of the PPPP scheme.
- Improvement of collection and transport system through procurement of collection vehicles and introduction of the container system.

(2) Mid-Term Plan (2016-2020)

- Increase of collection rate up to 65% in 2020.
- Formation of six (6) franchisees for implementation of the PPPP scheme.
- Improvement of collection and transport system through procurement of collection vehicles and introduction of the container system.

(3) Long-Term Plan (2021-2030)

- Increase of collection rate up to 100% in 2030.
- Formation of nine (9) franchisees for implementation of the PPPP scheme.
- Improvement of collection and transport system through procurement of collection vehicles and introduction of the container system.

3.5.2 3R and Intermediate Treatment Plan

(1) Short-Term Plan (2011-2015)

- Waste reduction ratio of 5% (0% in 2009) to the potential waste discharge amount in 2015.
- Total resource recovery amount of about 180 tons per day or the equivalent ratio of about 10% to the potential waste collection amount in 2015.

(2) Mid-Term Plan (2016-2020)

- Waste reduction ratio of 10% (5.3% in 2009) to the potential waste discharge amount in 2020.
- Total resource recovery amount of about 270 tons per day or the equivalent ratio of about 12.5% to the potential waste collection amount in 2020.

(3) Long-Term Plan (2021-2030)

- Waste reduction ratio of 10% to the potential waste discharge amount in 2030.
- Total resource recovery amount of bout 450 tons per day or the equivalent ratio of about 16% to the potential waste collection amount in 2030.

3.5.3 Final Disposal Plan

(1) Short-Term Plan (2011-2015)

- Reduction of secondary pollution from Dandora Dumpsite by urgent improvement works on the site.
- Preparation and commencement of construction of new sanitary landfill site at Ruai.
- Reduction of number of illegal dumpsites in the city.

(2) Mid-Term Plan (2016-2020)

- Minimisation of secondary pollution from Dandora Dumpsite by closure works on the site.
- Preparation of a post-closure land use plan for Dandora.
- Operation of an effective sanitary landfill at Ruai.
- Elimination of major illegal dumpsites in the city.

(3) Long-Term Plan (2021-2030)

- Minimisation of adverse effects from the new landfill site by proper operation and management.

3.5.4 Organisational Restructuring and Human Resources Development Plan

(1) Short-Term Plan (2011-2015)

- Establishment of the new public-owned and ring-fenced corporation in charge of the overall solid waste management services by the end of 2014.
- Establishment of the preparatory organisation for the new public-owned corporation inside the Department of Environment by the middle of 2011.
- Establishment of transparent financial management for the solid waste management services by the new public-owned corporation by the end of 2011.
- Strengthening of the technical and managerial capacities of the candidate staff of the new public-owned corporation with the support of external technical cooperation through implementation of a comprehensive capacity development programme during the 5-year period from 2011 to 2015.

(2) Mid-Term Plan (2016-2020)

- Improvement of the organisational structure of the new public-owned corporation based on feedback of results of the mid-term performance monitoring and assessment.
- Improvement of staff capacities of the new public-owned corporation based on feedback of results of the mid-term performance monitoring and assessment of the capacity development programme.

(3) Long-Term Plan (2021-2030)

- Improvement of the organisational structure of the public-owned corporation based on feedback of results of the long-term performance monitoring and assessment.
- Improvement of staff capacities of the new public-owned corporation based on feedback of results of the long-term performance monitoring and assessment on the capacity development programme.

3.5.5 Legal and Institutional Reform Plan

(1) Short-Term Plan (2011-2015)

- Legalisation of establishment of the new public-owned and ring-fenced corporation as well as transparent financial management of the solid waste management services.
- Strengthening and modification of monitoring and enforcement functions of the legal framework related to the solid waste management.
- Legalisation of simplification of the procurement and contractual process of the new public-owned corporation.
- Legalisation of financial assistance system for the enlargement of investment on the improvement of collection and transportation services by the private sector.

(2) Mid-Term Plan (2016-2020)

- Selection and implemention of the optimum public-private partnership scheme through the arrangement of a comprehensive legal framework and procedures.
- Improvement of the SWM-related Acts, Regulation and By-laws based on the feedback of the results of the mid-term performance monitoring and assessment of the status of legal enforcement.

(3) Long-Term Plan (2021-2030)

- Achievement of efficient legal enforcement by consolidating the SWM-related Acts, Regulations and By-laws into the comprehensive SWM legal framework.
- Improvement of the SWM-related Acts, Regulation and By-laws based on feedback of results of the long-term performance monitoring and assessment on the status of legal enforcement.

3.5.6 Financial Management Plan

(1) Short-Term Plan (2011-2015)

- More detailed analysis of cost of waste treatment for a more cost-oriented waste charging system through the establishment of the cost accounting system.
- Increase of revenue of CCN/SWMPC with the establishment of the new waste charging system for households.
- Increase of revenue with the revision of the waste charging system for business establishments for sustainable and stable financial conditions.

(2) Mid-Term Plan (2016-2020)

- More efficient SWM service provision through the newly established independent accounting system for SWMPC.
- Improvement of rationale and suitable relationship between waste charge and cost of waste management with the review of the cost accounting system for SWMPC.
- Further increase of revenue with the review of the waste charging system in relation to the level and the collection system for waste charges.

(3) Long-Term Plan (2021-2030)

- Sustainable and stable increase of revenue with the revision of the waste charging system in relation to the level and the collection system for waste charges.
- Assurance of fair competition and suitable waste charge level for all SWM service providers with the application of the new waste charging system.
- Improvement of collection rate of waste charge and increase of revenue with the monitoring and supervision of the collection system of waste charges by all SWM service providers.

3.5.7 Private Sector Involvement Promotion Plan

(1) Short-Term Plan (2011-2015)

- Establishment of efficient and reliable private sector involvement scheme for the collection and transportation services, and the construction and management of sanitary landfill sites and intermediate treatment facilities through the new public corporation for SWM.
- Establishment of financial assistance system for the enlargement of investment for the improvement of the collection and transportation services by the private sector.

(2) Mid-Term Plan (2016-2020)

- Delivering services in lower income areas by the concept of cross-subsidy and introduction of new collection service boundaries for the first three zones.
- Securing transparency and accountability of contracts and tendering process with private service providers based on the feedback of the results of the mid-term performance monitoring and assessment of private service providers after their 5-year operations.
- Achievement of transparency and accountability of the financial assistance to the private sector based on the feedback of results of the mid-term performance monitoring and assessment.

(3) Long-Term Plan (2021-2030)

- Securing transparency and accountability of contracts and tendering process with private service providers based on feedback of results of the long-term performance monitoring and assessment of private service providers after their 10-year operations.
- Improvement of collection and transportation services in low income areas by expansion of the new collection service boundaries for the additional six zones.
- Achievement of transparency and accountability of the financial assistance to the private sector based on feedback of results of the long-term performance monitoring and assessment.
- Achievement of the long-term agreement on the solid waste management among the public sector, the private sector and communities based on the concept of public-private-people partnership.

3.5.8 Community Participation Promotion Plan

(1) Short-Term Plan (2011-2015)

- Strengthening of coordination among CBOs, CCN and residents on SWM.
- Enhancement of knowledge of CBOs to improve their collection services.
- Enhancement of residents' awareness to get their participation in SWM and to promote 3R.
- Commencement of collection services by CBOs with full participation of communities.
- Enhancement of knowledge of teachers and students in primary education on SWM.
- Commencement of recycling in primary schools.
- Commencement of composting activities by CBOs.

(2) Mid-Term Plan (2016-2020)

- Proper maintenance of coordination among CBOs, CCN and residents on SWM.

- Continuation of knowledge enhancement of CBOs to improve their collection services.
- Continuation of residents' awareness enhancement to get their participation in SWM and to promote 3R.
- Continuation of collection services by CBOs with full participation of the communities.
- Continuation of knowledge enhancement of teachers and students in primary education on SWM.
- Continuation of recycling in primary schools.
- Continuation of composting activities by CBOs.

(3) Long-Term Plan (2021-2030)

- Attainment of sustainable proper coordination through the establishment of a committee composed of CBOs, CCN and residents.
- Attainment of a Proper CBO training system operated by CCN with the collaboration of trained CBOs and NGOs.
- Attainment of a proper awareness creation system operated by CCN with the collaboration of NGOs and resident associations.
- Attainment of a proper training system on SWM for schools teachers and students by CCN in collaboration with KIE.
- Promotion of obligatory recycling system in all Nairobi primary schools by CCN.
- Establishment of the Compost Producers CBO Association which conjointly with CCN will continue promoting the insertion of more CBOs in composting activities.

CHAPTER 4. FORMULATION OF THE MASTER PLAN

4.1 Introduction

This **Chapter** presents the formulation of the SWM Master Plan together with the technical options and institutional and financial arrangements. The first two sections, **Section 4.2** and **Section 4.3,** present the socioeconomic aspects such as population and economic projection including social conditions, and the conditions of waste generation and composition from the present situation to the target year 2030. Based on these basic conditions, technical approaches are analysed and evaluated to establish the three (3) strategic components of the SWM Master Plan, namely; (1) the collection and transportation plan; (2) the 3R and intermediate treatment plans; and (3) the final disposal plan, as discussed in **Section 4.4**. The action plans for the technical options are then defined in **Section 4.5**, and the soft components, such as institutional, financial and legal restructuring plans including private sector involvement promotion and community participation promotion plans, are explained in **Section 4.6** to **Section 4.10**. **Section 4.11** presents the urgent projects and preparatory actions that should be carried out basically by the City Council's own effort to improve the sanitary condition in the city to some extent. The timing and scale of the action plans proposed in the Master Plan are shown in the plans of operation given in **Section 4.12**. Finally, **Section 4.13** describes the evaluation of the Master Plan in terms of technical, environmental, social, institutional, oraganisational, economic and financial points of view. All detailed data and analysis relevant to each Section are given in **Volume 3, Supporting Report, and** in **Volume 4, Data Book**.

4.2 Socioeconomic Aspect

4.2.1 Population Projection

(1) Population Census Data

The latest population census was carried out by the Kenya National Census of Statistics in 2009. However, no consolidated report on population data was published at the time of updating of the solid waste master plan. Instead, the past population census data of Nairobi for the years 1969, 1979, 1989, 1999 and 2008 were obtained, as shown in the following **Table 4.2.1**. The total population of Nairobi increased from 509,286 in 1969 to 3,038,600 in 2008. The growth rate during the period from 1969 to 1999 is estimated to be 4.8% per annum while the growth rate from 1999 to 2008 dropped at approximately 3.5% per annum.

Table 4.2.1 Past Populations of Nairobi

Year	1969	1979	1989	1999	2008
Population	509,286	827,775	1,324,570	2,143,254	3,038,600

Source: http://www.citypopulation.de/Kenya.html: Population from 1969 to 1999
http://www.knbs.or.ke/: Population 2008; Population Projection

(2) Projection of Future Population

Analyses were made to develop the numerical analysis models from the trend line of the past population data and the obtained analysis models, the Exponential Model and the Polynomial Model, of which results of computation reflected or coincided closely with the past trend of

population increase. The following **Table 4.2.2** and **Figure 4.2.1** show the results of population projection together with the population projection of other representative studies. Population projection by the Exponential Model resulted in a little over 8.2 million in 2030 and the Polynominal Model projected the population of 5.9 million in 2030. On the other hand, the projection of Nairobi Metro 2030 shows the population of 7.6 million in 2030 and the Master Plan for Urban Transport in the Nairobi Metropolitan Area projected 4.2 million in 2025 which is a little lower than that of the result of the Polynomial Model which projected 5.2 million. As a result of comparison with the future population projections of the other studies, it was decided to adopt the rounded figures of the Polynomial Model which show a moderate value of about 3% population growth per annum in the future.

Table 4.2.2 Projection of Future Population and Reference Future Population

Year	Population Projected by Nairobi Metro 2030[*1]	Master Plan of Urban Transport in Nairobi Metropolitan Area[*2]	Exponential Model: $y=495{,}285e^{0.0462x}$	Polynomial Model: $y=1{,}216.9X^2+14{,}902X+498{,}390$	Adopted Future Population[*3]
2008	3,038,600		3,001,698	2,930,473	2,930,000
2009			3,143,630	3,041,510	**3,040,000**
2010		3,078,500	3,292,273	3,154,981	**3,150,000**
2011			3,447,944	3,270,886	3,270,000
2012	3,620,000		3,610,976	3,389,224	3,390,000
2013			3,781,717	3,509,996	3,510,000
2014			3,960,531	3,633,203	3,630,000
2015		3,389,900	4,147,800	3,758,842	**3,760,000**
2016			4,343,924	3,886,916	3,890,000
2017	4,400,000		4,549,321	4,017,424	4,020,000
2018			4,764,431	4,150,365	4,150,000
2019			4,989,711	4,285,740	4,290,000
2020			5,225,644	4,423,549	**4,420,000**
2021			5,472,733	4,563,792	4,560,000
2022	5,360,000		5,731,505	4,706,468	4,710,000
2023			6,002,512	4,851,578	4,850,000
2024			6,286,334	4,999,123	5,000,000
2025		4,176,400	6,583,576	5,149,100	**5,150,000**
2026			6,894,873	5,301,512	5,300,000
2027	6,360,000		7,220,889	5,456,358	5,460,000
2028			7,562,320	5,613,637	5,610,000
2029			7,919,896	5,773,350	5,770,000
2030	7,560,000		8,294,379	5,935,497	**5,940,000**

Source: [*1] Population in 2008 was obtained from the population projection of Kenya National Census of Statistics. Population from 2012 to 2030 was obtained from the population projection of Nairobi Metro 2030 by the Ministry of Nairobi Metropolitan Development.
[*2] JICA: *The Study of Master Plan for Urban Transport in the Nairobi Metropolitan Area*, *Final Report*, March 2006, pp. 11-15.
[*3] Rounded result of Polynomial Model by ten thousand.

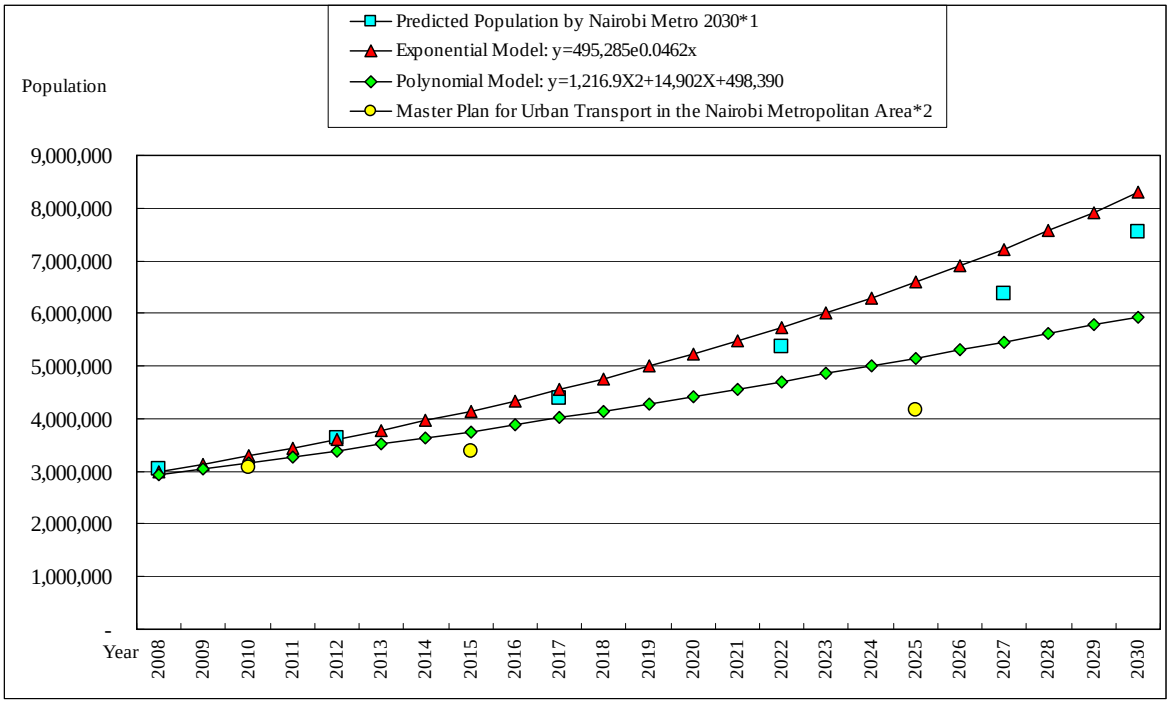


Figure 4.2.1 Projection of Future Population and Reference Future Population

(3) Future Population in Divisions and in Proposed Waste Collection Zones

The total population of CCN has been computed by the Polynominal Model as aforementioned. The future population of each Division of CCN and the proposed waste collection zones were estimated in proportion to the ratio to total CCN population of each sub-location obtained from the population census in 1999. **Table 4.2.3** shows the population of the nine divisions of CCN including Starehe/CBD, and **Table 4.2.4** shows the population of each waste collection zone proposed under the SWM Master Plan. Additionally, the location of each CCN division in **Table 4.2.3** and the waste collection zones in **Table 4.2.4** are shown in **Figure 4.2.2**.

Table 4.2.3 Future Population of CCN Divisions

Year / CCN Divisions	2009	2010	2015	2020	2025	2030
Starehe/CBD	333,243	345,301	412,169	484,517	564,539	651,139
Makadara	280,041	290,174	346,367	407,165	474,412	547,186
Kamkunji	286,817	297,195	354,747	417,017	485,890	560,425
Kasarani	480,733	498,127	594,590	698,960	814,399	939,326
Embakasi	616,841	639,161	762,935	896,855	1,044,978	1,205,275
Westlands	294,475	305,130	364,219	428,151	498,864	575,388
Dagoretti	341,139	353,483	421,935	495,998	577,916	666,567
Langata	406,712	421,428	503,038	591,337	689,002	794,693
Total	**3,040,000**	**3,150,000**	**3,760,000**	**4,420,000**	**5,150,000**	**5,940,000**

Table 4.2.4 Future Population of Proposed Waste Collection Zones

Year / Proposed Waste Collection Zone	2009	2010	2015	2020	2025	2030
Zone 1	205,461	212,896	254,123	298,730	348,068	401,461
Zone 2	205,225	212,651	253,830	298,386	347,667	400,998
Zone 3	304,005	315,005	376,006	442,007	515,009	594,010
Zone 4	164,606	170,562	203,591	239,328	278,855	321,631
Zone 5	183,844	190,496	227,385	267,299	311,446	359,221
Zone 6	205,823	213,271	254,571	299,256	348,681	402,168
Zone 7	173,120	179,385	214,123	251,708	293,280	338,268
Zone 8	156,051	161,698	193,011	226,891	264,363	304,916
Zone 9	208,151	215,683	257,450	302,640	352,624	406,716
CCN/SWMPC Zone	1,233,714	1,278,355	1,525,909	1,793,755	2,090,008	2,410,611
Total	**3,040,000**	**3,150,000**	**3,760,000**	**4,420,000**	**5,150,000**	**5,940,000**

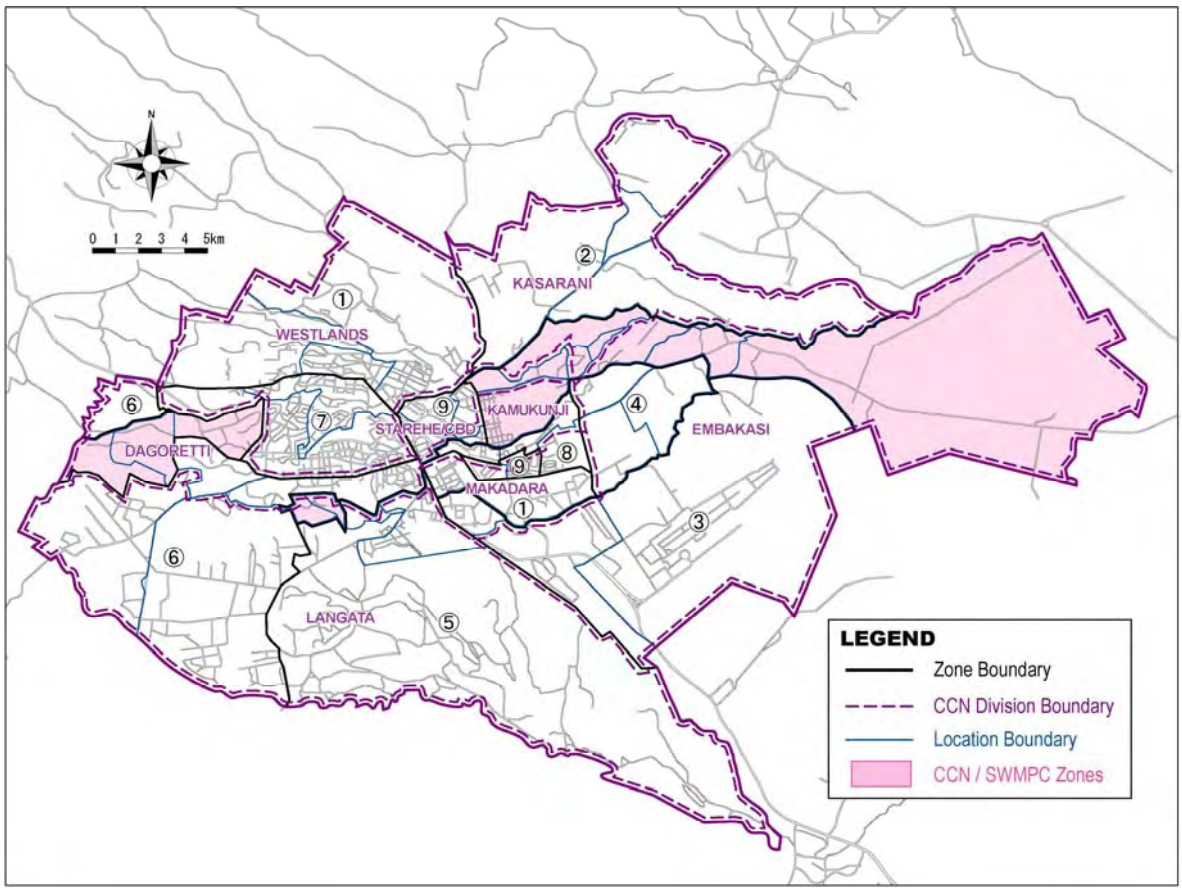


Figure 4.2.2 Location Map of CCN Divisions and Proposed Waste Collection Zones

4.2.2 Economic Projection

(1) Population of Kenya

Sine there is no available projection of population in Kenya, the future population was based on the data provided from the Kenya National Bureau of Statistics (KNBS) for the period from 2000 to 2008 and the *"World Economic Data Base, 2010"* prepared by the International Monetary Fund (IMF) for the period from 2010 to 2015. The projection for 2016 to 2030 was made by setting up the average annual growth rates during the period from 2015 to 2020 and from 2020 to 2030 respectively.

The results of projection are shown in the table below. The population of Kenya would increase from 39,710 thousand to 45,408 thousand during the period from 2015 to 2025 with the average annual growth rate of 1.4% and to 48,438 from 42,569 thousand to 48,438 thousand during the period from 2020 to 2030 with the average annual growth rate of 1.3% respectively.

Table 4.2.5 Projection of Population, GDP and Per Capita of Kenya

Year	Population (1,000 Persons)	GDP at Constant Prices of 2000 (Billion KSh)	Per Capita GDP (KSh)
2000	30,100	967.8	3,215.4
2001	30,865	1,013.6	3,283.9
2002	31,517	1,016.6	3,225.6
2003	32,165	1,044.9	3,248.6
2004	32,808	1,093.2	3,332.0
2005	33,445	1,157.5	3,460.8
2006	34,046	1,231.0	3,615.8
2007	34,653	1,316.8	3,800.1
2008	35,265	1,336.7	3,790.4
2009	35,884	1,364.8	3,803.4
2010	36,508	1,420.9	3,891.9
2011	37,134	1,503.0	4,047.4
2012	37,770	1,597.8	4,230.2
2013	38,410	1,701.5	4,429.9
2014	39,060	1,812.8	4,641.0
2015	39,710	1,931.3	4,863.4
2016	40,266	2,056.8	5,108.1
2017	40,830	2,190.5	5,365.0
2018	41,401	2,332.9	5,634.8
2019	41,981	2,484.5	5,918.2
2020	42,569	2,646.0	6,215.9
2021	43,122	2,812.7	6,522.7
2022	43,683	2,989.9	6,844.6
2023	44,250	3,178.3	7,182.5
2024	44,826	3,378.5	7,537.0
2025	45,408	3,591.4	7,909.0
2026	45,999	3,817.6	8,299.4
2027	46,597	4,058.1	8,709.0
2028	47,203	4,313.8	9,138.9
2029	47,816	4,585.6	9,590.0
2030	48,438	4,874.4	10,063.3
Average Annual Growth Rate (%)			
2000-2009	1.97	3.89	1.88
2009-2015	1.70	5.96	4.18
2015-2020	1.40	6.50	5.03
2020-2030	1.30	6.30	4.94

Source: Figures during 2000-2015 are based on the *Statistical Year Book of Kenya, 2009*, Central Bureau of Statistics Kenya (CBSK) and the *"World Economic Outlook"*, 2010, IMF

(2) GDP of Kenya

Since there is no available and official projection of gross domestic product (GDP) in Kenya, the target annual growth rate of GDP was set as 10% in Kenya Vision 2030, which is rather ambitious and depends on the condition of future activities of each industrial sector. Inasmuch as the methodology of GDP projection is basically the same as that of the GDP of Kenya, the projection of future GDP was based on the Kenya National Bureau of Statistics (KNBS) for the period from 2000 to 2008 and the *"World Economic Data Base, 2010"* prepared by IMF for the period from 2010 to 2015. The projection from 2016 to 2030 was made by setting up the average annual growth rates during the period from 2015 to 2020 and from 2020 to 2030 respectively.

The results of projection are also shown in the preceding **Table 4.2.5**. The GDP of Kenya would increase from KSh 1,931.3 billion to KSh 2,646.0 billion during 2015 to 2025 at the constant price of year 2000 at the average annual growth rate of 6.5% and to KSh 3,591.4 billion at the average annual growth rate of 6.3% respectively. From the results of projection of population and GDP, the Per Capita GDP (PCD) was figured out. The PCD would increase from KSh 4,863.4 to KSh 7,909.0 from 2015 to 2020 at the average annual growth rate of 5.03% and would increase from KSh 6,215.9 in 2020 to KSh 10,063.3 in 2030 at the average annual growth rate of 4.94% respectively.

(3) GRDP of Nairobi City

(a) Population of Nairobi

The population projection for Nairobi City was conducted through building up by the regression model based on the discrete historical date during the 1960's to 2000's. The detailed methodology is described in **Section 4.2.1**.

(b) GRDP of Nairobi City

The projection of gross regional domestic product (GRDP) of Nairobi City was conducted on the following assumptions:

Scenario 1

There have been some discussions among various sources regarding the contribution ratio of the GRDP of Nairobi City to the GDP of Kenya such as 45%, 60% and so on. However, these figures seem to be unofficial. Therefore, in this study, the share of GRDP of Nairobi City is set tentatively at 45% in the year 2010. Besides, it is assumed that the growth rate of Per Capita GRDP of Nairobi City is the same as that of the Per Capita GDP of Kenya.

Scenario 2

The share of GRDP of Nairobi City is set tentatively at 20% in the year of 2010. It is also assumed that the growth rate of the Per Capita GRDP Nairobi City is the same as that of the Per Capita GDP of Kenya.

(c) Results of Projection

The results of projection are shown in **Tables 4.2.6 and 4.2.7** and in **Figures 4.2.2 and 4.2.3**. The population projection is common to each scenario. The population is expected to increase at the growth rate of 3.31% from 3,759 thousand to 4,424 thousand for the period from 2015 to 2020 and increase at the growth rate of 2.88% to 5,940 thousand in 2030.

The results of Scenario 1 show that the GRDP would increase from KSh 952.4 billion to KSh 1,432.4 billion during 2015 to 2020 and increase to KSh 3,112.0 billion in 2030. The Per

Capita GRDP was figured out to increase from KSh 25,338.6 to KSh 32,384.7 at the growth rate of 5.03% and increase to KSh 52,429.8 in 2030 at the growth rate of 4.94%. The growth rates are the same as of those of the GDP of Kenya. The share of GRDP to GDP is expected to increase from 45% in the year 2010 to 63.8% in the year 2030. However, there is apprehension that the ratio of GRDP to GDP will be constant as 5.2 times, which is automatically calculated, and this is an extremely high rate to be assumed as the possible rate. Therefore, Scenario 1 is considered to be not practicable as the projection.

The GRDP is expected to increase from KSh 424.1 billion to KSh 637.9 billion during 2015 to 2020 and increase to KSh 5,935 billion in 2030. The Per Capita GRDP is figured out to increase from KSh 11,283.2 to KSh 14,420.8 at the growth rate of 5.03% and increase to Khs 23,346.9 in 2030 at the growth rate of 4.94%. The share of GRDP to GDP is expected to increase from 20% in the year 2010 to 28.4% in the year 2030. The rate of GRDP to GDP is figured out to be constant as 2.3 times, which is automatically calculated as in Scenario 1. This rate is lower than that of Scenario 1 and it is considered to be more practicable than that of Scenario 1.

Table 4.2.6 Projection of GDP and Per capita GDP of Kenya (Scenario 1)

Year	Population (1,000 Person)	GRDP at Constant Prices of 2000 (Billion KSh)	Per Capita GRDP (KSh)	Share of GRDP to GDP of Kenya (%)	Ratio of Per Capita GRDP to Per Capita GDP (Times)
2000	2,130	356.8	16,752.3	36.9	5.2
2001	2,221	380.1	17,109.2	37.5	5.2
2002	2,315	389.1	16,805.4	38.3	5.2
2003	2,412	408.2	16,925.4	39.1	5.2
2004	2,511	435.8	17,359.7	39.9	5.2
2005	2,612	471.0	18,030.8	40.7	5.2
2006	2,716	511.6	18,838.2	41.6	5.2
2007	2,822	558.7	19,798.5	42.4	5.2
2008	2,930	578.7	19,748.0	43.3	5.2
2009	3,040	602.7	19,815.6	44.2	5.2
2010	3,150	639.7	20,276.8	45.0	5.2
2011	3,270	689.7	21,087.0	45.9	5.2
2012	3,390	747.0	22,039.5	46.8	5.2
2013	3,510	810.1	23,079.5	47.6	5.2
2014	3,630	878.5	24,179.8	48.5	5.2
2015	3,760	952.4	25,338.6	49.3	5.2
2016	3,890	1,034.4	26,613.0	50.3	5.2
2017	4,020	1,122.9	27,951.5	51.3	5.2
2018	4,150	1,218.4	29,357.4	52.2	5.2
2019	4,290	1,321.5	30,833.9	53.2	5.2
2020	4,420	1,432.6	32,384.7	54.1	5.2
2021	4,560	1,550.9	33,983.2	55.1	5.2
2022	4,710	1,678.4	35,660.5	56.1	5.2
2023	4,850	1,815.5	37,420.7	57.1	5.2
2024	5,000	1,963.0	39,267.7	58.1	5.2
2025	5,150	2,121.7	41,205.9	59.1	5.2
2026	5,300	2,292.4	43,239.7	60.0	5.2
2027	5,460	2,475.8	45,374.0	61.0	5.2
2028	5,610	2,672.9	47,613.6	62.0	5.2
2029	5,770	2,884.6	49,963.7	62.9	5.2
2030	5,940	3,112.0	52,429.8	63.8	5.2
Average Annual Growth Rate (%)					
2000-2009	4.04	6.00	1.88	-	-
2009-2015	3.59	7.93	4.18	-	-
2015-2020	3.31	8.51	5.03	-	-
2020-2030	2.98	7.76	4.64	-	-

Source: JICA Survey Team

Table 4.2.7 Projection of GRDP and Per capita GRDP of Nairobi City (Scenario 2)

Year	Population (1,000 Person)	GRDP at Constant Prices of 2000 (Billion KSh)	Per Capita GRDP (KSh)	Share of GRDP to GDP of Kenya (%)	Ratio of Per Capita GRDP to Per Capita GDP (Times)
2000	2,130	158.9	7,459.7	16.4	2.3
2001	2,221	169.2	7,618.7	16.7	2.3
2002	2,315	173.3	7,483.4	17.0	2.3
2003	2,412	181.8	7,536.9	17.4	2.3
2004	2,511	194.1	7,730.2	17.8	2.3
2005	2,612	209.7	8,029.1	18.1	2.3
2006	2,716	227.8	8,388.6	18.5	2.3
2007	2,822	248.8	8,816.2	18.9	2.3
2008	2,930	257.7	8,793.7	19.3	2.3
2009	3,040	268.4	8,823.8	19.7	2.3
2010	3,150	284.9	9,029.2	20.0	2.3
2011	3,270	307.1	9,390.0	20.4	2.3
2012	3,390	332.6	9,814.1	20.8	2.3
2013	3,510	360.7	10,277.3	21.2	2.3
2014	3,630	391.2	10,767.2	21.6	2.3
2015	3,760	424.1	11,283.2	22.0	2.3
2016	3,890	460.6	11,850.7	22.4	2.3
2017	4,020	500.0	12,446.7	22.8	2.3
2018	4,150	542.6	13,072.8	23.3	2.3
2019	4,290	588.4	13,730.3	23.7	2.3
2020	4,420	637.9	14,420.8	24.1	2.3
2021	4,560	690.6	15,132.6	24.6	2.3
2022	4,710	747.4	15,879.5	25.0	2.3
2023	4,850	808.4	16,663.3	25.4	2.3
2024	5,000	874.1	17,485.8	25.9	2.3
2025	5,150	944.8	18,348.9	26.3	2.3
2026	5,300	1,020.8	19,254.6	26.7	2.3
2027	5,460	1,102.5	20,204.9	27.2	2.3
2028	5,610	1,190.2	21,202.2	27.6	2.3
2029	5,770	1,284.5	22,248.7	28.0	2.3
2030	5,940	1,385.8	23,346.9	28.4	2.3
Average Annual Growth Rate (%)					
2000-2009	4.04	6.00	1.88	-	-
2009-2015	3.59	7.93	4.18	-	-
2015-2020	3.31	8.51	5.03	-	-
2020-2030	2.98	7.76	4.64	-	-

Source: JICA Survey Team

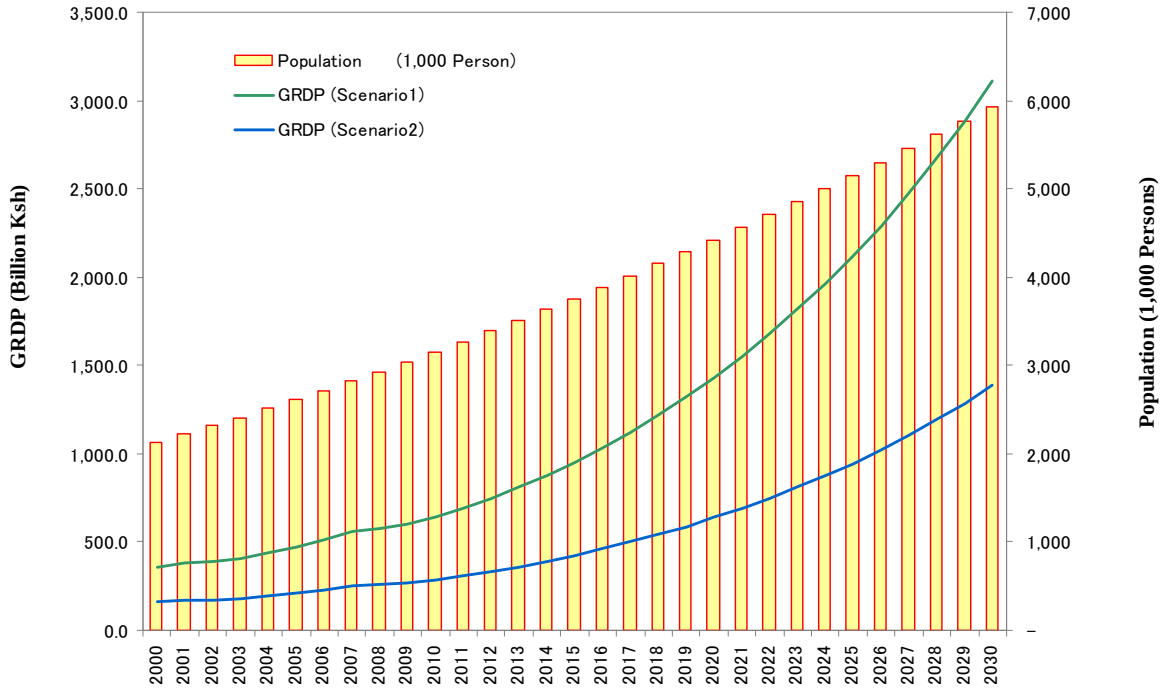


Figure 4.2.3 Projection of Population and GRDP of Nairobi City

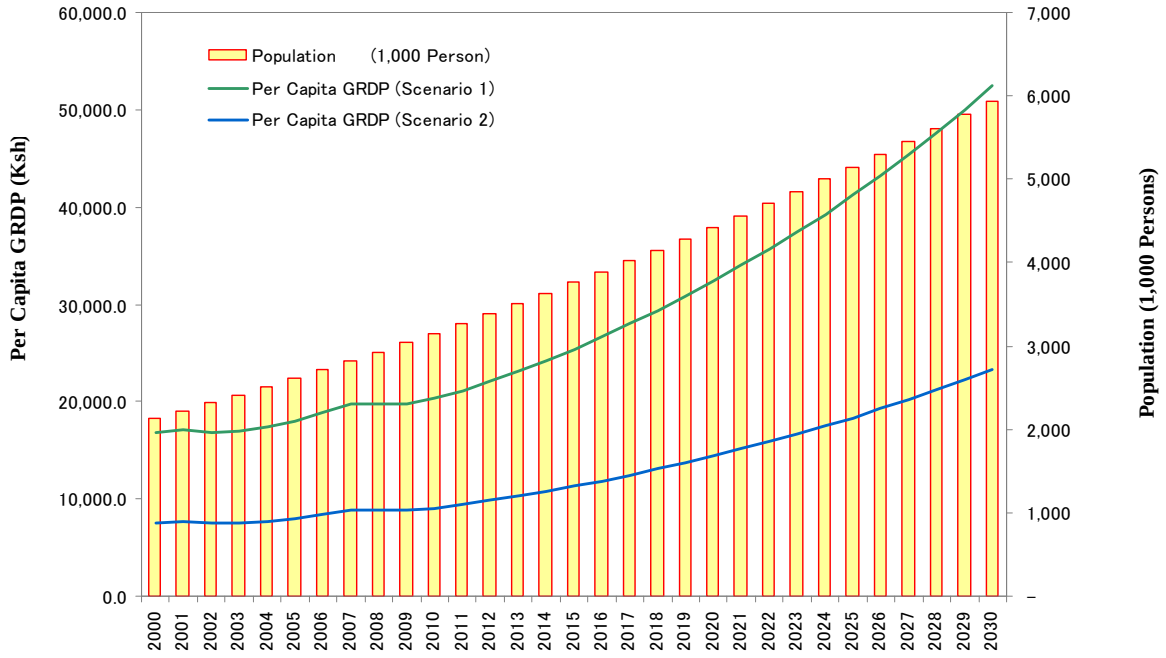


Figure 4.2.4 Projection of Population and Per Capita GRDP of Nairobi City

4.2.3 Social Consideration

The collection of waste is quite satisfactory in high and middle income areas where the private sector provides the services. However, in the low and slum areas the rate of collection is low due to the lack or poor collection service provided by CCN or the private collectors, which is the reason why the residents opt to discharge their waste anywhere resulting in a high negative impact to the environment and the health of the population living in these areas.

It was noted that CBOs play an important role on providing primary collection of garbage in the low and slum areas. It is opportune to point out that in many places of the low and slum areas the road condition is bad or there is no access into the area. Under these circumstances, only the CBOs can provide the collection services and for this reason the JICA Survey Team focused its attention to the development of these groups to increase the collection ratio which is still low in these areas.

(1) CBOs' Activities

The major findings of the survey on these groups are as follows:

(a) CBOs provide mainly primary collection services of garbage door-to-door to households located in the low and slum areas.

(b) Once collected the garbage is taken to the collection point where some CBOs recover valuable materials and the residual is transported by CCN to the disposal site.

(c) The CBOs are requesting CCN to allocate more accessible collection points and to construct facilities for recycling and storage of the valuables.

(d) To improve the current working condition of CBOs, increase the rate of collection in the low and slum areas, and improve their recycling activities, these groups need assistance from CCN in the provision of basic material and equipment and the related training on SWM which must include training on environment, recycling, safe disposal, financial management, laws, institutions, etc.

(e) CCN charges a fee from the CBOs for the transportation of waste to the disposal site. The criteria for establishing the fee need to be regulated.

(f) Residents are sometimes reluctant to pay the charges causing financial difficulty to the CBOs.

(g) The development of environmental education programmes for the residents is considered fundamental for awareness-raising in order to get their collaboration on SWM. In this regard, CCN must organise CBO workshops at the grassroots level for awareness creation in the communities. The education programme should include, but not limited to, aspects of environmental pollution by solid waste and its relation to public health, the importance of cost-sharing in SWM, the management of waste at source, and the legal and institutional issues.

(h) CCN needs to improve its relationship with CBOs; likewise, CCN should control the operation of CBOs to promote good service and overcome the negative perception given by costumers. In this sense, it is indispensable to create the Unit for Public Awareness, Environmental Education and Community Participation to deal with the CBOs (main tasks: licensing, training, supervision) and the communities to get their involvement in SWM.

(2) Waste Pickers

Waste picking is a response to poverty, a fundamental component of the Kenyan recycling industry, a major generator of income for poorer households, and a key factor in reducing the amount of waste to be disposed by society. CCN had listed the names of about 600 waste pickers at Dandora Dumpsite as of April 2010 although the number of waste pickers at the Dumpsite is estimated from 1,200 to 1,500. (see the list of waste pickers in **Section G of Volume 4, Data Book**). The waste pickers are divided into five youth groups at present. However, details of their activities are not well grasped by CCN. Accordingly, it will be necessary to conduct a detailed study on waste pickers in the feasibility stage in order to incorporate them in any re-structuring plan.

(3) Strategic Implications

The strategic implications of these points are summarised below.

(a) Waste Management by CBOs in the Low Income and Slums Areas

Significant points are:

(i) Single-issue objectives (such as improved waste management) combined with centralised solutions are often inappropriate; integrated approaches involving the communities themselves are more appropriate.

(ii) The starting point for strategy planning is the understanding of existing programmes and activities of NGOs and CBOs, and of strategies to be developed in collaboration with these groups.

(iii) Since waste is a principal source of income for people living in the informal areas, the role of government should be to facilitate the creation of community-based schemes rather than support centralised projects in direct competition with them.

(iv) Micro-enterprises offer an important opportunity for improving the effectiveness of community-based initiatives.

(b) Management and Control of Waste Pickers

Policy responses to waste picking can be addressed specifically towards door-to-door collectors, city site waste pickers and Dandora Dumpsite waste pickers.

(i) Door-to-door collectors are not perceived to be a problem, and no policy actions are proposed.

(ii) City site waste pickers are perceived to be a nuisance, but effective collection services should reduce the problem considerably. Their forcible removal is not recommended as this will merely cause social tensions elsewhere.

(iii) Closure of the Dandora site will remove the sole source of income from site-based waste pickers, most of whom will want to shift to the new landfill site. Denying waste pickers' access to the new site is likely to be expensive and socially undesirable. Policy should be directed towards managing the activities of waste pickers on the site.

(iv) It is recommended that waste pickers should not be permitted to reside at the new site.

(v) The Recovery Material Facility (RMF) that is intended to be constructed after closure of Dandora Dumpsite should be encouraged to employ some of the waste pickers currently working at the site. Other waste pickers who live in the slum areas could be incorporated to work with the CBOs operating at those places. In this sense, it is proposed to carry out a detailed study on waste pickers in the city in order to formulate a mitigation plan for them.

(4) Recommendations

The Unit for Public Awareness, Environmental Education and Community Participation (PEC) within the Environmental Planning and Management Section of CCN headed by an Environmental Manager should be created.

Essential areas of work are:

(a) The formation of new CBOs in low income and slum areas and establishment of links with relevant existing NGOs and CBOs;

(b) The control of CBO activities;

(c) The development of training programmes for CBOs;

(d) The development of educational programmes addressed to the people in order to create awareness on their involvement in SWM; and

(e) The control of waste pickers' activities.

4.3 Future Waste Generation and Composition Analysis

4.3.1 General

Future solid waste generation amount by the year 2030 is projected based on the results obtained in the field survey. The projection for years 2009, 2015, 2020, 2025 and 2030 are presented in this section. The following considerations were taken in the updating of future waste amounts:

- Population;
- Area;
- Income Group; and
- Gross Domestic Product.

4.3.2 Population Projection in Nairobi City

The most direct influence on waste generation is the change in population. As described in **Subsection 4.2.1**, the annual population of Nairobi City for the planning period was estimated, as shown in **Table 4.3.1**

Table 4.3.1 Forecast of Future Population of Nairobi City (Unit: 10^3 person)

Year	2009	2015	2020	2025	2030
High Income	397	491	578	673	776
Middle Income	1,066	1,319	1,550	1,807	2,084
Low Income	1,576	1,950	2,292	2,670	3,080
Total	**3,040**	**3,760**	**4,420**	**5,150**	**5,940**

Source: JICA Survey Team, 2010

4.3.3 Relationship between Gross Domestic Product (GDP) and Waste Discharge

GDP is one of the important indicators which may represent levels of social welfare, industrial technology and import of goods. The growth rate in GDP is thus expected to have a larger impact on the

waste amount per capita of developing countries than the developed countries and it will also remarkably result in changes in the composition of waste at a certain welfare level.

Based on the JICA Study on Integrated Solid Waste Management in 1998, there is a correlation between the waste increase rate per capita and the growth rate in GDP per capita. Therefore, for updating the study, 0.5% is also assumed as the increase rate per capita of waste generation.

4.3.4 Assumptions in the Projection of Future Waste Generation Amount

For the projection in the different generation sources of wastes, the conditions for estimation are as set out below.

(1) Residential Waste (Domestic Waste)

The data on waste generation amount per capita was obtained in the field survey. Waste discharge amount is calculated by subtracting self-disposal amount from generation amount. The self-disposal amount is estimated based on the interview conducted with the Inspectors of the respective divisions who manage the waste collection system within the city. Then the percentage of self-disposal amount in each area is verified from the Head of the Solid Waste Collection under the Department of Environment. The waste discharge amount per capita is assumed to increase according to the 0.5% growth rate in GDP per capita, the same as the assumption used in the 1998 JICA Integrated SWM Master Plan for Nairobi City.

(2) Commercial Waste (Restaurant, Hotel, Shop, etc.)

Commercial waste generation is projected based on the number of establishments located in each of the eight (8) divisions of the city: Starehe, Makadara, Kamkunji, Kasarani, Embakasi, Westlands, Dagoretti and Langata. The increase of waste generation is in proportion to the increase in population. The projected waste generation amount of commercial establishments is about 25% of household waste. The projected waste generation amount of commercial and other establishments is also distributed among the nine (9) operational zones and the CCN/SWMPC-Zone [see Section 4.9.1(3), pages 4-134 to 4-136] in proportion to the coefficient derived from the relation between the division-based population and the zone-based population. The amount of waste projected for each zone as of 2010 was estimated, as shown in **Figure 4.3.1**.

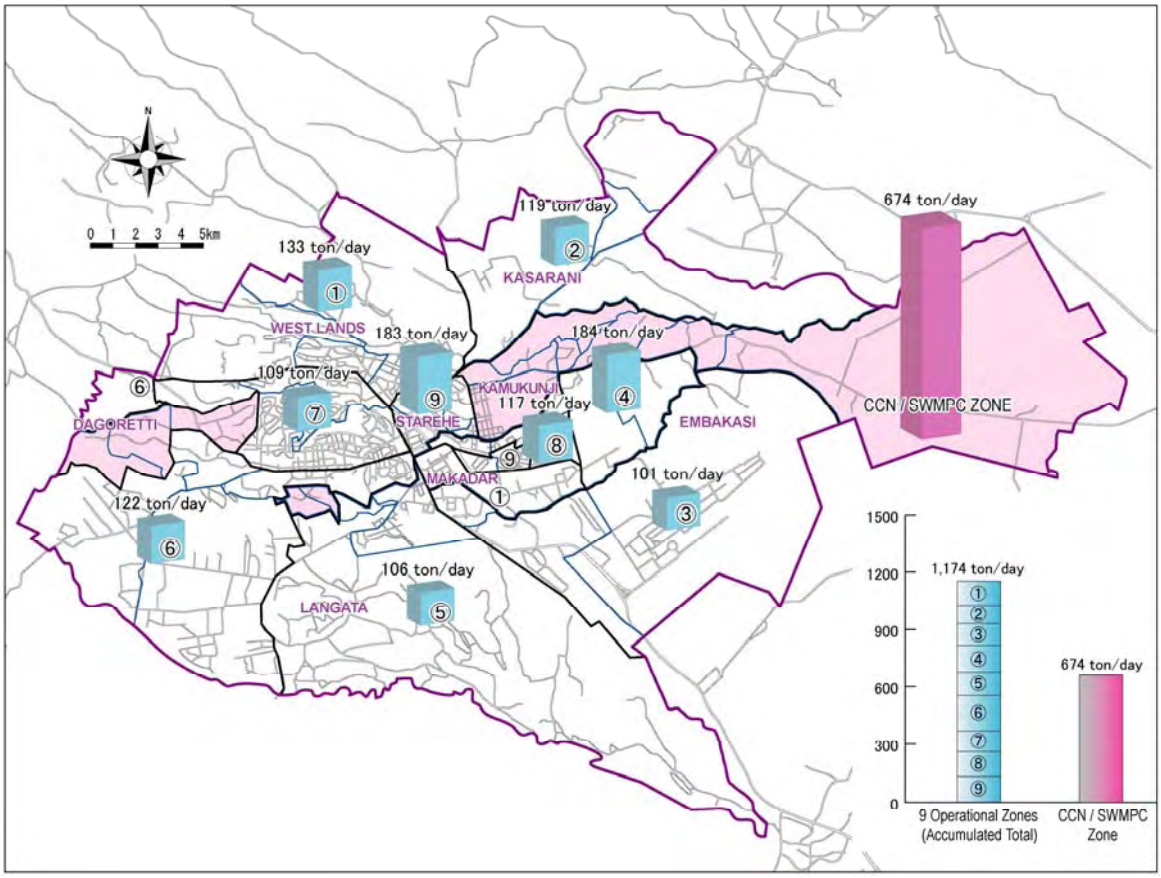


Figure 4.3.1 Amount of Waste Projected for Each Zone as of 2010

(3) Market Waste

Market waste generation is also forecast based on the field survey. The waste generation in each market will increase based on the increase of population ratio. At present, there are forty-four (44) markets within Nairobi City.

(4) Road Waste

The generation amount of road waste is projected based on the field survey. The generation amount will not increase and it is computed based on the length of road for sweeping service. The waste generators of road waste come from the residences and establishments. For estimation purposes, road waste generation in each zone is computed but in the total computation of waste generation in the whole city, the amount is not added considering that the amount is already included in the domestic and commercial wastes.

4.3.5 Projection of Waste Amount Generation

Based on the assumptions above, the projection of waste amount in each waste generator is as discussed below.

(1) For domestic waste, the projected waste generation in each zone is shown in **Table 4.3.2**.

Table 4.3.2 Projection of Household Waste in Nairobi City (ton/day)

Zone	2009	2015	2020	2025	2030
Zone 1	100	127	153	183	217
Zone 2	97	124	149	178	211
Zone 3	81	104	125	149	176
Zone 4	141	179	216	258	305
Zone 5	95	121	146	174	206
Zone 6	106	135	163	194	230
Zone 7	85	109	131	157	185
Zone 8	74	94	114	136	160
Zone 9	96	122	147	176	208
CCN/SWMPC Zone	444	588	681	814	962
Total	1,318	1,747	2,025	2,419	2,860

Source: JICA Survey Team, 2010

(2) For commercial waste, the projection of waste generation in each zone is shown in **Table 4.3.3**.

Table 4.3.3 Projection of Commercial Waste in Nairobi City (ton/day)

Zone	2009	2015	2020	2025	2030
Zone 1	26	33	39	47	56
Zone 2	16	21	25	30	35
Zone 3	20	26	31	37	43
Zone 4	33	42	51	61	72
Zone 5	11	14	16	20	23
Zone 6	12	15	18	22	26
Zone 7	21	26	33	39	46
Zone 8	26	32	40	48	57
Zone 9	66	81	102	122	144
CCN/SWMPC Zone	208	255	319	382	451
Total	439	538	675	806	953

Source: JICA Survey Team, 2010

(3) For road sweeping waste, the result of the projection of waste generation is shown in **Table 4.3.4**. As mentioned above, the amount of waste generation is projected not to increase every year and is not added to the total amount of waste generation in Nairobi City.

Table 4.3.4 Projection of Road Sweeping Waste in Nairobi City (ton/day)

Zone	2009	2015	2020	2025	2030
Zone 1	10	10	10	10	10
Zone 2	1	1	1	1	1
Zone 3	3	3	3	3	3
Zone 4	2	2	2	2	2
Zone 5	2	2	2	2	2
Zone 6	2	2	2	2	2
Zone 7	9	9	9	9	9
Zone 8	4	4	4	4	4
Zone 9	8	8	8	8	8
CCN/SWMPC Zone	18	18	18	18	18
Total	60	60	60	60	60

Source: JICA Survey Team, 2010

(4) For market waste, the projected waste amount generation is shown in **Table 4.3.5**.

Table 4.3.5 Projection of Market Waste in Nairobi City (ton/day)

Zone	2009	2015	2020	2025	2030
Zone 1	8	10	12	14	16
Zone 2	6	7	9	10	12
Zone 3	0	0	0	0	0
Zone 4	11	13	15	18	21
Zone 5	0	0	0	0	0
Zone 6	4	5	6	7	8
Zone 7	2	2	3	3	4
Zone 8	17	20	24	28	32
Zone 9	21	25	30	35	40
CCN/SWMPC Zone	23	28	33	38	44
Total	90	111	131	152	176

Source: JICA Survey Team, 2010

To summarise the above projected results, the projection of total waste amount in Nairobi City is as shown in **Table 4.3.6** and **Figure 4.3.2**.

Table 4.3.6 Projection of Total Waste Amount Generation in Nairobi City (ton/day)

Zone	2009	2015	2020	2025	2030
Residential	1,318	1,747	2,025	2,419	2,860
Commercial	439	538	675	806	953
Road	(60)	60	60	60	60
Market	90	111	131	152	176
Total	1,848	2,352	2,831	3,378	3,990

Note: Road sweeping waste amount is included in household and commercial wastes.

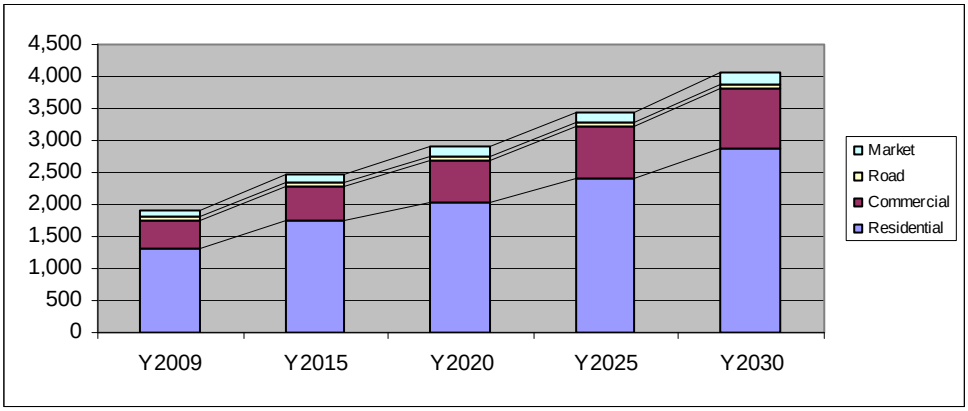
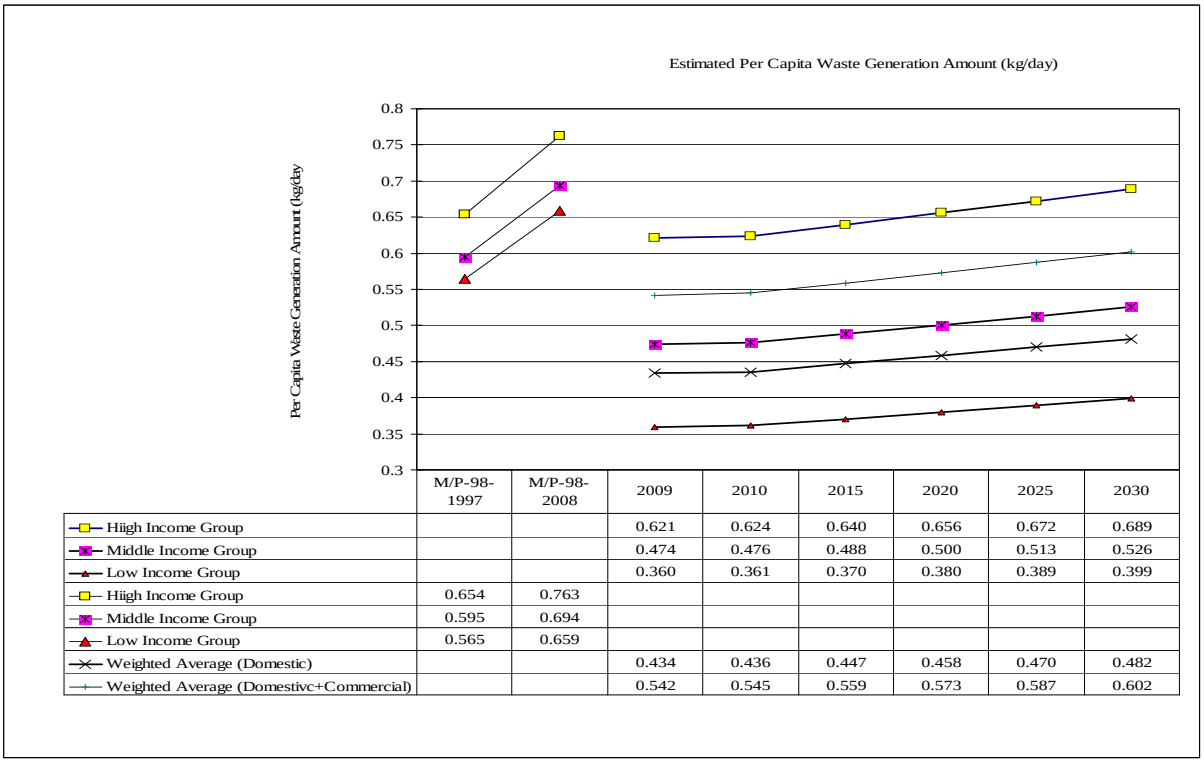


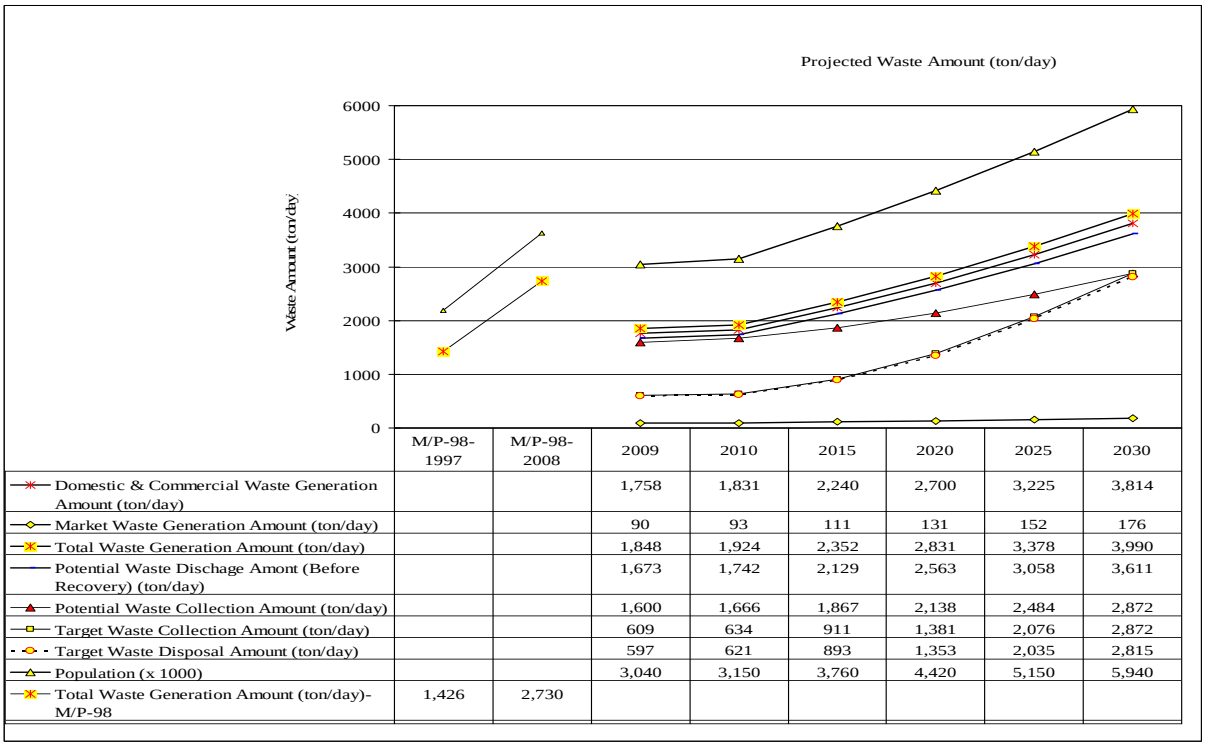
Figure 4.3.2 Projection of Total Waste Amount in Nairobi City

In comparison with the projection in the JICA Integrated Solid Waste Master Plan of 1998 for Nairobi City, the projected waste amount generation in 2009 is lower than the projected waste generation in this previous study. This is because of the growth rate considered and used in the prediction of both the 1998 and the current study. The rate in the previous study was set up higher in consideration of the high economic growth of Kenya and the world during that time. However, both studies have the same trend of result, that the highest amount of wastes generated come from the residential areas followed by those coming from the commercial establishments. The amount of commercial wastes has greater value in the current study because a more accurate number of establishments was gathered and used in the computation. (See **Figure 4.3.3 and Figure 4.3.4** for the comparison of the previous and current study about the estimated per capita waste generation amount and projected waste amount, respectively.)



	M/P-98-1997	M/P-98-2008	2009	2010	2015	2020	2025	2030
Hiigh Income Group			0.621	0.624	0.640	0.656	0.672	0.689
Middle Income Group			0.474	0.476	0.488	0.500	0.513	0.526
Low Income Group			0.360	0.361	0.370	0.380	0.389	0.399
Hiigh Income Group	0.654	0.763						
Middle Income Group	0.595	0.694						
Low Income Group	0.565	0.659						
Weighted Average (Domestic)			0.434	0.436	0.447	0.458	0.470	0.482
Weighted Average (Domestivc+Commercial)			0.542	0.545	0.559	0.573	0.587	0.602

Figure 4.3.3 Estimated Per Capita Waste Generation Amount (kg/day)

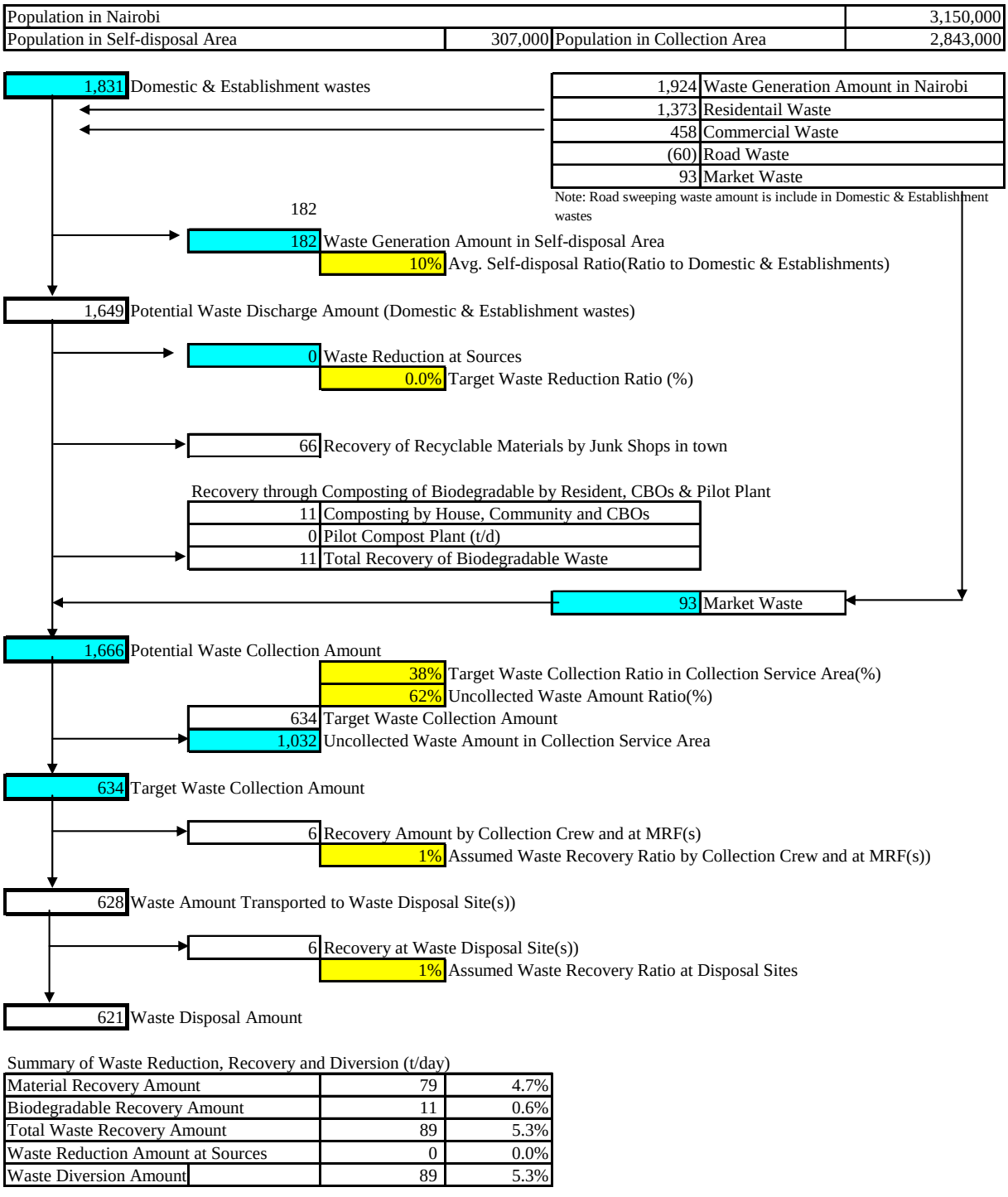


	M/P-98-1997	M/P-98-2008	2009	2010	2015	2020	2025	2030
Domestic & Commercial Waste Generation Amount (ton/day)			1,758	1,831	2,240	2,700	3,225	3,814
Market Waste Generation Amount (ton/day)			90	93	111	131	152	176
Total Waste Generation Amount (ton/day)			1,848	1,924	2,352	2,831	3,378	3,990
Potential Waste Dischage Amont (Before Recovery) (ton/day)			1,673	1,742	2,129	2,563	3,058	3,611
Potential Waste Collection Amount (ton/day)			1,600	1,666	1,867	2,138	2,484	2,872
Target Waste Collection Amount (ton/day)			609	634	911	1,381	2,076	2,872
Target Waste Disposal Amount (ton/day)			597	621	893	1,353	2,035	2,815
Population (x 1000)			3,040	3,150	3,760	4,420	5,150	5,940
Total Waste Generation Amount (ton/day)-M/P-98	1,426	2,730						

Figure 4.3.4 Comparison of Projected Waste Amount (ton/day)

4.3.6 Projection of Future Waste Flow

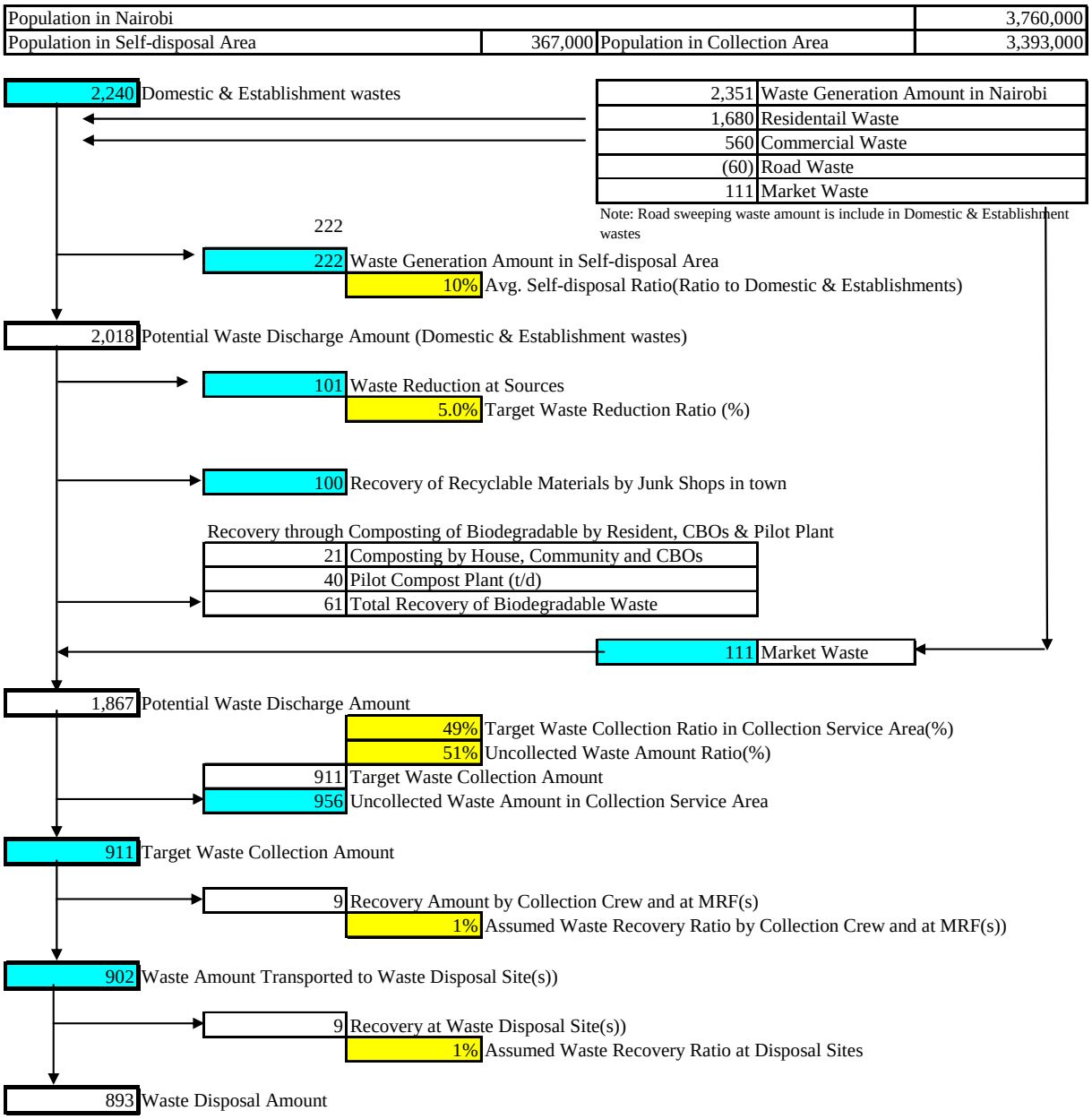
Based on the assumptions and projections above, the projections of waste flow up to year 2030 are as shown in **Figure 4.3.5 to Figure 4.3.9**.



Summary of Waste Reduction, Recovery and Diversion (t/day)

Material Recovery Amount	79	4.7%
Biodegradable Recovery Amount	11	0.6%
Total Waste Recovery Amount	89	5.3%
Waste Reduction Amount at Sources	0	0.0%
Waste Diversion Amount	89	5.3%

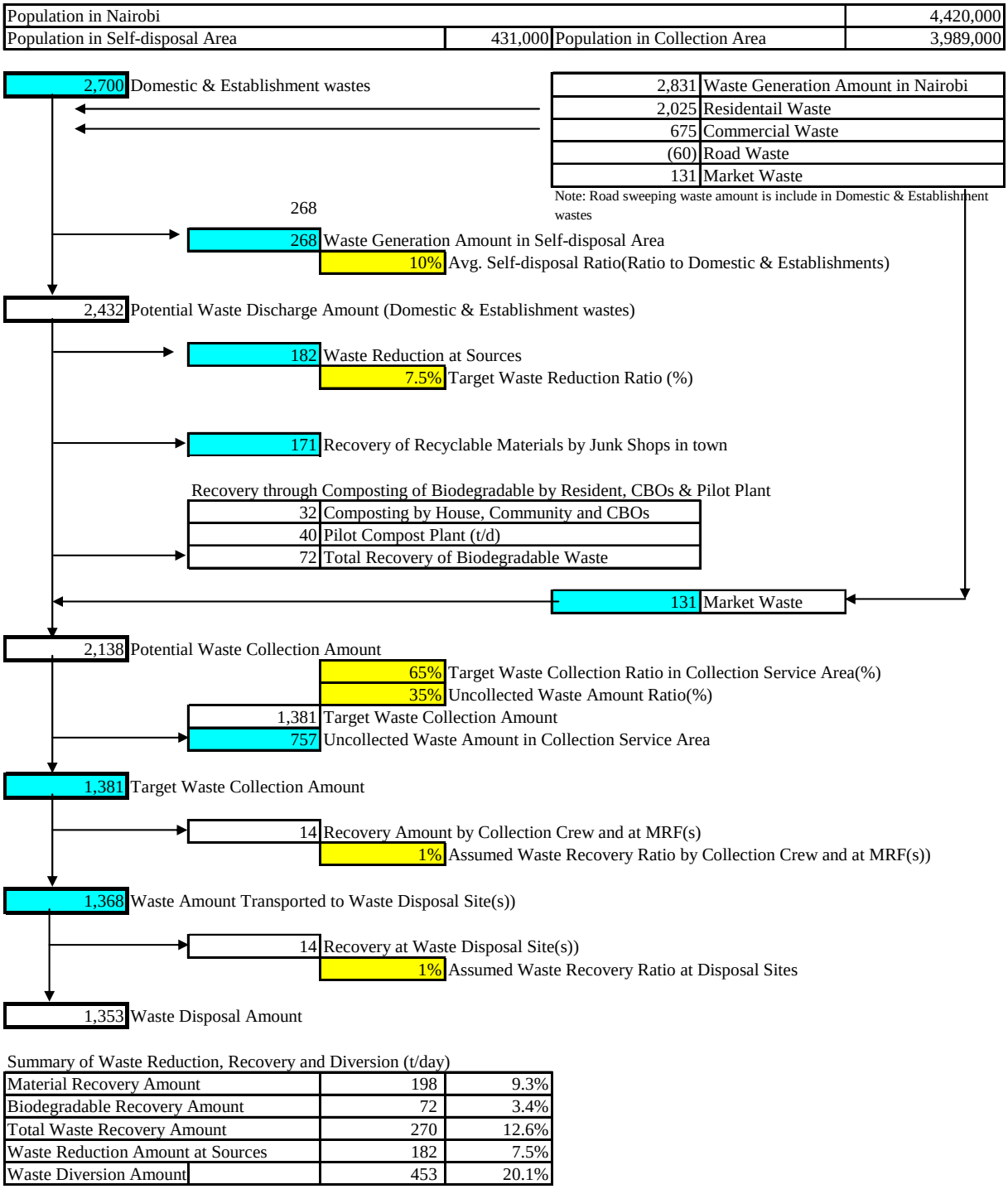
Figure 4.3.5 Future Waste Flow in Nairobi City (Year 2010)



Summary of Waste Reduction, Recovery and Diversion (t/day)

Material Recovery Amount	118	6.3%
Biodegradable Recovery Amount	61	3.3%
Total Waste Recovery Amount	180	9.6%
Waste Reduction Amount at Sources	101	5.0%
Waste Diversion Amount	280	14.6%

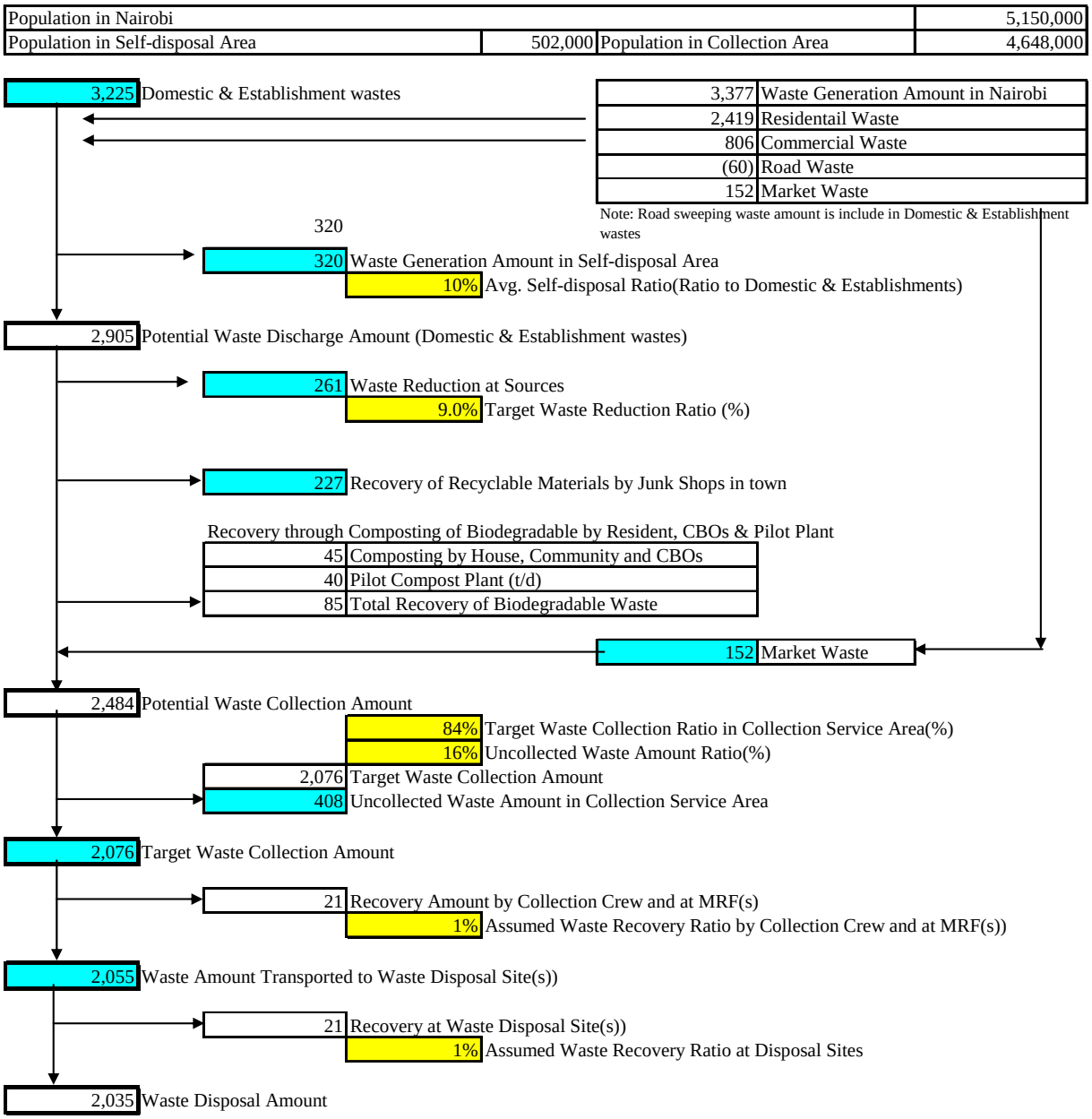
Figure 4.3.6 Future Waste Flow in Nairobi City (Year 2015)



Summary of Waste Reduction, Recovery and Diversion (t/day)

Material Recovery Amount	198	9.3%
Biodegradable Recovery Amount	72	3.4%
Total Waste Recovery Amount	270	12.6%
Waste Reduction Amount at Sources	182	7.5%
Waste Diversion Amount	453	20.1%

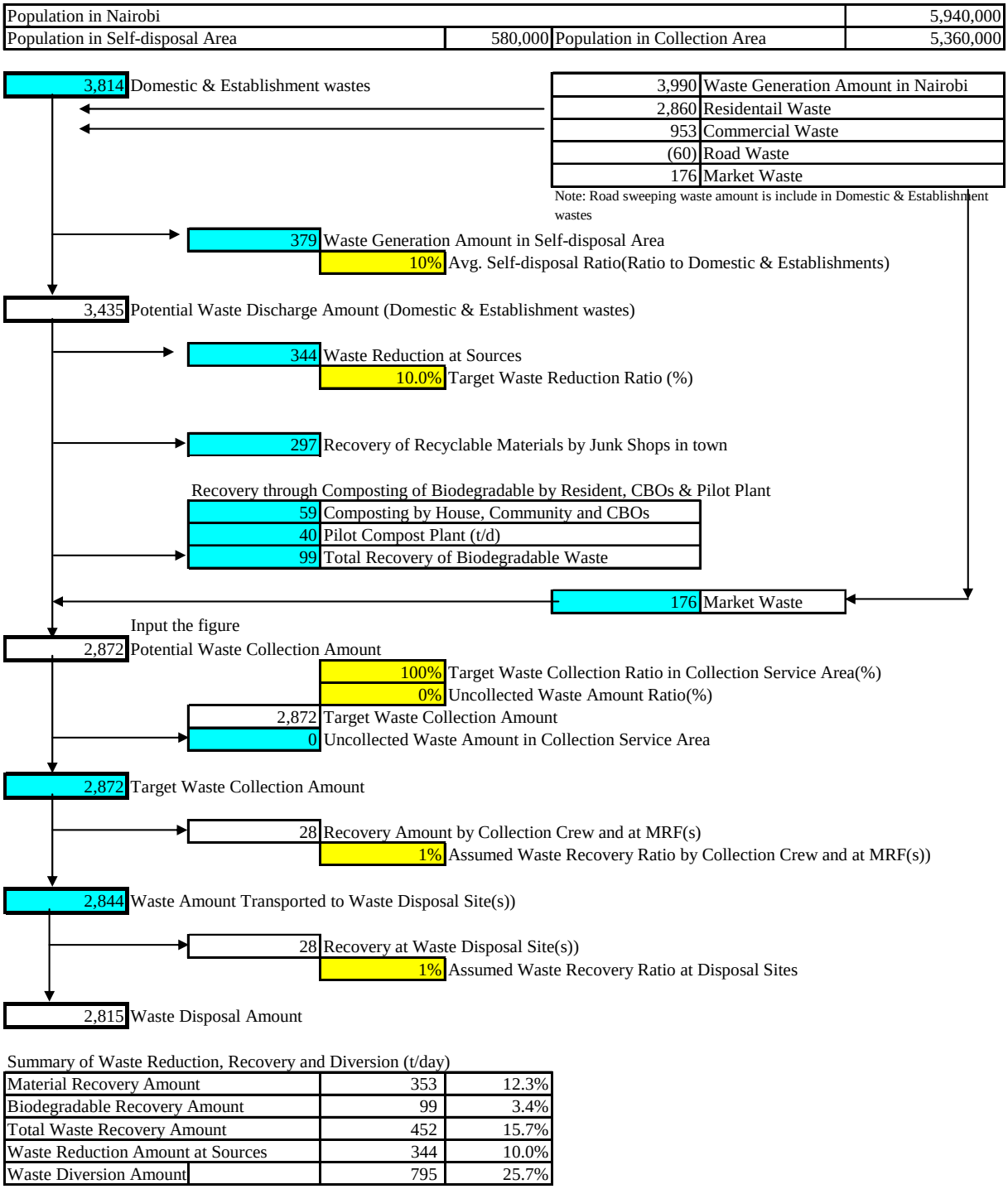
Figure 4.3.7 Future Waste Flow in Nairobi City (Year 2020)



Summary of Waste Reduction, Recovery and Diversion (t/day)

Material Recovery Amount	269	10.8%
Biodegradable Recovery Amount	85	3.4%
Total Waste Recovery Amount	353	14.2%
Waste Reduction Amount at Sources	261	9.0%
Waste Diversion Amount	615	23.2%

Figure 4.3.8 Future Waste Flow in Nairobi City (Year 2025)



Summary of Waste Reduction, Recovery and Diversion (t/day)

Material Recovery Amount	353	12.3%
Biodegradable Recovery Amount	99	3.4%
Total Waste Recovery Amount	452	15.7%
Waste Reduction Amount at Sources	344	10.0%
Waste Diversion Amount	795	25.7%

Figure 4.3.9 Future Waste Flow in Nairobi City (Year 2030)

4.4 Development and Evaluation of Technical Options

4.4.1 Collection and Transportation Plan

(1) Planning Concept

(a) Shift from Division-Based Operation to Proposed Zone-Based Operation

According to the proposed PPPP scheme, the collection operation will shift from the existing division based operation to the zone-based operation corresponding to the residents' income level. "Division-based operation" is the current operation practice of the private collectors in the smallest administrative unit of a Division based on their own "door-to-door" contract with their customers in which their operation cannot be controlled by CCN. "Zone-based operation", on the other hand, is the proposed collection system in which the same franchisee will operate in a zone and the same amount of waste charge is uniformly applied on the income level of the zone.

Based on this proposed PPPP scheme for the future collection system, the collection area in Nairobi City will be divided into nine (9) franchise zones and another one (1) zone such as the slum area where it will be difficult for private collectors to collect the waste charge. Private collectors (franchisees) will collect the residential and commercial wastes from the above nine (9) zones for the future expected increase of income level. CCN and its contractors will then concentrate their collection on the residential or commercial areas outside of the above 9 franchise zones, or concentrate operation on the collection of market waste and road sweepings, since CCN will still operate in these areas. Since the inspection or monitoring of private collection activities in the above 9 zones also will be CCN's crucial role in the future SWM system, the development of the collection and transportation plan should be conducted based on the proposed future zone-based operation system.

(b) Future Development of Transportation Network

The JICA Survey Team conducted an interview with the officials of the Urban Road Authority on March 8, 2010 to get a clearer understanding of the future road development plan and also the current ongoing projects in Nairobi City. **Table 4.4.1** and **Figure 4.4.1** show the future road development plan. According to the said authority, it develops its projects based on *"The Study on Master Plan for Urban Transport in the Nairobi Metropolitan Area in the Republic of Kenya"* which was conducted by JICA in March 2006. **Table 4.4.1** shows the main bypass roads to be constructed in 2015 and operated in 2016. For the development of the technical options especially for the transportation system, these future road network development plans or their implementation should be taken fully into consideration.

Table 4.4.1 List of Future Road Networks in Nairobi Metropolitan Area

Name of Road	Type of Development	Actual Progress	Estimated Completion Year	No. in Map (Figure 4.4.1
Southern Bypass	New	Preparation for design review and construction	2015	①
Link Road	New	Design and preparation of tender for its construction using Japanese fund is ongoing.	2015	②
Northern Bypass	New	Under construction by a Chinese contractor using Chinese Fund	2012	③
Greater Southern Bypass	New	Proposed for design and tender	To be determined	④
Ngong Road	Widening of existing road	Design and preparation for tender is ongoing.	2015	⑤
Outer Ring Road	Widening of existing road	Proposed for widening	2015	⑥
Eastern Bypass	New	Under construction	2012	⑦
Greater Eastern Bypass	New	Proposed for design and tender	To be determined	⑧

Source: Urban Road Authority

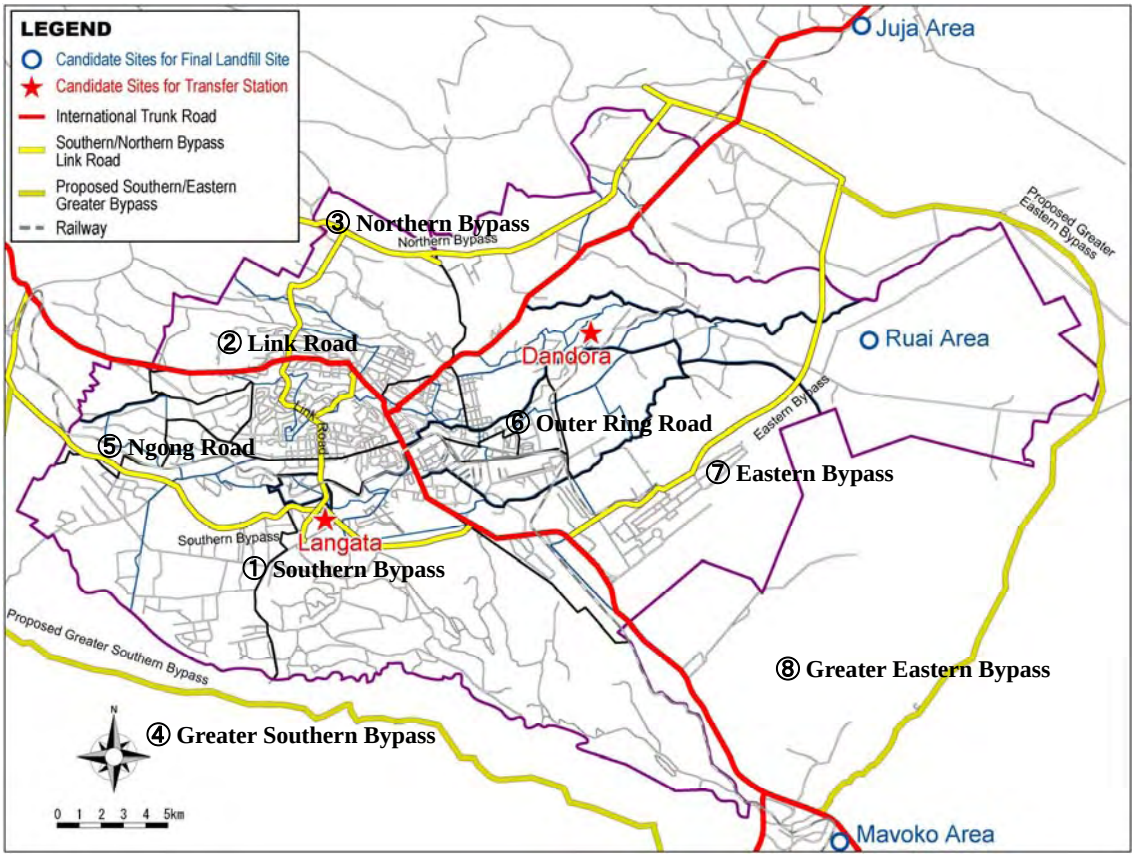


Figure 4.4.1 Map of Future Plans of Road Network Development for Nairobi Metropolitan Area

(2) Possible Technical Options

Nairobi City has a wide variety of land use or residential pattern from high income detached houses to the dense shanty houses of low income or slum areas. The collection system and the role of

collectors should be determined by taking this situation into consideration. The transportation system, on one hand, should be examined by taking all possible modes of transportation into account. For example, the transfer-transport using the road networks or the existing railway system will be possible options and they are worthy of studying if they have any advantage on the transport of wastes in a long distance to the proposed final disposal site.

(a) Collection System

Two types of collection method, namely; the station method and the door-to-door collection system are currently being done. CCN operates its collection work through the station method, while private collectors operate by the door-to-door method through a contract with customers who can afford to pay the waste charges. The collection system should be selected by taking into consideration the local condition such as type of generation source, land use, residential pattern or current state of operation of waste collectors to the fullest extent.

(i) Station Type of Collection

This system is suitable for areas such as markets, housing complex (apartments) or slums where much amount of wastes are generated and waste generators could not be identified. The container plus detachable container carrier is recommended for these areas to raise the collection frequency. Dump trucks (tippers) adopt the container collection system.

(ii) Door-to-Door Type of Collection

This method is already applied by private collectors who are able to identify the waste generators easily for collecting the waste charges. This method can be applied continuously in the future. In this case, the compactor or dump truck (tipper) is recommendable.

On the other hand, the type of vehicle has merits and demerits as shown in **Table 4.4.2.** Dump trucks have merit of lower cost compared to the compactor and the container plus detachable container carrier in spite of the demerit of being unsanitary, adverse impact on the urban aesthetic environment or heavy burden on loading work. The compactor has the merit of being sanitary and the demerit of higher cost compared to the dump truck. The container system has the merit of high efficiency of collection and the demerit of regular replacement of containers.

Table 4.4.2 Technical Options by Type of Collection Vehicle

Type of Collection Vehicle	Merit	Demerit
Dump Truck	• Robust • Lower cost compared to compactor and detachable container carrier	• Unsanitary • Adverse impact on aesthetic environment of urban areas • Heavy burden on crew-loading work
Compactor	• Sanitary • Low impact on loaders work environment	• Higher cost compared to dump truck • Sufficient maintenance is required
Container plus Detachable Container Carrier	• High frequency of collection is expected	• Regular replacement of container is necessary

(b) Transportation System

There are three technical methods of transporting waste in Nairobi City: the direct haul and transfer-transport system using the road networks, and the transport using existing railway

transportation system. The technical options of transport system concern the combination of transfer systems (including options without transfer system) and the three (3) candidate landfill sites: Ruai (which is located in the eastern part of Nairobi City and inside of the jurisdiction of Nairobi City); Mavoko (which is located south of Nairobi City and outside of the jurisdiction of Nairobi City); and Juja (which is located south of Nairobi City and also outside of the jurisdiction of Nairobi City). Two sites of transfer station, the Langata and the Dandora (the existing dumping site) are considered as the candidate sites for transfer station.

In terms of collection area, solid wastes generated in the city will be collected and transported based on the 9 zones that will be divided into the west, central and east areas if the transfer station is built in the future. The solid waste in each area will then be delivered to the nearest transfer station, and then transferred to the final landfill site. **Figure 4.4.2** shows the location map of candidate sites of each option and the collection areas. The candidate site of Kariobangi South for the development of a transfer station, which was identified as a candidate site in the initial stage of the survey, is not selected because the current residences are close to the site and the future priority of land use will be horticulture, storage facilities and *matatu* (local transportation using one-box type car) terminal.

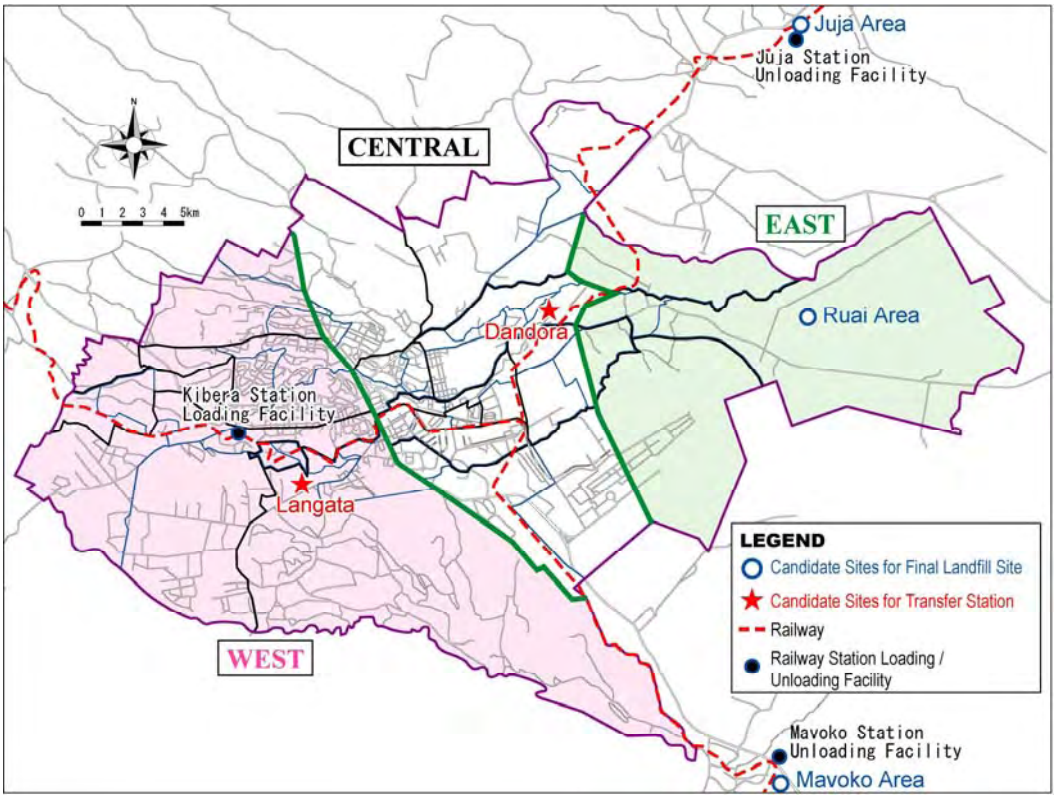
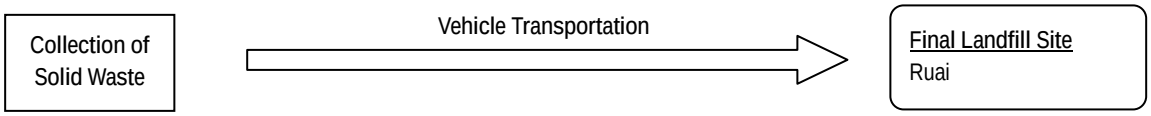


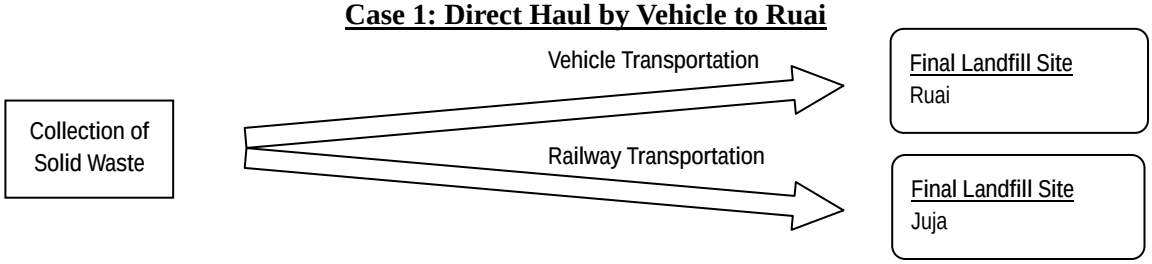
Figure 4.4.2 Location Map of Technical Options for Transport System

The existing railway station at Kibera is considered as the loading facility for wastes using the railway transportation system, and the existing Mavoko and Juja stations are considered as the unloading facilities using the railway transportation system. All of the alternatives shall include Ruai as the final disposal site since Ruai is the only site for final landfill already secured by the City Council of Nairobi. The candidate sites in Juja and Mavoko are owned by private entities and hence the land acquisition process is necessary which may take a long time to complete. Since the final landfill site is indispensable for any solid waste management, any risk such as delay of services should be eliminated as much as possible in order to start operating this key element of the management system. The nine (9) options illustrated below are thus considered for comparison purposes.

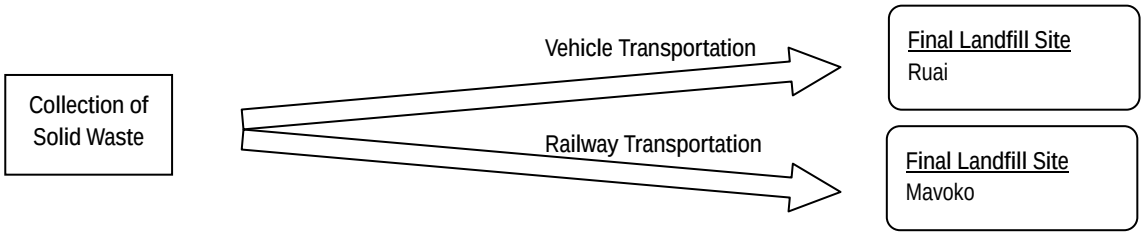
No Transfer Station Option



Case 1: Direct Haul by Vehicle to Ruai



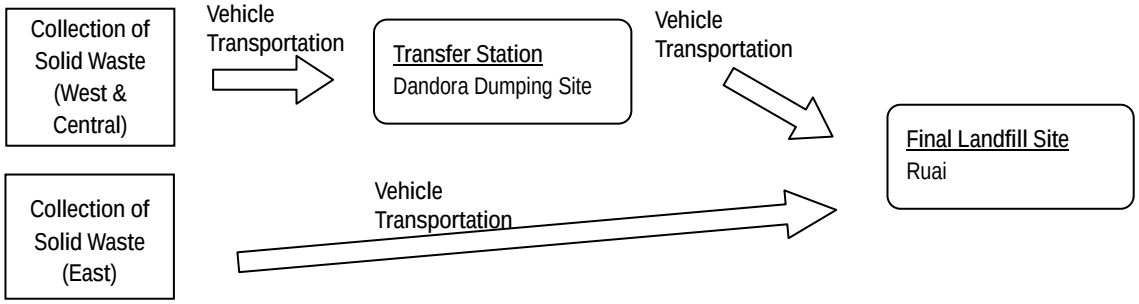
Case 2: Direct Haul by Vehicle to Ruai and by Railway to Juja



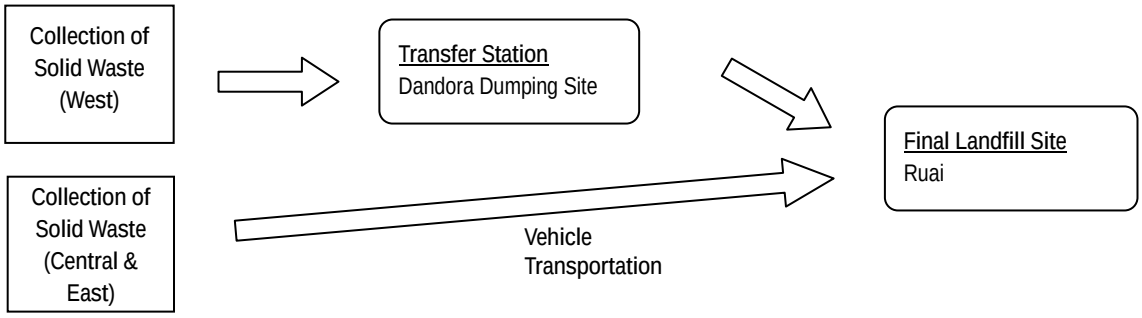
Case 3: Direct Haul by Vehicle to Ruai and by Railway to Mavoko

(The railway passes very close to both the candidate landfill sites of Juja and Mavoko. Therefore, the railway transportation option may be selected if either Juja or Mavoko is chosen as the candidate site for final landfill.)

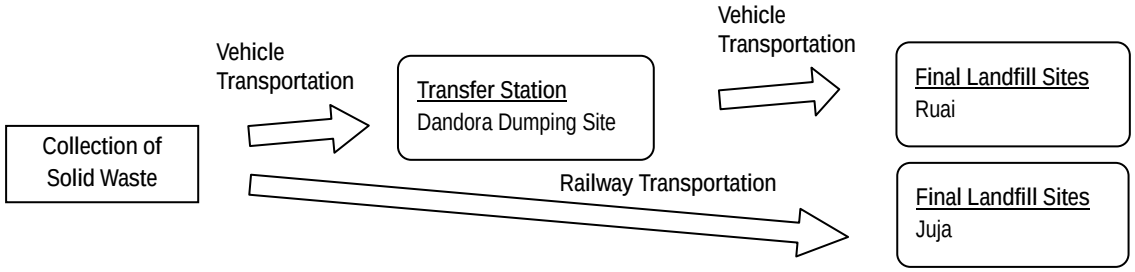
Transfer Station only at Dandora Dumpsite



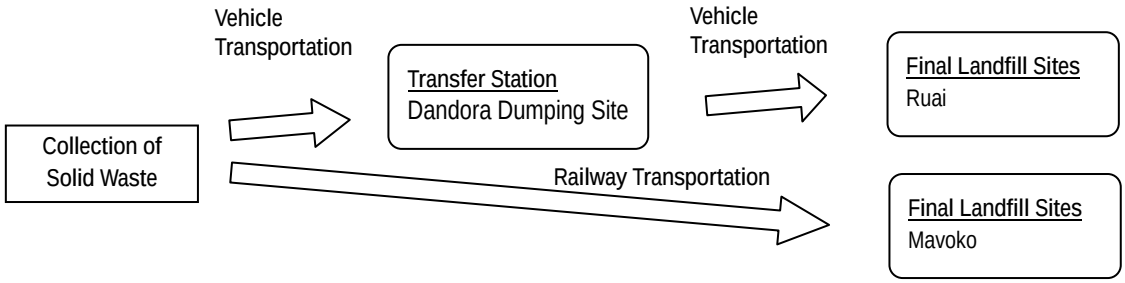
Case 4: Wastes from West and Central Areas are first hauled by Vehicle to the Transfer Station at Dandora and then to Ruai; Waste from the East Area is hauled directly by Vehicle to Ruai



Case 5: Waste from the West Area is first hauled by Vehicle to the Transfer Station at Dandora and then to Ruai; Waste from the Central and East Areas are hauled directly by Vehicle to Ruai



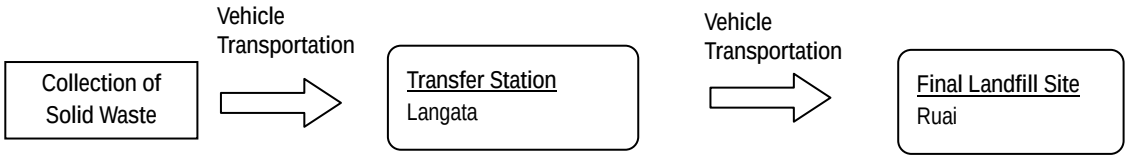
Case 6: Waste is first hauled by Vehicle to the Transfer Station at Dandora and then to Ruai, and hauled directly by Railway to Juja



Case 7: Waste is first hauled by Vehicle to the Transfer Station at Dandora and then to Ruai, and hauled directly by Railway to Mavoko

(If a transfer station is to be built at Dandora, the railway system should be adopted for the waste transportation to either the Juja or the Mavoko final landfill because these sites are located near the railway track.)

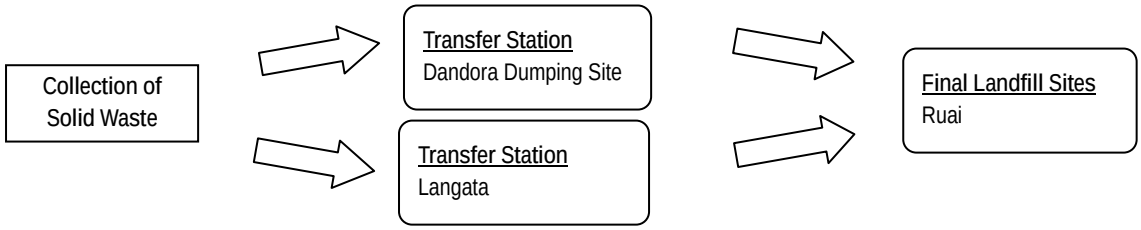
Transfer Station only at Langata



Case 8: Waste is first hauled by Vehicle to the Transfer Station at Langata and then to Ruai

(If the transfer station is to be built only at Langata which is located in the west side of Nairobi, the railway system should not be considered since the railway only has the advantage of avoiding the traffic congestion in the city centre assuming that another landfill site is provided in Juja or Mavoko. To transfer the waste at Langata to the Ruai final landfill, the transport vehicle can pass through the Southern Bypass and the International Trunk Road to Ruai.)

Transfer Station at Dandora Dumpsite and Langata



Case 9: Waste is first hauled by Vehicle to either the Transfer Station at Dandora or Langata and then to Ruai

(If a transfer station is to be built both at Dandora and Langata, the railway system will not be considered for the same reason as Case 7 above. All wastes will be hauled by vehicle to Ruai.)

The details of each alternative are given in **Table 4.4.3**. In case of direct haul to the Ruai final landfill site as shown in Case 1, the collected waste in the west area is to be transported to the Ruai final landfill site for a distance of 32 km, while in the railway transportation as shown in Cases 2, 3, 6 and 7, the collected waste in the west area is to be transported to Juja and Mavoko stations for 52 and 47 km, respectively.

Table 4.4.3 Details of Technical Options of Transport System

Case No.	Collection Area & Transfer System	Final Landfill Site	Details of Technical Option
1	Direct Haul to Ruai (No Transfer System)	Ruai	Generated waste is hauled directly to Ruai final landfill site. • Distance: West to Ruai: 32 km; Central to Ruai: 16 km; East to Ruai: 7 km
2	West: Railway Transport to Juja (940 t/d) Central, East: Direct Haul to Ruai	Juja / Ruai	Generated waste in the west area of Nairobi City is transported by railway to Juja. Wastes generated in central and east are transported directly to Ruai final landfill site. • Distance: West to Juja: 52 km; Central to Ruai: Same as Case 1; East to Ruai: Same as Case 1
3	West: Railway Transport to Mavoko (940 t/d) Central, East: Direct Haul to Ruai	Mavoko / Ruai	Generated waste in the west area of Nairobi City is transported by railway to Mavoko. Wastes generated in central and east are transported directly to Ruai final landfill site. • Distance: West to Mavoko: 47 km; Central to Ruai: Same as Case 1; East to Ruai: Same as Case 1
4	West & Central: Road Transport through Transfer Station at Dandora Dumpsite (2,600 t/d) East: Direct Haul to Ruai	Ruai	Wastes in west and central areas are transported to Ruai final landfill site through the transfer station in Dandora Dumpsite. Wastes in east areas are hauled directly to Ruai final landfill site. • Distance: West to Dandora: 16 km; Central to Dandora: 5 km; East to Ruai: Same as Case 1
5	West: Road Transport through Transfer Station at Dandora Dumpsite (940 t/d) Central, East: Direct Haul to Ruai	Ruai	Generated waste in the west ares of Nairobi City is transported to Ruai through the transfer station in Dandora Dumpsite. Wastes generated in central and east are hauled directly to Ruai final landfill site. • Distance: West to Dandora: Same as Case 4; Central to Dandora: Same as Case 4; East to Ruai: Same as Case 1
6	West: Railway Transport to Juja Central: Road Transport through Transfer Station at Dandora to Ruai (1,590 t/d) East: Direct Haul to Ruai	Juja / Ruai	Generated waste in the west area of Nairobi City is transported by railway to Juja. Waste in the central part is transported to Ruai through the transfer station in Dandora Dumpsite. • Distance: West to Juja: Same as Case 2; Central to Dandora: Same as Case 4; East to Ruai: Same as Case 1
7	West: Railway Transport to Mavoko Central: Road Transport through Transfer Station at Dandora to Ruai (1,590 t/d) East: Direct Haul to Ruai	Mavoko / Ruai	Generated waste in the west area of Nairobi City is transported by railway to Mavoko. Waste in the central part is transported to Ruai through the transfer station in Dandora Dumpsite. • Distance: West to Mavoko: Same as Case 3; Central to Dandora: Same as Case 4; East to Ruai: Same as Case 1
8	West: Road Transport through Langata Transfer Station (940 t/d) Central, East : Direct Haul to Ruai	Ruai	Generated waste in the west area of Nairobi City is transported to Ruai through the transfer station in Langata. Wastes generated in central and east are hauled directly to Ruai final landfill site. • Distance: West to Langata: 7 km; Central to Ruai: Same as Case 1; East to Ruai: Same as Case 1
9	West: Road Transport through Transfer Station (940 t/d) at Langata to Ruai Central: Road Transport through Transfer Station (1,590 t/d) at Dandora St. to Ruai East: Direct Haul to Ruai	Ruai	Generated waste in the west area of Nairobi City is transported to Ruai through the transfer station in Langata. Waste generated in the central area is transported to Ruai through the transfer station at Dandora. Waste in the east area is hauled directly to Ruai. • Distance: West to Langata: Same as Case 8; Central to Dandora: Same as Case 4; East to Ruai: Same as Case 1

(3) Selection Procedure

The optimum collection system should be proposed through the qualitative evaluation of the current operation of each collector, the local situation of housing, the combination type of collection vehicles, and the collection frequency. After the optimum collection system has been proposed, the required number of collection vehicles should be estimated from the target collection waste amount (the detailed information is shown in **Section C of Volume 3, Supporting Report)**. Then, the required number of collection system (vehicle) as of 2030, the final target year, should be input into each technical option in **Table 4.4.3** and the integrated system of collection and transport should be developed for each option.

The technical options were selected based on the principle of minimum costs of capital, operation and maintenance since all of the options have minimal adverse impacts on the surrounding socio-environmental condition based on the first screening in the IEE (Initial Environmental Examination). The detailed information is given in **Section G of Volume 3, Supporting Report**.

(4) Evaluation of Collection System

The collection system shown in **Table 4.4.4** is proposed as the future collection system. In Zones 1 to 9, the private franchisees should take the initiative in the collection of residential and commercial wastes using compactors (50%) and dump trucks (50%) based on the door-to-door collection system, except the station collection method in housing complexes and apartments. CCN and the contractors, on the other hand, will operate in the CCN/SWMPC zone (outside the 9 franchised zones) using the combination of container plus detachable container carrier and dump trucks through the station collection method, and they should concentrate on the collection of market waste and road sweepings using detachable container carriers and dump trucks. In the low income or slum areas in Zones 1 to 9, the CBOs and residents shall conduct primary collection using push carts or containers as the community-based activities. However, private franchisees will be able to collect domestic wastes from the areas they could access. Large capacity collection vehicles such as the 8-ton or 10-ton class are not recommended since it was gathered from the survey that most of the large-capacity dump trucks got stuck or slipped during the rainy days at the existing Dandora Dumpsite.

Table 4.4.4 Proposed Collection System

Zone	Collection Area	Collection Method	Frequency of Collection	Type of Vehicle to be Applied	Responsible Collector
Zone 1 to 9	High Income / Middle Income / Business Establishment / Commercial Area	• Detached house: Door-to-door collection • Housing complex/ Apartment: Station collection	Twice a week	50%: Compactor (4 ton) 50%: Dump Truck (4 ton)	Private franchisee
	Low Income / Slum Area	Primary collection	Twice a week	Push cart/ Container	Residents/ CBOs
		Station collection	Twice a week	Dump truck (4 ton)	Private franchisee
	Markets & Parks	Station collection (Collection at collection points)	Daily	Container ($8m^3$: 4 ton) + Detachable Container Carrier (4 ton)	CCN*[1] + Contractors
	Roads	Street sweeping	Daily	Dump truck (4 ton)	CCN + Contractors
	Whole Areas	Vehicle for supervision/ inspection	-	Pick-up truck	CCN

Zone	Collection Area	Collection Method	Frequency of Collection	Type of Vehicle to be Applied	Responsible Collector
CCN/SWMPC Zone	Slum Area	Primary collection by residents and CBOs	Twice a week	Container + Push cart	Residents, CBOs
		Container collection method (Collection at collection points)	Twice a week	Container ($8m^3$: 4 ton) + Detachable Container Truck (4 ton)	CCN + Contractors
		Station Collection	Twice a week	Dump truck (4 ton)	CCN + Contractors
	Street Sweeping	Cleansing	Daily	Dump truck (4 ton)	CCN + Contractors
Whole Areas		Vehicle for supervision/ inspection	-	Pick-up truck	CCN

Note: *1 CCN will be transferred to SWM Public Corporation from 2016.

(5) Cost Comparison of Integrated Collection and Transportation System Options

(a) Target Collection Ratio, Waste Amount and Required Number of Collection Vehicles

The target collection ratio and waste amount in the whole Nairobi City are as estimated in **Table 4.4.5** for each target year. The detailed information is shown in **Section C of Volume 3, Supporting Report**. The target collection rate in the whole Nairobi City in **Table 4.4.5** was obtained the identification of the current collection rate at each location, weighing the collection rate by the waste generation amount at each location to that of the whole Nairobi City, and finally summating each collection rate at all locations.

Table 4.4.5 Target Collection Ratio and Waste Amount of Nairobi City

Target Year	2010	2015	2020	2025	2030
Collection Ratio (%)	38.0	48.8	64.6	83.6	100.0
Waste Amount (t/d)	634	911	1,381	2,076	2,872

The required number of collection vehicles is shown in **Table 4.4.6**. The detailed information is given in **Section C of Volume 3, Supporting Report**.

Table 4.4.6 Required Number of Collection Vehicles in Each Target Year

Target Year	2010	2015	2020	2025	2030
Case 1*	108	154	230	336	450
Case 2, Case 3, Case 8	108	154	205	292	395
Case 4	108	154	175	252	330
Case 6, Case 7, Case 9	108	154	174	250	327
Case 5	108	154	206	294	398

Note *: Case number indicates numbers in Table 4.4.3.

(b) Cost Estimation for the Integrated Collection and Transportation System Options

The technical options in **Table 4.4.3** were evaluated in terms of cost of capital, operation and maintenance for collecting and transporting waste from the three areas, west, central and east. The required number of collection vehicles shown in **Table 4.4.6** was used for the evaluation. **Table 4.4.7** shows the estimation results of each technical option. As shown in this table, the technical option in Case 1 (Direct Haul to Ruai Final Landfill Site) is ranked as the least cost followed by Case 5 (Construction of Transfer Station at Dandora Dumpsite to Transport the Waste in West Part). For the cost comparison of technical options in Table 4.4.7, depreciation cost is not taken into consideration in order to figure out the actual cost and compare those of

each option based on the same approach in other JICA study cases since depreciation cost is a cost transaction in accounting which does not accompany actual expenditure. The depreciation cost will become higher in proportion to the capital cost, and the results in **Table 4.4.7** will be the same even if depreciation cost is considered since Case 1 has the lowest operation and maintenance cost which will not depend on the depreciation cost.

Table 4.4.7 Results of Cost Estimation for Technical Options

Case	Capital Cost				Operation and Maintenance Cost				Total Cost per ton (KSh/ton)
	Collection (Million KSh)	Transport (Million KSh)	Total (Million KSh)	Cost per ton (KSh/ton)	Collection (Million KSh/year)	Transport (Million KSh/year)	Total (Million KSh/year)	Cost per ton (KSh/ton)	
1	**2,819**	**0**	**2,819**	**263**	**395**	**503**	**898**	**857**	**1,120**
2	2,515	3,717	6,232	604	432	726	1,158	1,105	1,709
3	2,515	3,376	5,891	571	432	726	1,159	1,105	1,676
4	2,162	10,467	12,629	1,242	327	738	1,065	1,016	2,259
5	**2,515**	**3,731**	**6,246**	**606**	**432**	**480**	**912**	**870**	**1,476**
6	2,144	9,055	11,199	1,100	394	866	1,261	1,203	2,303
7	2,144	8,714	10,858	1,067	394	867	1,261	1,203	2,270
8	2,515	3,454	5,969	578	432	525	958	913	1,492
9	2,144	8,792	10,936	1,074	394	661	1,056	1,007	2,081

From the cost estimation for the integrated collection and transportation system, the following two options were selected as the economical options:

(a) Case-A: Direct haul to Ruai final landfill site

Case-A is the project that will transport all wastes in Nairobi City to the Ruai final landfill site without passing through a transfer station. The project will consist of the procurement and replacement of collection vehicles by CCN to attain the target collection ratio at each target year.

(b) Case-B: Construction of a transfer station at Dandora Dumpsite

A transfer station will be built at the existing Dandora Dumpsite to initially transport the waste in the west area which is set at 940 t/d at the target year of 2030 before finally transporting it to the Ruai final landfill site. In this case, the waste in central and east areas will be hauled directly to the Ruai final landfill site. In parallel with the the development of the transfer station, collection vehicles will be procured by CCN. A material recovery facility (MRF) will be also installed inside the transfer building, which will provide job opportunities for some of the existing waste pickers at the Dandora Dumpsite.

(6) Evaluation of Integrated Collection and Transportation System Options

(a) Implementation Schedule

Case-A: Direct haul to Ruai final landfill site

The implementation schedule of the proposed project is shown in **Figure 4.4.3.** The procurement of collection vehicles will be implemented in 2013, 2015, 2020, and 2025. Containers should be replaced every 5 years.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1. Procurement																					
- Vehicles				O		O					O					O					
- Container				O		O					O					O					
2. Replacement																					
- Vehicles															—	—	—	—	—	—	—
- Container									O		O			O		O			O		O
3. Operation & Maintenance					—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure 4.4.3 Implementation Schedule of Case-A: Direct Haul to Ruai Final Landfill Site

Case-B: Construction of transfer station at Dandora Dumpsite

The implementation schedule of the proposed project is shown in **Figure 4.4.4**. The procurement of collection vehicles will be implemented in 2013, 2015, 2020, and 2025, same as Case-A. During 2015 and 2016, the construction of the transfer station will be carried out. The procurement of transport vehicles should be implemented in 2016.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1. Collection Vehicles																					
1.1 Procurement																					
- Vehicles				O		O					O					O					
- Container				O		O					O					O					
1.2 Replacement																					
- Vehicles															—	—	—	—	—	—	—
- Container									O		O			O		O			O		O
2. Transfer Station																					
2.1 Construction																					
- Design, Tender				—	—																
- Construction						—	—														
- Procurement of Transport Vehicles							O														
- Replacement of Transport Vehicles																	—	—	—	—	—
- Replacement of Transport Containers												O					O				O
3. Operation & Maintenance					—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure 4.4.4 Implementation Schedule of Case-B: Construction of Transfer Station at Dandora Dumpsite

(b) Project Cost

Case-A: Direct haul to Ruai final landfill site

The procurement of collection vehicles is shown in **Table 4.4.8**. The detailed information of estimating procurement number is shown in **Section C of Volume 3, Supporting Report**. The procurement and project cost with 10% physical contingency for the engineering and procurement cost is shown in **Table 4.4.9 and Table 4.4.10**, respectively. The number of collection vehicles to be procured was computed with consideration on contingency by setting the load efficiency of vehicles at 80% and procurement number against the increasing number of collection vehicles to be required at the year after 5 years of actual procurement. The detailed information is shown in **Section C Volume 3, Supporting Report**.

Table 4.4.8 Procurement Number of Collection Vehicles (Case-A)

Type of Vehicle	2013	2015	2018	2020	2023	2025	2028	2030	Total
Compactor	0	0	0	0	0	0	0	0	0
Dump Truck	1	42	0	1	0	55	0	0	99
Container Carrier	22	20	0	22	0	43	0	0	107
Pick-up Truck	10	0	0	10	0	10	0	0	30
Total - Vehicles	33	62	0	33	0	108	0	0	236
Container	47	40	50	79	50	144	50	148	608

Table 4.4.9 Procurement Cost of Collection Vehicles (Case-A)

Unit: in KSh Thousand

Type of Vehicles	2013	2015	2018	2020	2023	2025	2028	2030	Total
Compactor	0	0	0	0	0	0	0	0	0
Dump Truck	4,502	189,076	0	4,502	0	247,600	0	0	445,680
Container Carrier	118,848	108,044	0	118,848	0	230,133	0	0	575,873
Pick-up Truck	9,566	0	0	9,566	0	9,566	0	0	28,699
Container	44,962	38,265	47,832	75,574	47,832	137,756	47,832	141,582	581,635
Total	177,878	335,385	47,832	208,491	47,832	625,054	47,832	141,582	1,631,887

Table 4.4.10 Project Cost (Case-A)

Unit: in KSh Thousand

Year	Engineering Cost (1)	Procurement Cost (2)	O & M Cost (3)	Physical Contingency (4) = 10% of [(1)+(2)]	Total (1)+(2)+(3)+(4)
2011	8,894			889	9,783
2012	8,894			889	9,783
2013	16,769	177,878	0	19,465	214,112
2014	16,769		98,851	1,677	117,297
2015		335,385	105,969	33,539	474,893
2016			114,954	0	114,954
2017	4,783		124,262	478	129,523
2018	10,425	47,832	133,885	5,826	197,968
2019	10,425		144,111	1,043	155,579
2020		208,491	154,356	20,849	383,696
2021			167,330	0	167,330
2022	4,783		181,171	478	186,432
2023	31,253	47,832	195,202	7,909	282,196
2024	31,253		210,135	3,125	244,513
2025		625,055	225,621	62,506	913,182
2026			241,485	0	241,485
2027	4,783		258,354	478	263,615
2028		47,832	275,364	4,783	327,979
2029	14,158		293,416	1,416	308,990
2030		141,582	312,567	14,158	468,307
Grand Total	163,189	1,631,887	3,237,033	179,508	5,211,617

Case-B: Construction of transfer station at Dandora Dumpsite

The procurement of collection vehicles is shown in **Table 4.4.11**. The detailed information on the estimation of procurement number is shown in **Section C of Volume 3, Supporting Report**. The procurement and project cost with 10% physical contingency for the engineering and procurement cost is shown in **Table 4.4.12 and Table 4.4.13**, respectively. The number of collection vehicles was computed based on the same approach as in Case-A.

Table 4.4.11 Procurement Number of Collection Vehicles (Case-B)

Type of Vehicle	2013	2015	2018	2020	2023	2025	2028	2030	Total
Compactor	0	0	0	0	0	0	0	0	0
Dump Truck	1	40	0	1	0	54	0	0	96
Container Carrier	22	18	0	22	0	40	0	0	102
Pick-up Truck	10	0	0	10	0	10	0	0	30
Total of Vehicles	33	58	0	33	0	104	0	0	228
Container	47	36	50	73	50	132	50	136	574

Table 4.4.12 Procurement Number of Collection Vehicles (Case-B)

Unit: in KSh Thousand

Type of Vehicles	2013	2015	2018	2020	2023	2025	2028	2030	Total
Compactor	0	0	0	0	0	0	0	0	0
Dump Truck	4,502	180,073	0	4,502	0	243,098	0	0	432,175
Container Carrier	118,848	97,239	0	118,848	0	213,926	0	0	548,862
Pick-up Truck	9,566	0	0	9,566	0	9,566	0	0	28,699
Container	44,962	34,439	47,832	69,834	47,832	126,276	47,832	130,103	549,109
Total	177,878	311,751	47,832	202,751	47,832	592,867	47,832	130,103	1,558,845

Table 4.4.13 Project Cost (Case-B)

Unit: in KSh Thousand

Year	Cost of Collection Vehicles		Cost of Transfer Station			O&M of Collection Vehicles	O&M of Transfer Station	Physical Contin-gency*	Total
	Engineering Cost	Procurement of Collection Vehicles	Engineering Cost	Construction of Transfer Station	Procurement of Transport Vehicles				
2011	8,894							889	9,783
2012	8,894							889	9,783
2013	15,588	177,878	106,627					30,009	330,102
2014	15,588	0	106,627			95,566		12,222	230,003
2015		311,751	62,954	1,259,081		102,314		163,379	1,899,479
2016		0	62,954	1,259,081	873,455	110,817		219,549	2,525,856
2017	4,783	0				119,623	65,179	478	190,063
2018	10,138	47,832				128,726	70,610	5,797	263,103
2019	10,138	0				138,400	76,042	1,014	225,594
2020		202,751	60,073			148,087	83,284	26,282	520,477
2021		0			600,727	160,344	90,526	60,073	911,670
2022	4,783	0				173,421	97,768	478	276,450
2023	29,643	47,832				186,671	106,820	7,748	378,714
2024	29,643	0				200,774	115,873	2,964	349,254
2025		592,867	62,800			215,396	124,926	65,567	1,061,556
2026		0	2,727		628,000	230,374	132,168	63,073	1,056,342
2027	4,783	0	2,727		27,273	246,301	141,220	3,478	425,782
2028		47,832	2,727		27,273	262,356	150,273	7,783	498,244
2029	13,010	0	62,800		27,273	279,395	161,136	10,308	553,922
2030		130,103			628,000	297,471	170,189	75,810	1,301,573
Total	155,885	1,558,845	533,016	2,518,163	2,812,000	3,096,036	1,586,012	757,791	13,017,748

Note: *The physical contingency is calculated as 10% of the total cost of civil works, equipment and engineering services.

(c) Evaluation of Both Cases

Both Case-A and Case-B have been evaluated and Case-A (Direct Haul to Ruai Final Landfill Site) was selected from the financial and economical viewpoint as well as technical viability, as explained in **Section 4.13**.

(7) Collection and Transportation in Low Income and Slum Areas

(a) Current Issues Identified

Currently, CBOs conduct waste collection in low income or slum areas. However, the following problems were identified in relation to their activities:

- CBOs do not collect residential wastes from all households (Low collection ratio by CBOs' primary collection on households).
- Extremely low frequency of collection by CCN and contractors' collection vehicles.
- CBO lack collection tools, causing obstacles to their collection activities.
- Collection vehicles could not access the collection points inside the slum areas because of bad road condition or steep topography. Accordingly, CBOs are obliged to carry out their collection activity manually.
- Very few collection points designated; accordingly, CBOs are obliged to discharge their collected waste into undesignated collection points resulting in illegal dumping.

(b) Actions Required

Taking the above situations into consideration, the following actions are proposed:

(i) Enhancement of partnerships among CCN, CBOs and residents

Stakeholder meetings should be held to build the relationship of mutual understanding toward the solution of problems. They shall be implemented through pilot projects in future technical cooperation schemes. The detailed information is shown in **Section F of Volume 3, Supporting Report.**

(ii) Education to residents toward appropriate discharge of household waste including source segregation

The education of residents toward the appropriate discharge of household waste or the raising of sanitation awareness should be carried out. For the actual action, education materials shall be prepared and distributed to the residents. These shall be implemented through pilot projects in future technical cooperation schemes. The detailed information is shown in **Section F of Volume 3, Supporting Report.**

(iii) Enhancement or expansion of CBO activities toward the increase of primary collection rate from residents

The enhancement or expansion of CBOs who are currently the main actors in the primary collection in low income and slum areas is necessary in order to raise the primary collection rate. Support to the CBOs or the creation of new CBOs in areas where collection activities are not carried out will be necessary. This shall be implemented through pilot projects in the future technical cooperation schemes. The detailed information is shown in **Section F of Volume 3, Supporting Report.**

(iv) Formulation and implementation of deployment plan of designated collection points

One of the causes of illegal dumping or piling of wastes in low income or slum areas is the failure of CBOs to deliver collected waste to the designated collection points due to their insufficient number. The container collection system in these target areas is proposed and the place of installation of containers should be decided in advance of the actual installation work.

The formulation of a deployment plan for designated collection points and its actual implementation is proposed through consultation among CCN, CBOs and residents to obtain agreement.

(v) Construction or improvement of access roads to the collection points to raise collection frequency

The lack of access to collection points or the bad condition of existing roads is one of the big problems to be solved for the SWM in the target areas. The access in slum areas is extremely poor, causing bottlenecks for the collection vehicles to reach the collection points. The construction of new roads or improvement of existing roads will be necessary to remove these bottlenecks. In the master plan, the construction of 100-m roads and returning places (15m x 15m) for container carriers is proposed in 75 slums for the target short-term and mid-term implementation scheme.

(8) Regular Cleanup Plan

Scattered wastes have been identified along the road sides, causing the unsanitary condition and disfigurement of the urban environment of Nairobi City. A regular cleanup shall then be necessary to improve the situation. In the master plan, the regular cleanup of roadsides in the 8 divisions excluding the CBD Zone twice a year is proposed. The cleanup shall be carried out through contract-out to subcontractors and with the use of wheel loaders and dump trucks.

(9) Operation and Maintenance Plan

According to the procurement plan, collection vehicles mainly composed of container carriers will be procured, and the procured vehicles can be deployed at the existing division offices. The plan of CCN to relocate the existing workshop at Ragos Road to the Kaloleni Depot is welcome for the future increase of vehicles. The training of technicians is also important and the contract-out of maintenance work will be one option to cope with the future maintenance.

4.4.2 3R and Intermediate Treatment Plan

As stated earlier in **Section 3.4**, the 3R and Intermediate Treatment Plan shalll be formulated with the involvement of stakeholders through the utilisation of existing functions to the maximum extent including improvement. In addition, the intermediate treatment plan shall be formulated in consideration of the applicable technology in Kenya and the least cost alternatives to avoid excessive financial burden to CCN. With the aforementioned as a basic rule, the 3R and Intermediate Treatment Plan are as discussed below.

(1) 3R Plan

(a) Outline for Development of 3R Plan

The programmes under the 3R plan were formulated basically with soft component programmes defining the roles, responsibilities and activities of each party including CCN, waste generators and the central government. The implementation of rogrammes should be carried out through the primary initiative and effort of CCN. There are many programmes commonly practiced in the world for 3R activities which can be categorised with waste generation source control, waste discharge control, waste recovery and reuse, and recycling of materials. These programmes are also applicable for the 3R activities in Nairobi City. The programmes and activities will be performed mostly with the raising of awareness of waste generators and stakeholders through public campaigns, formal and school education, pilot projects and capacity development of the CCN staff concerned. In addition, the hard

component programme will be considered for activating the recovery of recyclable materials by the development of material recovery facilities. Each programme under the 3R plan is as elaborated below.

(b) Technical Options of 3R

Basically, the 3R scheme is composed of many kinds of soft component programmes for waste reduction, recovery, reuse and recycling to promote 3R activities among the parties concerned. The plan should be implemented comprehensively with all the possibly effective programmes which are divided into the four categories summarised below. The 3R programmes in the four categories are inter-related, and should be implemented to achieve the goals of 3R.

- Waste Generation Source Control for Waste Reduction
- Waste Discharge Control for Recovery and Waste Diversion
- Recovery of Recyclables at Sources and Reuse
- Recycling of Recyclable Materials

(i) Waste Generation Source Control for Waste Reduction

The programmes under the waste generation source control target the activities to minimise the generation of waste through the production of durable goods and the avoidance of over-packaging in distribution and sale, and by motivating and changing the awareness of waste generators toward a lifestyle of resource and environmental conservation. These activities should be implemented in five sub-programmes, namely; production control, distribution and sale control, consumer control, waste charge control, and commercial and institutional waste control.

(ii) Waste Discharge Control for Recovery and Waste Diversion

Waste discharge control aims at reducing the amount of waste discharged by individual waste generation sources through self-disposal at the backyard, converting organic waste into compost, repair and reuse of broken instruments and appliances, and exchange or sale of reusable goods within the community. These activities should be carried out at the waste generation sources.

(iii) Recovery of Recyclables at Sources and Reuse

Activities under this programme intend to enhance the recovery of recyclable materials through segregation at waste generation sources, recovery of recyclable materials before the waste is discharged to the waste collection service, securing the routes for recovery and trading of recyclable materials, etc. These activities require extensive participation of the stakeholders and the communities.

(iv) Recycling of Recyclable Materials

Recycling industries or the recyclers should take the primary role in the activities of this programme by performing regular and constant recovery of recyclable materials and utilising the recovered materials for the production of goods. Support of CCN and the relevant government agencies is also important for the implementation of these activities by recycling industries or recyclers.

Figure 4.4.5 shows the conceptual flow of the four programmes and sub-programmes for easier understanding of the 3R activities.

There are several key elements involved in the implementation of 3R programmes. For example, the strong initiative of CCN is inevitable for promoting the 3R activities. The increase of efficiency in recovering recyclable materials and securing a storage area, a distribution centre, networking, etc., are also indispensable for the sustainability of 3R activities. The following subsections explain these key elements and the proposed target level associated with the 3R Plan for Nairobi City.

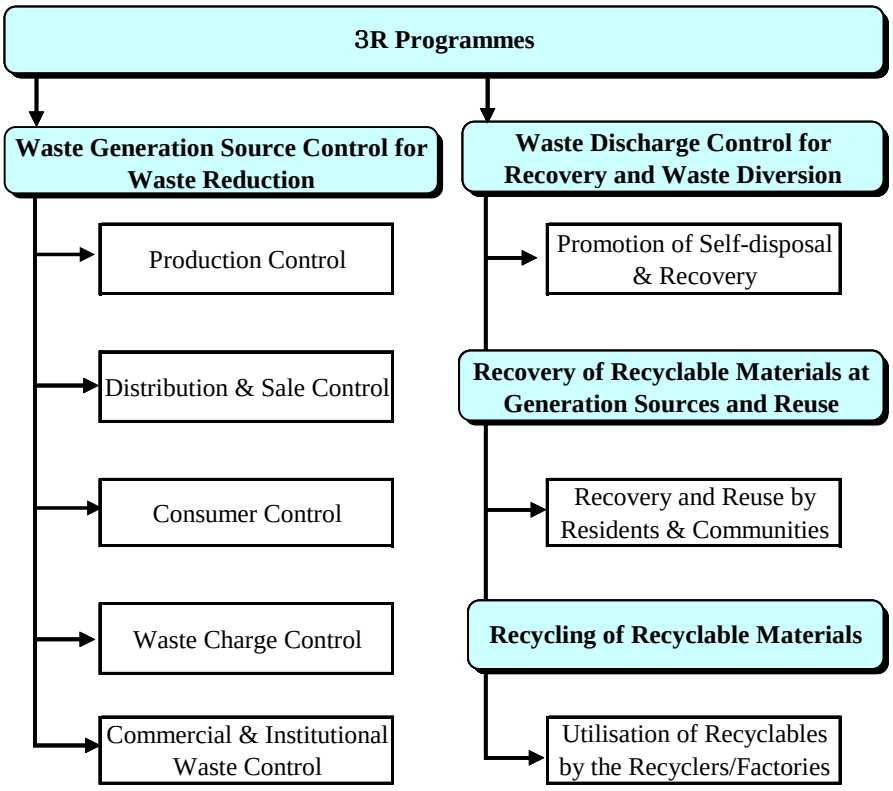


Figure 4.4.5 Conceptual Flow of Implementation of 3R Programmes

(c) Technical Options of Resource Recovery

In the process of recovery of recyclable materials from municipal waste in Nairobi, the following four technical options are considered depending on the waste segregation condition summarised in **Table 4.4.14**. Those technical options are explained in the following paragraphs.

Table 4.4.14 Technical Option for Recovery of Recyclable Waste

Technical Option	Segregation Condition	Function of MRF, Buy-Back Centre or Waste Bank
Option 1	Segregation at Waste Generation Source	Secondary segregation of recyclable materials, storage and distribution centre
Option 2	Mixed Waste	Primary and secondary segregation of mixed waste and recovery of recyclable materials, storage and distribution centre
Option 3	Mixed Waste and Recovery by Collection Workers	Secondary segregation of recyclable materials, storage and distribution centre
Option 4	Mixed Waste and Recovery by Waste Pickers at Disposal Site	MRF may not be required

Option 1:

This option is set in the highest hierarchy of resource recovery since the most challenging segregation activities at generation sources require the involvement or active participation of waste generators in the solid waste management system of the local government unit. Source separation is practiced partly in Nairobi and waste pickers working in town collect the recyclable materials directly from the waste generators. Segregation at source shall be set up for a base as the local government unit implements resource recovery from waste. Option 1 stands on the fact that waste as mixed is only waste but wastes as segregated become resources and are expectable for the recovery of more amounts of recyclable materials. With this Option 1, the MRF will function as the place for secondary segregation, storage and distribution, similar to the function of the Buy-Back Centre or the Waste Bank.

Option 2:

Mixed waste collection is a system practiced in Nairobi today and potentially recyclable materials get dirty due to mixing, especially with food waste. As mixed waste is discharged, recovery of recyclable materials becomes hard work for the necessity of primary and secondary segregation or sorting. In case the MRF is used as the recovery place, the recovery process should be designed with manual and/or mechanical segregation systems for received mixed waste and need considerations to the neighboring environment and to the health risk on workmen.

Option 3:

Recyclable materials are picked out from mixed waste as in Option 2. However, the key player for recovery is not the MRF but the waste collection workers, which is commonly practiced today in the course of waste collection service. Recovered recyclable waste is then brought to the dealers handling waste at the Dandora Dumpsite. Due to the picking-out action for recyclable materials in the course of loading waste to the vehicles, the efficiency of waste collection as a whole becomes low. In this option, the function of MRF is the same as that of Option 1 because the recyclable materials are segregated by the waste collection workers.

Option 4:

Recyclable materials in mixed waste are finally recovered by the waste pickers at the Dandora Dumpsite. The current system of resource recovery is carried out in combination with Option 3 in addition to the recovery by waste pickers in town of waste segregated by the waste generators in Option 1. Since the recovery work at the disposal site influences the landfill work, waste-picking will be banned at the new landfill site. Accordingly, the MRF will no longer be required because the waste will be hauled to the disposal site.

Among the above four (4) options, Option 1 is recommended as the most effective method of recovery of recyclable materials from municipal waste, because the segregation at source before mixing with other wastes is easier and more amounts of recyclable materials would be recovered. Option 3, recovery of recyclables by waste collection workers, may be acceptable as long as the waste-picking would not disturb their waste collection work and risks to collection workers are avoided as well.

(d) Initiatives of CCN for 3R Activities

In order to implement the 3R activities effectively and efficiently, CCN shall take the primary role to set up the implementing policies, purposes, strategies, and the phased target levels in addition to the coordination role for the parties concerned. The establishment of a Special Task Force in the DoE will thus be required to formulate the implementation plans and

programmes of 3R including public campaign, school and formal education, the encouragement of people, support/assistance, and the coordination to form a linkage among the residents, CBOs, NGOs, other community groups, waste pickers and junkshops in town. The Special Task Force shall be composed of experts in the field of solid waste management and social services and the office staff to support the expert staff.

The role of CBOs is increasing especially in solid waste collection, so that the Special Task Force will be required to monitor, instruct and control their activities. The CBOs and the other groups involved in the solid waste management services shall be registered with CCN and their number updated annually to assure the provision of regular services to the communities.

(e) Enhancement of 3R Activities

More recyclable materials will be recovered as segregation is carried out at residential houses and workplaces of the establishments. However, the waste generators in Nairobi still lack the awareness to the limited natural resources or the worldwide "save the earth" movement. For the purpose of recycling, the recovery of recyclable materials shall be enforced as social activities. The segregation and recovery of recyclables at the waste generation sources will need the active participation of waste generators so that the following activities shall be included in the implementation of 3R including the enhancement of resource recovery:

- Demonstration of 3R at pilot areas in communities which shall involve the waste generators, waste pickers, junkshops and CBOs;
- Demonstration of 3R at pilot workplaces with the participation of all staff of establishments;
- Raising awareness through education and public campaign to encourage the participation of waste generators in the 3R activities;
- Support of CCN on the recovery activities by providing transportation for recyclable materials to the junkshops or to the recycling factories; and
- Promotion of recovery of food waste and biodegradable waste for home composting and community level composting.

(f) Collection, Storage and Transport of Recyclable Materials

After the segregation of recyclable materials at the generation sources, the waste generators store them until they are sold. The buyers, junkshops in town or CBOs go around town to collect recyclables in exchange for money. Most of the junkshops and the CBOs do not have collection vehicles and use hand carts or tricycles for the collection and storage of recyclable materials for a month or so until the volume is enough for one truck load to be transported to the dealers or to the recyclers. To facilitate the material recovery activities, the following measures would be effective:

- The support of CCN to the groups through the provision of a site for secondary segregation and temporary storage of recyclable materials;
- The provision of regular collection services for residual wastes after recovery of recyclable materials at site; and
- The provision of vehicles by CCN/Contractors to the groups with minimal fee or free of charge for the transportation and sale of recyclable materials.

(g) Setup of MRF, Waste Bank or Buy-Back Centre for Waste Recovery

The current situation of recovery of recyclable materials by waste generators is not always active due to the lack of a recovery system to attract or give benefits to the people. The trading

of recyclable materials through the MRF, the Waste Bank or the Buy-Back Centre is considered as one of the solutions to activate waste recovery through initiation of the following programmes:

- The opening and management of the MRF, the Waste Bank or the Buy-Back Centre by CCN or CBOs or NGOs or junkshops or dealers of junked materials where the junkshop activities are relatively low; and
- The stabilisation of buying/selling prices of recyclable materials by CCN or by the Ministry of Industrialisation.

(h) MRF Centre Option at Dandora as Relief Measure for Waste Pickers

One of the alternative plans of waste collection and transport include the plan to construct a transfer station at Dandora, functioning partly as a material recovery facility. This alternative is proposed aiming at giving relief to about 60 waste pickers who will lose their source of income after the closure of the Dandora Dumpsite. The scale of the MRF Centre shall be determined to avoid financial overburden to CCN, but it should be able to accommodate 60 waste pickers, which is about 10% of the waste pickers presently working at the dump site. In case the waste collection and transport alternative will not be implemented, one of the relief measures will not materialise. In line with the social considerations for implementing the solid waste management projects, the construction of a material recovery facility centre at the closed area of Dandora Dumpsite is one of the options for the relief of waste pickers. The Dandora MRF centre option is outlined as follows:

- The Dandora MRF centre is proposed as the distribution centre with recycling facilities to be operated and maintained by the organised groups of waste pickers linking with the junk dealers and recyclers and assisted by CCN.
- The Dandora MRF centre shall have the main function of receiving only recyclable materials from collection vehicles, secondary sorting, shipping to recyclers/factories, and as information centre of stocked recyclable materials through a web page.
- For the purpose of providing relief to more waste pickers, the Dandora MRF centre may be provided with the additional function as pilot compost plant to convert biodegradable waste collected from the neighbouring houses and hawkers' markets.

The conceptual plan of the Dandora MRF centre is as follows;

Required Site Area	:	Approximately 5,000 m^2
Total Floor Area	:	Approximately 1,900 m^2
Receiving Amount of Recyclable Materials	:	Maximum 20 tons per day
Receiving Amount of Biodegradable Waste	:	Maximum 4 tons per day
Storage of Recyclable Materials	:	2 weeks
Number of Operation Staff	:	Approximately 60 persons
Component Facilities	:	Receiving Area, Secondary Sorting Area, Processing Area, Storage Area, Shipping Area, Composting Area, Management Office, Appurtenant Facilities

The project cost of the Dandora MRF Centre described above is estimated to be approximately KSh 116 million for investment cost and KSh 119 million for operation and maintenance cost from 2017 to 2030, excluding land acquisition cost. For details, refer to the cost estimate given in **Section D of Volume 4, Data Book**.

(i) Legislative Measures for Promotion of 3R Activities

In Japan, the Ministry of Environment enforces several laws and regulations for establishing a recycling-based society. These laws are as follows:

- The Basic Environment Law;
- The Basic Law for Establishing the Recycling–based Society;
- Waste Management and Cleansing Law;
- Law for Promotion of Effective Utilisation of Resources;
- Container and Packaging Recycling Law;
- Electric Household Appliance Recycling Law;
- Construction Material Recycling Act;
- Food Recycling Law; and
- Law on Promoting Green Purchasing.

In Kenya, the Environmental Management and Coordination (Waste Management) Regulations of 2006, in relation to Sections 92 and 147 of the Environmental Management and Coordination Act, (No. 8 of 1999), is implemented by the National Environment Management Authority (NEMA). The said Waste Management Regulation of 2006 stipulates the responsibilities of waste generators concerning segregation, but it does not have a clear definition of the means of compliance by the waste generators. In order to establish a recycling-based society, the enactment of a comprehensive legislative arrangement is required, together with the enforcement of relevant laws and regulations like the case in Japan. In order to promote the 3R activities proposed in the SWM Master Plan, initially, the following legislative measures are required together with the enforcement of national level regulations and/or the By-law of CCN for performing the required activities and achieving the target level:

- Enactment of a law which will clearly define the roles and responsibilities of CCN, waste generators including residents and owners of establishments, CBOs, junkshops, waste collectors and transporters, recycling industries, Ministry of Local Government (MoLG), NEMA and other relevant central government agencies, regarding the 3R activities including waste segregation at source;
- Enactment of a law stipulating the provision of technical and financial assistance as well as support by CCN and/or the relevant government agencies to CBOs, junkshops, waste collectors and transporters, and recycling industries, for sustainable 3R activities;
- Formulation and implementation of guidelines stating the target recyclable materials, target level of waste reduction and resource recovery, and the linkage and roles of stakeholders in the activities;
- Establishment of regular financial sources of CCN's annual budget for the implementation of 3R activities; and
- Establishment of systems for monitoring, inspection and improvement of the 3R activities.

(j) Overall Target Level of 3R

The target level of each 3R activity is proposed by phase as listed in **Table 4.4.15**. The target levels were determined based on the characteristic of municipal waste in Nairobi City and the practices in many other countries. Reference shall be made to **Section D of Volume 3, Supporting Report**.

Table 4.4.15 Proposed Target Level of 3R Activities

3R Activities	2009	2015	2020	2025	2030
Waste Reduction	0%	5.0%	7.5%	10.0%	10.0%
Material Recovery	4.7%	6.3%	9.3%	10.8%	12.3%
Biodegradable Waste Recovery	0.6%	3.3%	3.4%	3.4%	3.4%
Waste Diversion for Final Disposal	5.3%	14.6%	20.1%	23.2%	25.7%

The draft of the National and Municipal Solid Waste Management Strategies prepared by the Office of the Deputy Prime Minister and the Ministry of Local Government states that the local authorities must meet the statutory 30% recovery ratio of waste by 2018 for the short-term and middle-term targets and progressively increase to over 50% by 2030 for the long-term target. It seems, however, that the draft target level is too high for the large cities to realise and it is also a challenging level even for the small cities. Moreover, the equation for determining the recovery ratio or the draft target level is not clear, especially, for the waste amount used as the denominator. Although the proposed target level of waste diversion ratio of about 26% in 2030 for 3R activities was determined based on the denominator taken from the potential waste collection amount and proposed at a practical level for large cities like Nairobi City, the target level and the 3R programmes should still be reviewed and the National and Municipal Solid Waste Management Strategies should be updated.

(k) Outline of Proposed 3R Plan

Based on the above considerations, the programmes under the 3R Plan should be implemented through the initiative of the Special Task Force proposed to be organised in the DoE of CCN through the actions taken on waste generators including residents, establishments, and all other stakeholders for participation to the programmes. The programmes to be implemented under the 3R Plan consist of the items shown in **Table 4.4.16 to Table 4.4.19**.

Table 4.4.16 Programmes under 3R Plan (1)

Waste Generation Source Control for Waste Reduction			
	Planning Purposes	Actions by CCN & Government Agencies	Actions by Consumers, Communities & Establishment
Production Control			
	Use of more returnable bottle goods	Encouragement & assistance of makers	Use of returnable bottle goods by the consumers and production of returnable bottle goods by the manufacturers
	Use of eco-friendly goods and over-packaging	Encouragement & assistance of the makers	Use of eco-friendly goods by the consumers and development/ production of eco-friendly goods by the manufacturers.
Distribution & Sale Control			
	Marketing of more returnable bottle goods	Control of non-returnable bottle goods	Ensure recovery & deposit systems
	Reduction of over packaging	Control of over-packaging goods	Sale/Purchase of simple packaging goods
Consumer Control			
	Reduction of domestic waste generation rate	Save the Earth campaign & education	Participation & change of previous habit
	Reduction of plastic shopping bags	Campaign & education on use of own shopping bag	Participation & use of own shopping bag

Waste Generation Source Control for Waste Reduction			
	Planning Purposes	Actions by CCN & Government Agencies	Actions by Consumers, Communities & Establishment
Waste Charge Control			
	Application of progressive rate waste tariff	Establishment of fair waste charge system	Payment of waste bill
	Penalty to unpaid bills	Monitoring & collection of unpaid bills	Acceptance for payment of waste charge
Commercial & Institutional Waste Control			
	Reduction of business waste generation rate	Public campaign, monitoring & control	Participation & change of previous habit of staff
	Application of progressive rate waste tariff	Establishment of fair commercial waste charge system	Payment of commercial waste bill

Table 4.4.17 Programmes under 3R Plan (2)

Waste Discharge Control for Recovery and Waste Diversion			
	Planning Purposes	Actions by CCN & Government Agencies	Actions by Consumers, Communities & Establishment
Promotion of Self-disposal & Recovery			
	Reduction of discharge amount at generation sources	Campaign for safe self-treatment/disposal	Participation in safe self-treatment/disposal
	Composting by individual house	Campaign, assistance & instruction of home composting	Participation in home composting
	Composting by community groups	Campaign, assistance & instruction of community composting	Participation in community composting
	Reduction of broken instrument & elect. appliances	Campaign, assistance, instruction of repair shops	Repair, sale and use second-hand goods
	Reduction of reusable waste	Campaign & assistance for garage/garden sale & exchange	Participation in garage/garden sale & exchange

Table 4.4.18 Programmes under 3R Plan (3)

Recovery of Recyclable Materials at Generation Source and Reuse			
	Planning Purposes	Actions by CCN & Government Agencies	Actions by Consumers, Communities & Establishment
Recovery and Reuse by Residents & Communities			
	Establishment of resource saving society	Save the Earth campaign & education	Participation in the activities
	Increase of efficiency of resource recovery operations	Determine the phased target level for recovery of recyclable materials	Segregation of recyclable materials
	Securing of routes for recovery & trading of recyclable materials	Encouragement, assistance to junkshops/ dealers and recovery centre(s)	Utilisation of the recovery routes
	Recovery of recyclable materials from domestic waste	Campaign, education, encouragement & assistance for establishment of the system	Recovery of more recyclable materials by residents & CBOs
	Recovery of recyclable materials from commercial & institutional wastes	Campaign, education, encouragement & assistance to the establishments	Recovery of more recyclable materials by the establishments

Table 4.4.19 Programmes under 3R Plan (4)

Recycling of Recyclable Materials			
	Planning Purposes	Actions by CCN & Government Agencies	Actions by Consumers, Communities & Establishment
Utilisation of Recyclables by the Recyclers/Factories			
	Enhancement of involvement of recycling industries	Encouragement & assistance to recyclers/factories	Participation in the waste recycling programme
	Regular recovery & shipping of recyclable materials	Assistance for linkage among the operators of recyclable materials	Participation in regular trading of recyclable materials
	Development of technologies for utilisation of recyclable materials	Encouragement & assistance to recyclers/factories	Production of new goods & use of recycling products

(2) Intermediate Treatment Plan

(a) Outline for Development of Intermediate Treatment Plan

Considering the overall financial constraint against the solid waste management by CCN, the SWM Master Plan is to be formulated with the required minimum system to be developed, especially, for waste collection services and waste disposal. Accordingly, the development of intermediate treatment shall be limited to the least cost options at this stage. However, the intermediate treatment facilities are indispensable for the establishment of an integrated solid waste management system for Nairobi City. Therefore, studies should be carried out for several intermediate treatment options towards future development in consideration of the result of waste composition analysis, as described in the following subsections.

In view of the technical options commonly discussed nowadays among the people concerned, the four (4) technical options including incineration, incineration with power generation, methanisation with power generation and composting were selected for evaluating the most appropriate intermediate treatment facilities for Nairobi City. These technical options were evaluated according to factors such as waste characteristics, progress of "waste to energy" projects in Nairobi City, practices in other countries, cost factor, etc. For the study on incineration facilities, no information on incineration facilities in developing countries was available during the survey and there is almost no incineration facility constructed to meet the scale for Nairobi City. Since there is a long history of development of intermediate treatment facilities by almost all the cities and municipalities in Japan, the information and data on practices in Japan were collected for evaluation, especially, of incineration facilities. The following items present the development of the plan and the evaluation for selecting the best option of intermediate facility.

(b) Proposed Technical Options of Intermediate Treatment for Nairobi City

There are many technical methods of intermediate treatment of municipal waste although some of them are effective only for small systems and some other options are technically sophisticated. Considering the waste characteristics, the waste amount for treatment and the technologies discussed with the people concerned, the following four technical options including incineration, incineration with power generation, methanisation with power generation and composting as shown in **Figure 4.4.6** were studied as possible intermediate treatment facilities for Nairobi City.

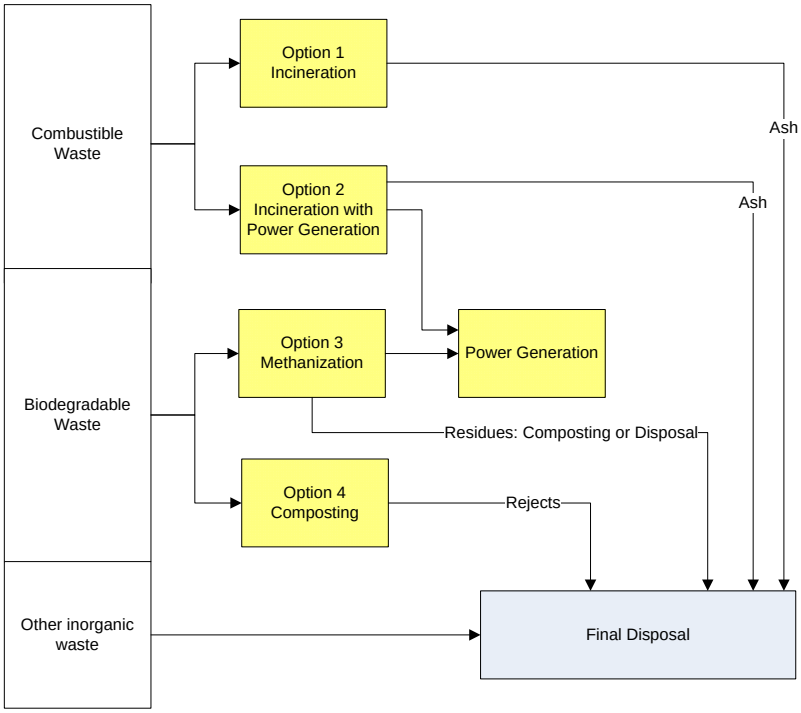


Figure 4.4.6 Technical Options of Intermediate Treatment

(c) Waste to Energy Project by KenGen

The Kenya Electricity Generating Company (KenGen) concluded a contract for consulting services in May 2010 to carry out a feasibility study for the Nairobi Urban Waste to Electricity Plant. The study is expected to be accomplished in six (6) months. The project focuses on the utilisation of waste at the landfill site(s) as the renewable energy site for generating electricity. Since the study report will not be completed by the time of submission of the updated SWM Master Plan in September 2010, the study on Waste to Energy was carried out independently taking into consideration the points mentioned below. It is hoped that the Waste to Energy Project of KenGen will refer to the updated SWM Master Plan in the feasibility study that will be conducted.

- Careful study on the characteristics of combustible waste in terms of low calorific value.
- Waste collection ratio/amount for determining the plant scale and available power generation capacity.
- Involvement or roles of CCN in project implementation.
- Availability of co-partner for implementation and financing agency(s).

(d) Intermediate Treatment Practiced in Japan

Table 4.4.20 and **Figure 4.4.7** provide data and information on the intermediate treatment practiced by 6,639 facilities in 1,817 local government units in Japan in fiscal year 2007. In Japan, the municipal solid waste amount for treatment and disposal reaches approximately 150,000 tons per day. The incineration method is the most popular treatment method with 68% followed by the recycling facilities, direct recycling, and the bulky waste treatment facilities with 6%, 5% and 5% respectively. Waste incinerators are, therefore, the major intermediate treatment facilities in Japan. This is due to the government policy requiring the local

government units to consider the limited land area within their jurisdiction and the necessity to reduce the volume of waste for final disposal. In addition, the calorific value of waste in Japan is high enough and advantageous for the introduction of incineration plants in the local government units except for the municipalities in rural areas where agriculture is the major industry.

Table 4.4.20 Intermediate Treatment and Disposal Practiced in Japan in Fiscal Year 2007

Treatment Method	Waste Amount (ton/day)	Ratio (%)	No. of Facilities
Self-disposal	153	0.10	227
Incineration	101,401	67.75	1,066
Direct-Disposal	3,225	2.16	808
Bulky Waste Treatment	6,744	4.51	1,195
Recycling Facilities	9,363	6.26	1,550
Composting Facilities	353	0.24	178
Production of Feed	1	0.00	2
Methane Generation	68	0.05	27
Refuse-Derived Fuels	1,952	1.30	144
Other Facilities	428	0.29	202
Direct-Recycling	7,220	4.82	1,240
Total	149,662	100.00	6,639

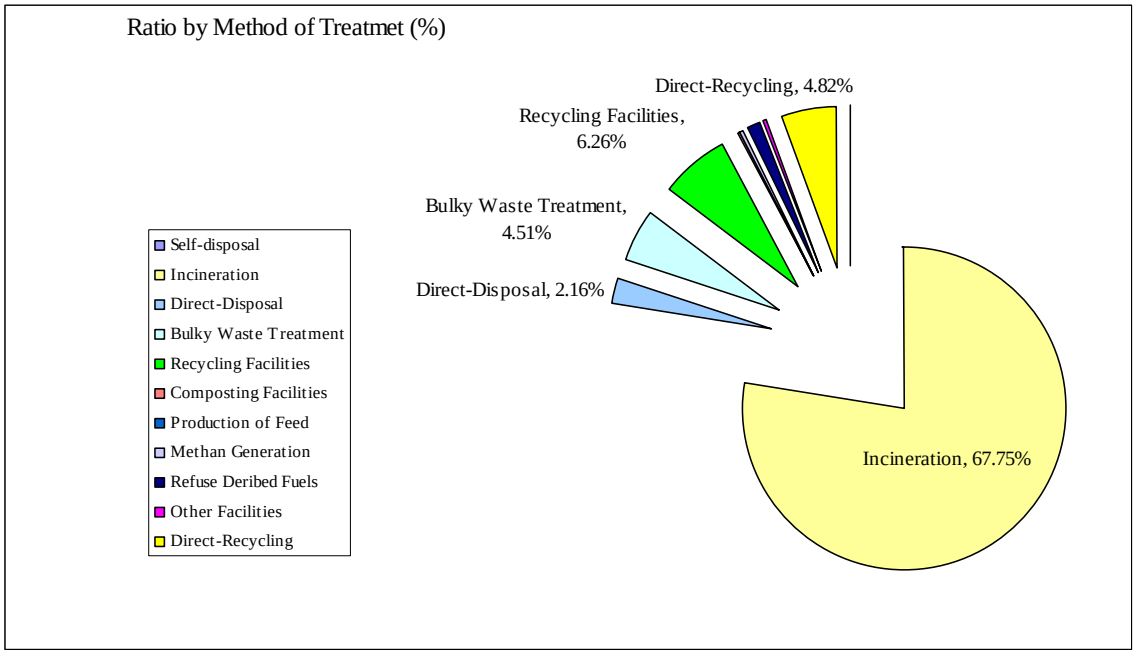


Figure 4.4.7 Intermediate Treatment and Disposal Practiced in Japan in Fiscal Year 2007

(e) Incineration Plants in Japan

The total number of incineration plants operated in Japan was 1,066 in fiscal year 2007. Some of the plants are installed with a power generator and some have no power generator, as summarised below.

- 224 plants with power generator have the maximum capacity of 1,800 ton/day (average plant size: 420 ton/day)
- 842 plants without power generator have the maximum capacity of 900 ton/day (average plant size: 80 ton/day)

Table 4.4.21 shows that the three contents of combustible wastes for incinerators with a power generator, i.e., water content, combustibles and Ash, are 44.1%, 48.6% and 7.3 % respectively. For the incinerators without a power generator, they are 47.9%, 45.2% and 6.9 % respectively. With regard to calorific value, the average computed from the three contents is more than 8,000 kJ/kg-waste for incinerators with a power generator and even the incinerators without a power generator it is more than 7,500 kJ/kg-waste.

Table 4.4.21 Calorific Value of Combustible Waste of 1,066 Incineration Plants in Japan in Fiscal Year 2007

Items	Incineration with Power Generator			Incineration without Power Generator		
Three Contents	Water Content (%)	Combustibles (%)	Ash (%)	Water Content (%)	Combustibles (%)	Ash (%)
Mean Value	44.1	48.6	7.3	47.9	45.2	6.9
Low Calorific Value (kJ/kg)	Computed Value	Measured Value		Computed Value	Measured Value	
Mean Value	8,153	9,384		7,540	8,398	

The planning of incineration by major intermediate treatment facilities largely depends on the characteristics of municipal wastes, specially, the calorific value. **Table 4.4.12** gives the summary of laboratory analysis of 30 samples of domestic waste in Nairobi City conducted from January to March 2010 by the local consultant engaged by the JICA Survey Team. The average water content reached almost 69.7%, Combustibles, 26.8%, and Ash, 3.5%. The water content of wastes in Nairobi City is very high due to the higher commingled ratio of food waste in municipal waste. Accordingly, the ratio of combustible waste becomes low and the condition is disadvantageous for the combustion of municipal waste. Low calorific value is computed from the three contents of waste by the following equation and the results:

Equation of Low Calorific Value (kcal/kg-waste): $45 \times V - 6W$

Where, V: Ratio of Combustibles in %

W: Water Content in %,

By inputting the laboratory test results in **Table 4.4.22** to the equation, the obtained low calorific value is 788 kcal/kg-waste, which is equivalent to 3,302kJ/kg-waste. This value is lower than the self-combustion limits so that the incineration of waste needs feeding of auxiliary fuel.

Table 4.4.22 Result of Laboratory Test of Three Contents (Domestic Waste), Jan-Mar 2010

Water Content	Combustibles	Ash
69.7%	26.8%	3.5%

(f) Methanisation and Composting in Japan

As shown in **Table 4.4.20**, the waste amount treated by methanisation in 27 facilities in Japan is only 0.05% and the largest plant treats about 12 tons per day[21]. On the other hand, waste amount treated by composting in 178 facilities reaches 0.24% and the largest plant treats about 30 tons per day.

Methanisation started only recently in Japan, especially, in the food industry for recycling of leftover food to comply with the Foodstuff Recycling Law of 2000. Methanisation is practiced more popularly in the farms where the breeding of hogs or cowshed use farm waste together with the excrement of pigs and/or cows. The generation of methane gas is carried out under

the constant temperature of biodegradable liquid in the methanisation tank through bacterial reaction and it becomes difficult to enlarge the plant scale. The information on technological reliability and the installed number of plants are still not enough to evaluate the introduction of large-scale methanisation plants for the treatment of biodegradables in municipal waste. In Japan, the composting of municipal waste is not a popular method for the treatment of municipal waste. However, the number of composting facilities has been increasing in the last 10 years and the attention of farmers in Japan is directed to compost for organic farming.

(g) Composting of Biodegradable Waste

With the higher ratio of food waste to biodegradable waste of more than 62% of municipal waste in Nairobi, composting will be the most practical means for intermediate treatment. The least cost composting method shouldl be developed taking into consideration the premises summarised below.

- The proposed Task Force in DoE shall prepare the implementation plan to promote home composting and community composting and explore the possibility of central composting.
- Implementation of home composting in pilot residential areas to provide training, instructions, information on home composting and its expansion to neighbouring areas.
- Involvement of CBOs or other community groups in providing, supporting, assisting and giving instructions on the operation of a community pilot plant and in expanding the system to the neighboring areas,
- Development of pilot central composting and management by CCN through the involvement of tenants of target public markets in the segregation of biodegradable waste for the supply of raw materials for composting.
- Evaluation of effectiveness of home composting, community composting and central composting for the continuation of programmes.
- Analysis of data on demand and supply of compost in Nairobi and the surrounding areas for the purpose of ensuring that compost derived from waste is supplied for farming and gardening.

The JICA SWM MP-98 report estimated the compost demand at 2,700 tons per day based on the horticulture area of 100,000 hectares in the vicinity of Nairobi City[22] and as mentioned in **Subsection 2.5.2(2)**, horticulture has grown in the last decade to become a major foreign exchange earner, employer and contributor to foods needs in the country. In addition, the report "Horticulture Industry in Kenya 2005" by the Export Processing Zone Authority (EPZA) of Kenya[23] also shows that quantities of principal horticulture exports increased from 200,000 in 1999 to 350,000 ton in 2003. Accordingly, it is understandable that the current compost demand in the vicinity of Nairobi City exceeds more than 2,700 tons per day.

(h) Qualitative Evaluation of Intermediate Treatment Options

Table 4.4.23 summarises the evaluation of options for intermediate treatment which could be applicable for the intermediate treatment facilities of Nairobi City. As a whole, waste characteristics are the key to choose the best alternative. Higher water content due to high ratio of food waste commingled in municipal waste in Nairobi City is disadvantageous to waste incineration. On the contrary, this high commingled ratio of food waste, biodegradable waste, gives an advantage to methanisation and composting. Considering the impacts to the environment, Option 4, composting, is a more environment-friendly system. As stated earlier, the development of intermediate treatment is obliged to take consideration of the financial

situation of CCN. The costs for investment, operation and maintenance in Option 1, Option 2 and Option 3 are not affordable to CCN and only Option 4, composting of biodegradable waste, is recommendable for the intermediate treatment in Nairobi City. The options of waste to energy may be reviewed again as the waste calorific value increases and the financial situation improves.

Table 4.4.23 Qualitative Evaluation of Intermediate Treatment Options

Evaluation Items	Option 1: Incineration	Option 2: Incineration with Power Generation	Option 3: Methanisation with Power Generation	Option 4: Composting
Objective Waste	Combustible Waste	Combustible Waste	Biodegradable Waste	Biodegradable Waste
Technical Reliability	Reliable	Reliable but complex in operation	Biological reaction is not stable	Biological reaction is not stable
Cost	Expensive	Very Expensive	Expensive	Cheaper
Environmental Aspect	Need removal of pollutants from combustion gas emission	Need removal of pollutants from combustion gas emission	Odour and risk of flammable gas	Odour in miss operation
Applicability	Small towns to large cities	Middle to large cities	Small towns, communities, farms or food waste treatment	Small town to middle cities
Recommendations for application to Nairobi solid waste intermediate treatment facilities	Future, wait for increase of calorific value of waste	Future, wait for increase of calorific value of waste and development/investment partner	Future, wait for the O&M information of large scale plants.	Implement home and community scale composting. Implement the pilot central compost plant for studying future development of practical scale central compost plant

(i) Outline of Proposed Intermediate Treatment Plan

The programmes to be implemented under the Intermediate Treatment Plan consist of the following components:

- Home Composting
- Community Composting
- Central Composting

Home Composting

Home composting is to be carried out in eight (8) Divisions of Nairobi City excluding the Central Business District (CBD). Fifty (50) households will form a home composting group in each Division, which is deemed sufficient in number to obtain samples for effectiveness analysis and for implementing the guidance on home composting through seminars and workshops in the Survey. The representative households will be selected from the high and middle income groups with wide lots or gardens.

Home composting is to be carried out in two (2) Divisions or 100 households per year, i.e., 400 households in total for four (4) years in consideration of the implementing capacity of CCN. All pilot home composting projects shall be carried out extensively during the first four (4) years in the short-term period through the provision of home composting units and regular visits to provide instructions regarding the production of quality home compost. During the first four (4) years, a facilitator shall promote home composting in the neighboring areas. From the fifth year onwards, a facilitator shall also maintain, promote and expand the

home composting to the other areas of Nairobi. The cost of supply for the first four (4) years shall be shouldered by CCN or by the technical assistance programme.

Community Composting

Community composting is to be carried out in collaboration with the Community Participation Promotion Plan in eight (8) Divisions in Nairobi City excluding the CBD. One (1) CBO will be assigned to each Division to manage the activities of pilot community composting in addition to the activities of segregation of recyclable materials at sources and primary waste collection in designated areas. The first two (2) community compost plants having the capacity of 200 kg per day are to be constructed in 2012. The capacity of the plant has been decided in consideration of the present practice in Nairobi City, in order to setup a compost plant with an appropriate scale and to secure permanent staff as well as the required area for the activity of one (1) CBO. The plants shall be operated immediately as pilot plants by the CBOs or other community groups to accumulate data for analysis and for searching the possibility for expansion of the community composting activities. After the two-year pilot period, six (6) plants, i.e., two (2) plants per year, shall be constructed and operated. Investment costs of these eight (8) community compost plants shall be shouldered by CCN or by the technical assistance programme.

Central Composting

Central composting is to be carried out with four (4) central compost plants basically targeted to input biodegradable waste discharged from city public markets. At present, 90 tons of market waste composed of 80 tons of biodegradable waste is discharged from 44 city markets per day. The central composting will target half of the biodegradable waste discharged from the city markets, which is equivalent to 40 tons per day. The cost-benefit conventional windrow-type composting process shall be applied for the central compost plant to be sited adjacent or nearby the city markets. Considering cost, availability of construction site and the scale of a pilot plant to analyse the effectiveness of large-scale composting in future, the central composting shall be carried out with four (4) plants of 10 tons each per day. The first plant with 10 tons per day is scheduled to be constructed and start operations in 2016. This first plant, a pilot plant, shall be tested for one (1) year in the following year to study the appropriateness of the design from the technical and economic points of view. After the one year evaluation period, another three (3) central plants shall be constructed at one (1) plant per year for further piloting for the development of large-scale central compost plants in Nairobi City. The investment cost and operation and maintenance cost shall be borne by CCN through project loan.

(j) Project Cost of 3R and Intermediate Treatment Plan

The programmes under the 3R plan shall be implemented in collaboration with the Community Participation Promotion Plan and the project cost of Community Composting shall refer to the Section of the Community Participation Promotion Plan. The project cost is estimated to be KSh 964.1 million. The project cost of each phase is summarised as follows:

Project cost of short-term period (2011-2015)	:	KSh 127.6 million
Project cost of mid-term period (2016-2020)	:	KSh 522.7 million
Project cost of long-term period (2021-2030)	:	KSh 313.8 million
Total	:	KSh 964.1 million

The overall project cost of 3R and Intermediate Treatment Plan including 10% of physical contingency to the construction works will be KSh 1,018.1 million.

4.4.3 Final Disposal Plan

Since the Dandora Dumpsite is currently causing major impacts on the local environment, the major objective of the final disposal plan is to immediately construct a new landfill site and to close the Dandora Dumpsite as soon as possible. Moreover, it will be necessary to introduce a sanitary landfill system on the new landfill site to ensure that it does not cause similar environmental impacts as those experienced in Dandora. Also, it will be necessary to address the numerous illegal dumpsites that are scattered everywhere in Nairobi City.

(1) Future Plans for Final Landfill Site

The survey, design and construction of the new landfill site will need to be implemented with a view to starting operation from 2017. The sanitary landfill system shall be introduced in the new landfill site to minimise the impacts to the local environment.

(a) Suitable Sanitary Level of Landfill System

The sanitary level of landfill system can be classified into four (4) types as shown in **Table 4.4.24**. The Dandora Dumpsite falls under Level 1. As for the new landfill site, considering the impacts on the local environment, it should correspond to Level 3, which includes basic leachate treatment facilities.

Table 4.4.24 Classification of Sanitary Level of Landfill System

	Required Level
Level 1	Controlled tipping
Level 2	With a bund and daily cover soil
Level 3	Effluent control of leachate
Level 4	Leachate treatment system

(b) Selection and Evaluation of Candidate Final Sanitary Landfill Sites

In order to introduce a sanitary landfill, it is necessary to select a site that is suitable for final landfill construction. A total of 17 sites located in and around Nairobi have been selected as candidates for the new landfill based on topographical conditions. These were evaluated according to the criteria shown below and the most suitable landfill site was selected. **Figure 4.4.8** shows the Location Map of Candidate Final Sanitary Landfill Sites.

(i) Authenticity regarding Reserved Areas or National Parks

Since the Government of Kenya had declared some areas as National Reserve Areas and/or National Parks, the Project should confirm that the sites selected for waste disposal are not assigned as such.

(ii) Jurisdiction of Military Authorities

The Project should confirm that the sites are not within or around a military facility.

(iii) Land Acquisition and Relocation

The Project should confirm the owner of the sites and the necessity of relocation if residents exist in the sites.

(iv) Volume of Candidate Site as Final Landfill

It is necessary to ensure that the area proposed for the landfill could be utilised for a number of years.

(v) Geological and Hydrological Situation

It is preferable to choose a site with good geological conditions to reduce construction and maintenance costs. Proposed sites located upstream of headwaters such as dams and/or lakes are not suitable for a landfill.

(vi) Historical Land Use and Future Land Use Plan

The Project should confirm the current usage given to the proposed sites as well as the future plans for such areas.

(vii) Accessibility to Existing Transportation and Future Transportation Plan

The Project should confirm the accessibility of the proposed sites as well as future road development for the surrounding areas.

The major constraints to the selection of candidate final landfill sites are given in **Table 4.4.25**.

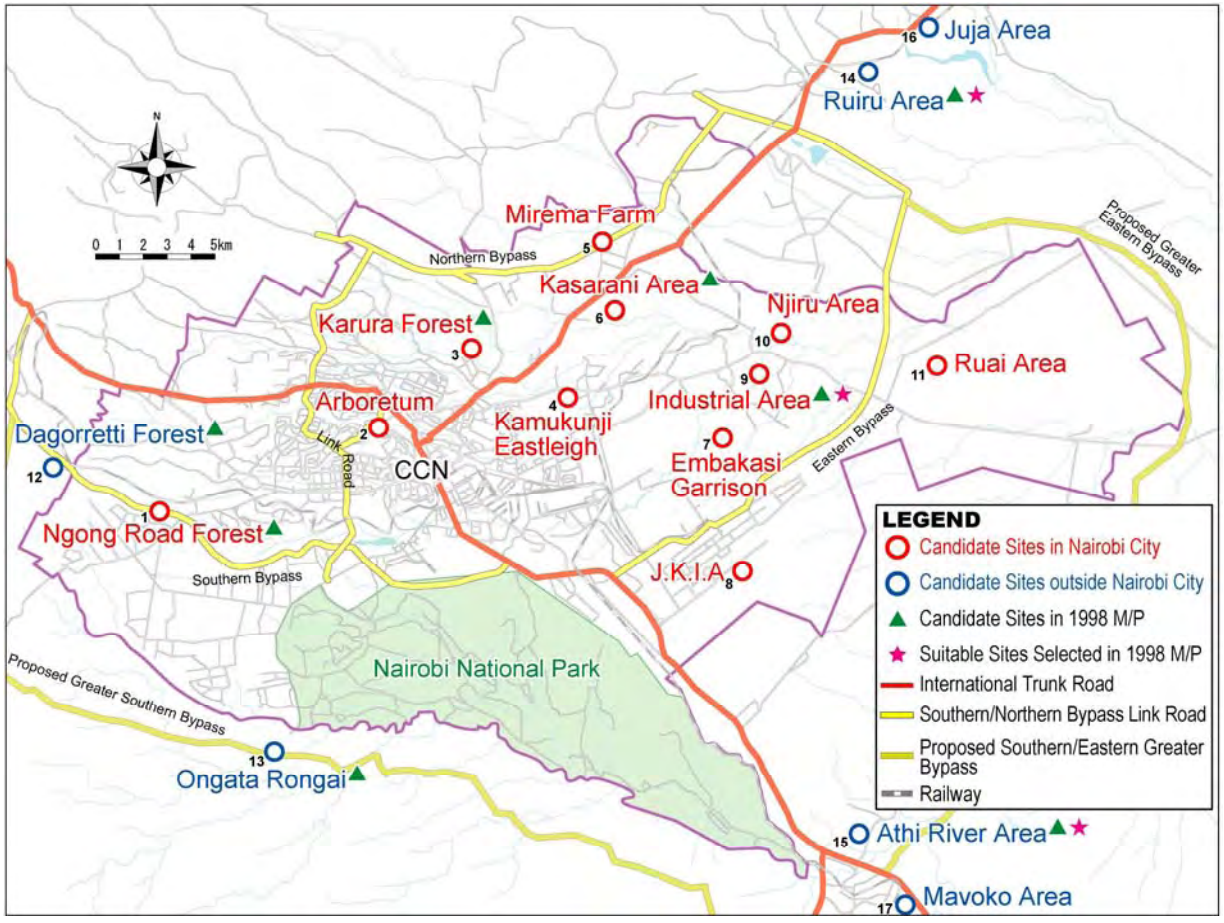


Figure 4.4.8 Location Map of Candidate Final Sanitary Landfill Sites

Note: Number indicated for each candidate sites refers to the same number in Table 4.4.25.

Table 4.4.25 Major Constraints to the Selection of Candidate Final Landfill Sites

No.	Site Name	Evaluation (Disadvantages)
1	Ngong Road Forest	Unsuitable (Include a forest; Capacity is not enough; Include a part of bypass plan area)
2	Arboretum	Unsuitable (Include a forest; Capacity is not enough; Close to State house)
3	Karura Forest	Unsuitable (Include a forest; Capacity is not enough)
4	Kamukunji Eastleigh	Unsuitable (Military reservation area; Capacity is not enough; Close to Embakasi Airport)
5	Mirema Farm	Unsuitable (Include a part of bypass plan area)
6	Kasarani Area	Unsuitable (Close to sports facilities; Electric power line is located in the site centre)
7	Embakasi Garrison	Unsuitable (Military reservation area; Access road is not paved)
8	J.K.I.A.	Unsuitable (Capacity is not enough; Close to Airport; Access road is not paved)
9	Industrial Area	Unsuitable (Capacity is not enough; Electric power line is located in the site)
10	Njiru Area	Unsuitable (Capacity is not enough; Access road is not paved)
11	**Ruai Area**	**Suitable** (Access road is not paved, Distance from the city centre: 28km)
12	Dagorretti Forest	Unsuitable (Out of Nairobi City; Include a forest)
13	Ongata Rongai	Unsuitable (Out of Nairobi City; Close to school and residential area)
14	Ruiru Area	Unsuitable (Out of Nairobi City; Residential area, Access road is not paved)
15	Athi River Area	Unsuitable (Out of Nairobi City; Plantation area; Distance from the city centre: 27km)
16	**Juja Area**	**Suitable** (Out of Nairobi City; Distance from the city centre: 32km)
17	**Mavoko Area**	**Suitable** (Out of Nairobi City; Distance from the city centre: 30km)

Note: Number indicated for each candidate sites refers to the same number in Figure 4.4.8.

As a result of the evaluation, three (3) sites, namely; the Ruai Area, the Juja Area and the Mavoko Area, are deemed to be suitable as final landfill sites. However, since the Juja and Mavoko areas are situated on private land outside of the city limits, it will be necessary to hold negotiations with the Thika County Council and the Mavoko Municipal Council which have jurisdiction over these areas, and this procedure could take time. Therefore, the basic plan shall be to utilise Ruai, which is CCN-owned land and located inside the city limits, while Juja Area and Mavoko Area will be examined as options for use in combination with Ruai. The options for the final landfill site as follows:

- Option 1 : Ruai Area
- Option 2 : Ruai Area + Juja Area
- Option 3 : Ruai Area + Mavoko Area

(c) Aviation Act (Ruai Area)

Since the Ruai Area is about 39,000 feet away from the runway of the Jomo Kenyatta International Airport (JKIA), it is presumed that this area is not under the purview of the civil aeronautics law in relation to landfill construction. Detailed information on the civil aeronautics law is given in **Section E of Volume 3, Supporting Report**.

(d) Final Disposal and Facility Plan

(i) Landfill Site Capacity Requirement

Land-filling on the new landfill site will be conducted for 14 years from 2017 to 2030. The landfill capacity of the site will be the total of waste carried onto the site and the cover earth placed in order to prevent waste from flying off. Based on the previous master plan and other relevant studies, the bulk density of waste will be 1.0 cubic metre per ton (m^3/ton). Detailed information on the bulk density of waste is given in **Section E of Volume 3, Supporting Report**.

There are three types of cover soil, namely; daily cover soil, intermediate cover soil and final cover soil. In order to carry out a sanitary landfill, it is necessary to have cover soil equivalent to one-third the volume of waste (m^3). **Table 4.4.26** shows the landfill capacity of Option 1. In Option 1, i.e., the case where the new landfill site would be constructed in only Ruai, a capacity of 12,670,000 m^3 will be required. As for Option 2 or 3, the cases where the new landfill sites are going to be constructed at two places, i.e., one in Ruai and the other in Juja or Mavoko, the required capacity in these options will have to be 8,490,000 m^3 at Ruai and 4,180,000 m^3 at Juja or Mavoko.

Table 4.4.26 Landfill Site Capacity Requirements

Year	Waste Amount (t/d) (1)	Waste Amount (m^3/d) (2) = (1)*1.0	Waste Amount (m^3/year) (3) = (2)*365	Cover Soil (m^3/year) (4) = (3) / 3	Total Waste Amount (m^3/year) (5) = (3) + (4)	Total AccumulatedWaste Amount (m^3) (6)
2017	1,067	1,067.0	389,455	129,818	519,273	519,273
2018	1,159	1,159.0	423,035	141,012	564,047	1,083,320
2019	1,256	1,256.0	458,440	152,813	611,253	1,694,573
2020	1,353	1,353.0	493,845	164,615	658,460	2,353,033
2021	1,477	1,477.0	539,105	179,702	718,807	3,071,840
2022	1,610	1,610.0	587,650	195,883	783,533	3,855,373
2023	1,744	1,744.0	636,560	212,187	848,747	4,704,120
2024	1,887	1,887.0	688,755	229,585	918,340	5,622,460
2025	2,035	2,035.0	742,775	247,592	990,367	6,612,827
2026	2,177	2,177.0	794,605	264,868	1,059,473	7,672,300
2027	2,329	2,329.0	850,085	283,362	1,133,447	8,805,747
2028	2,481	2,481.0	905,565	301,855	1,207,420	10,013,167
2029	2,643	2,643.0	964,695	321,565	1,286,260	11,299,427
2030	2,815	2,815.0	1,027,475	342,492	1,369,967	**12,669,394**
Total			**9,502,045**	**3,167,349**	**12,669,394**	

(ii) Landfill Method

On the new landfill site, the semi-aerobic landfill method, which is expected to aid in the early stabilisation of leachate, should be introduced. **Figure 4.4.9** shows the typical structure of a sanitary landfill.

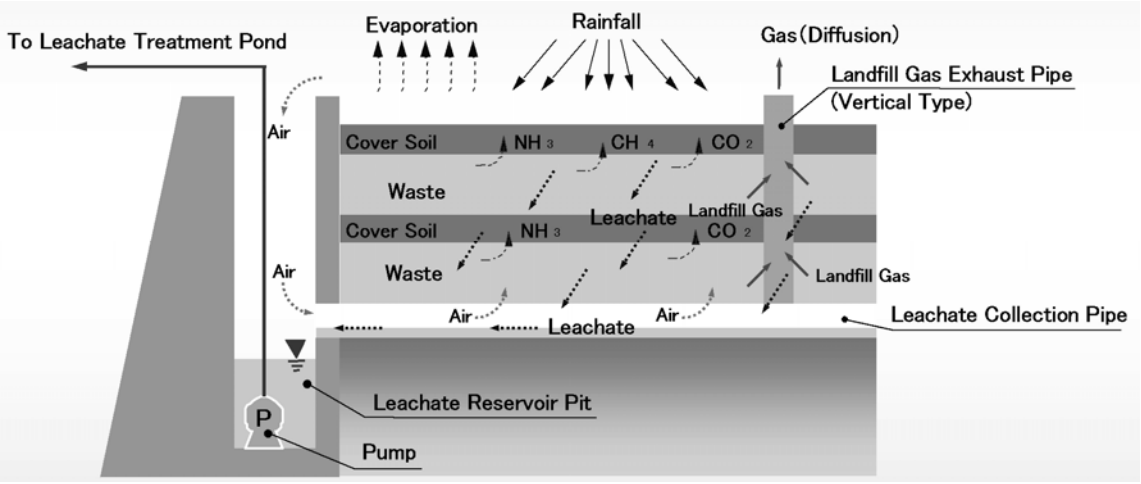


Figure 4.4.9 Typical Structure of Sanitary Landfill

(iii) Facility Plan and Design

The facilities shown in **Table 4.4.27** should be installed in order to realise the semi-aerobic landfill method on the new landfill site. A leachate treatment system that is easy and cheap to maintain should be adopted to realise the sustainable functions in the system. In addition, it should be necessary to secure the capacity of 5,100,000 m^3 or 7,600,000 m^3 at the Ruai site. In case the entire capacity is installed over one section, since the waste will be dumped indiscriminately over an extended area, the site management will become complicated. Moreover, since the leachate treatment facility becomes larger as the site area increases, the construction cost would also become more expensive. Accordingly, the site should be constructed as two distinct zones.

Table 4.4.27 Major Components of Landfill Site

1. Structure for Solid Waste Retention
1-1.Enclosure dike
1-2.Divider dike
2. Leachate Collection Facilities
2-1.Leachate collection pipe (main & branch)
2-2.Leachate reservoir pit
3. Leachate Treatment Pond
4. Landfill Gas Exhaust Equipment (pipe)
5. Rainwater Drainage
6. Access Road and Onsite Road
7. Groundwater Monitoring
8. Administrative Facility

Figure 4.4.10 shows the layout plan of Ruai, while **Figure 4.4.11** shows the vertical section view and structural drawing of leachate collection and drainage pipes and gas exhaust pipes, which are important facilities for the semi-aerobic landfill method.

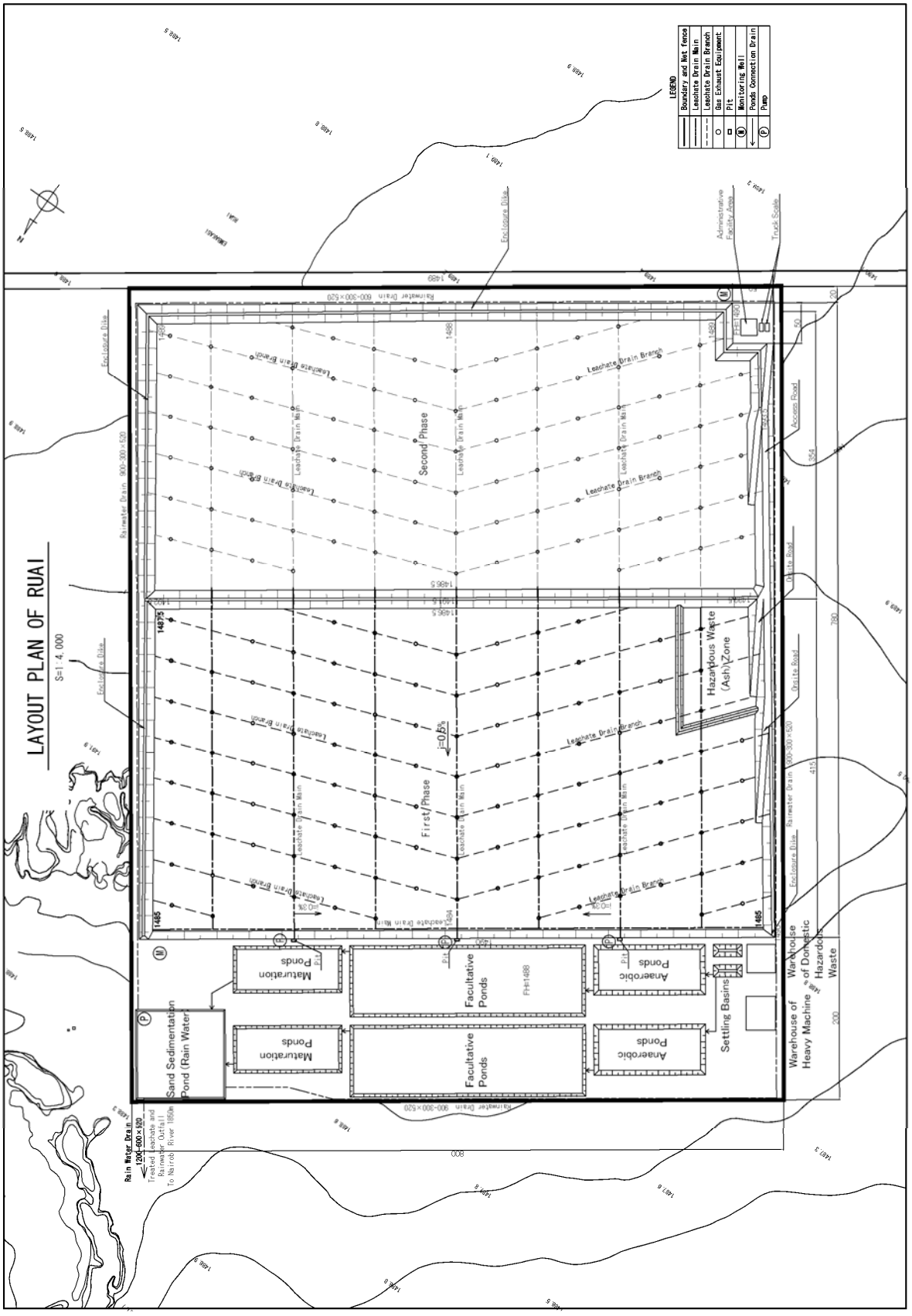


Figure 4.4.10 Layout Plan of Ruai Final Sanitary Landfill Site

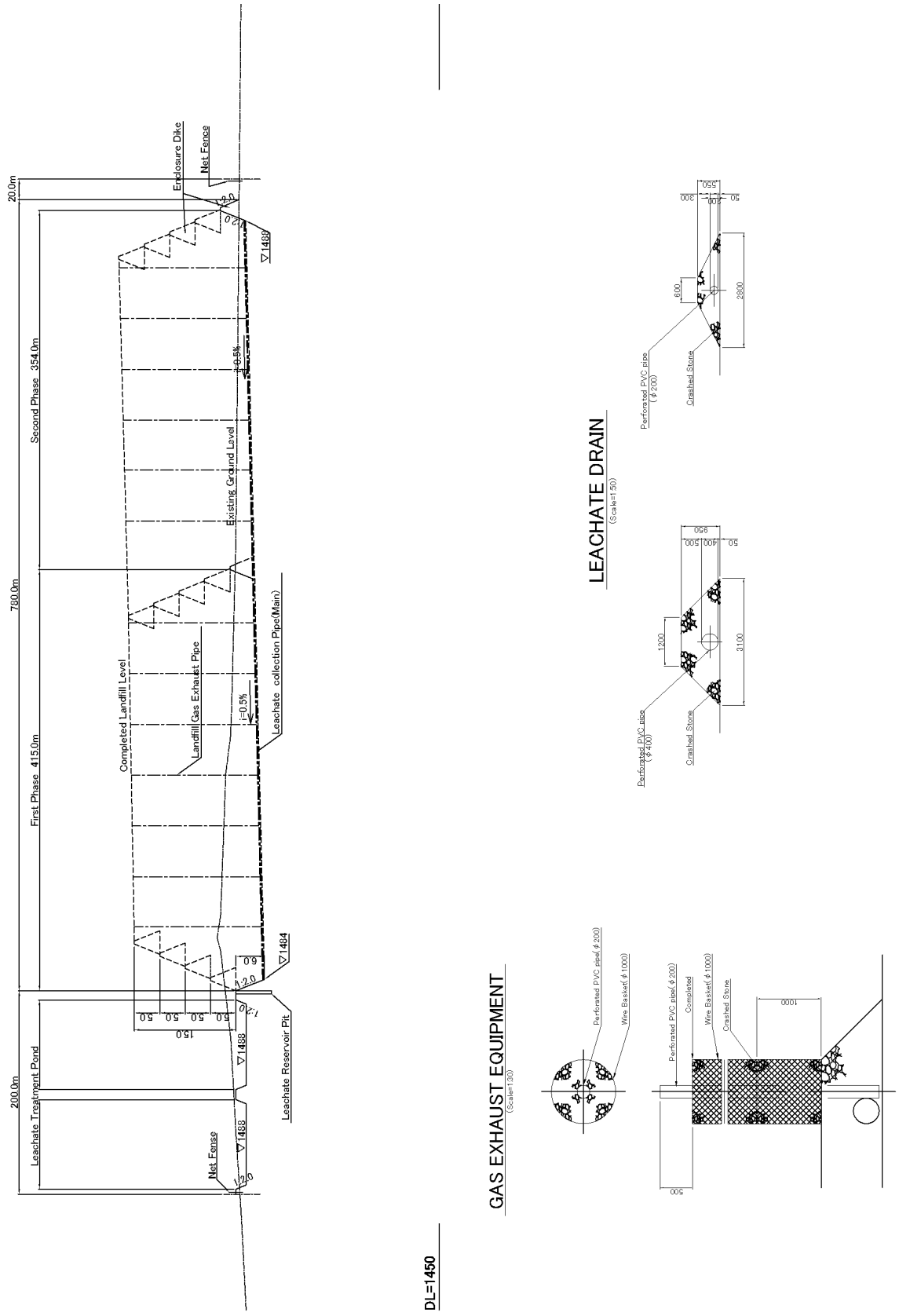


Figure 4.4.11 Vertical Section View of Ruai Final Sanitary Landfill Site

(d) Maintenance and Operation

It is important to implement appropriate maintenance in order to maintain landfill site functions and limit impacts on the local environment.

The daily flow of landfill work should be as follows: (i) weigh the waste as it is carried in; (ii) dump the waste in the designated positions; (iii) level the dumped waste; and (iv) apply covering soil at the end of the day.

Since the sandwich cell method shown in **Figure 4.4.12** will be introduced on the new landfill site, it will be necessary to conduct intermediate soil covering as the landfilling progresses.

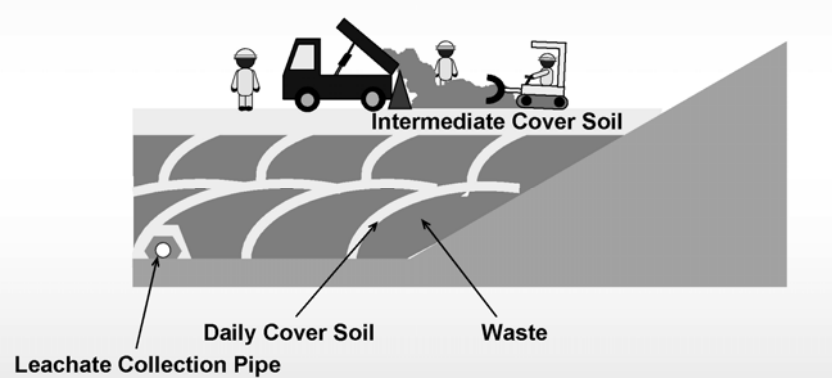


Figure 4.4.12 Sandwich Cell Method

In order to ascertain the impacts on the local environment and the state of waste, it will be necessary to implement the environmental monitoring shown in **Table 4.4.28**. Records of monitoring results should be stored until the landfilling has finished.

Table 4.4.28 Monitoring Items in Final Sanitary Landfill Sites

Monitoring Items	Monitoring Facilities	Frequency	Inspection Items
Treated Leachate	Sand Sedimentation Pond	1/month	pH, BOD, COD, SS, NH_4^+, TDS, E.coli, Total coliforms
Groundwater	Monitoring well (x 2)	2/year	pH, BOD, COD, SS, NH_4^+, TDS, E.coli, Total coliforms
Leachate	Leachate Reservoir Pit	4/year	pH, BOD, COD, SS, NH_4^+, TDS, E.coli, Total coliforms
Landfill Gas	Landfill Gas Exhaust Pipe (Vertical Type)	4/year	CH_4, CO_2, O_2, CO, H_2S,Temperature

(e) Cost Estimate

Table 4.4.29 shows the new landfill site construction cost and maintenance cost for each year in Option 1. The total cost up to 2030 will be approximately KSh 12.2 billion. When converted into the cost per unit weight of waste (tons) carried onto the site, this works out as KSh 1,279 per ton. As for Option 2, in which the new landfill site is combined with Juja or Mavoko, the unit cost will be KSh 1,331 per ton in the case of Ruai + Juja and KSh 1,401 per ton in the case of Ruai + Mavoko. The cheapest option is therefore to conduct landfilling on Ruai site only, i.e., Option 1.

Table 4.4.29 Annual Landfill Expenditure for New Final Sanitary Landfill Site at Ruai

(Unit: in Thousand KSh)

Year	Waste Amount (m^3/year)	Construction		Engineering Fee		O&M	Procurement of Heavy Machine Equipment	Total
		Main	Enclosure Dike	Design	Construction Supervision			
2013				180,800				180,800
2014								
2015		1,265,600			63,280			1,328,880
2016		2,350,400			117,520		140,300	2,608,220
2017	519,273					66,850		66,850
2018	564,047					69,830		69,830
2019	611,253		477,690			73,560		551,250
2020	658,460					77,280		77,280
2021	718,807		456,650			83,580	57,500	597,730
2022	783,533			67,250		88,030		155,280
2023	848,747		439,810			92,480		532,290
2024	918,340	470,750	404,040		23,538	96,920		995,248
2025	990,367	874,250			43,712	101,370		1,019,332
2026	1,059,473					109,810	70,500	180,310
2027	1,133,447		296,720			414,820		711,540
2028	1,207,420		292,510			439,810		732,320
2029	1,286,260		288,300			466,090		754,390
2030	1,369,967		260,940			493,650		754,590
Sub-Total	12,669,394	4,961,000	2,916,660	248,050	248,050	2,674,080	268,300	11,316,140
P/C	-	496,100	291,666	24,805	24,805	-	-	837,376
Total	-	5,457,100	3,208,326	272,855	272,855	2,674,080	268,300	**12,153,516**

Note: P/C stands for "Physical Contingency" which is calculated as 10% of construction cost and engineering services cost.

(f) Temporary Dumpsite

Since the new landfill site will start operating in 2017, it will be necessary to use a temporary disposal site until 2016. The temporary site will require the capacity of 2,251,000 m^3. Either the Dandora Dumpsite or the Kayole Dumpsite can be used as the temporary landfill site; however, considering the possible landfill capacity and the waste pickers on site, landfilling shall be continued on the Dandora Dumpsite. However, since almost all of the Dandora Dumpsite is privately-owned land, it will be necessary to secure consent from the landowners in order to continue landfilling.

(2) Closure Plan of Dandora Dumpsite

Since the Dandora Dumpsite imparts massive impacts on the local environment due to waste fly-off and landfill gas emissions, it will be necessary to close it down as early as possible. However, since the site will need to be used until 2016, the following issues should be examined:

- Implementation of Dandora Dumpsite Urgent Improvement Plan (2011-2016)
- Formulation of Dandora Dumpsite Closure Plan

(a) Implementation of Dandora Dumpsite Urgent Improvement Plan (2011-2016)

Apart from the weighing of waste, hardly any control is carried out on the Dandora Dumpsite. Therefore, considering the impacts on the local environment, it will be necessary to implement the following work in line with the continuation of landfilling:

- Levelling of incoming waste (whole dumpsite area: 46 ha)
- Implementation of soil covering (Required soil for covering shall be purchased. The volume of the soil is estimated at approximately 182,000 m^3 between 2011 and 2016.)
- Onsite road construction

The levelling and compacting of waste and covering of soil can be performed through efficiently operating the heavy equipment currently in use on Dandora Dumpsite, namely; two bulldozers and one excavator. However, one more bulldozer shall be necessary in site from 2012. Earth covering needs to be implemented with emphasis on the areas prone to waste fly-off and landfill gas. Construction residual earth shall be used as the covering soil; however, if this is not available, it will be necessary to purchase soil under the CCN budget. In the case where all soil is purchased, the budget of approximately KSh 40 million per year will be needed. The budget for making on-site roads has already been arranged within CCN; that is, KSh 200 million has been allocated for the period 2011 to 2014.

(b) Formulation of Dandora Dumpsite Closure Plan

The basic policy regarding the Dandora Dumpsite closure plan is to improve the current conditions and reduce the impacts on the local environment. Specifically, the following items should be implemented.

- Cover soil (460,000 m^3)
- Brick retaining walls (33,000 m^2)
- Rainwater drainage (3,800 m)
- Gas exhaust pipe (25 locations)

Figure 4.4.13 shows the top view of the closure plan.

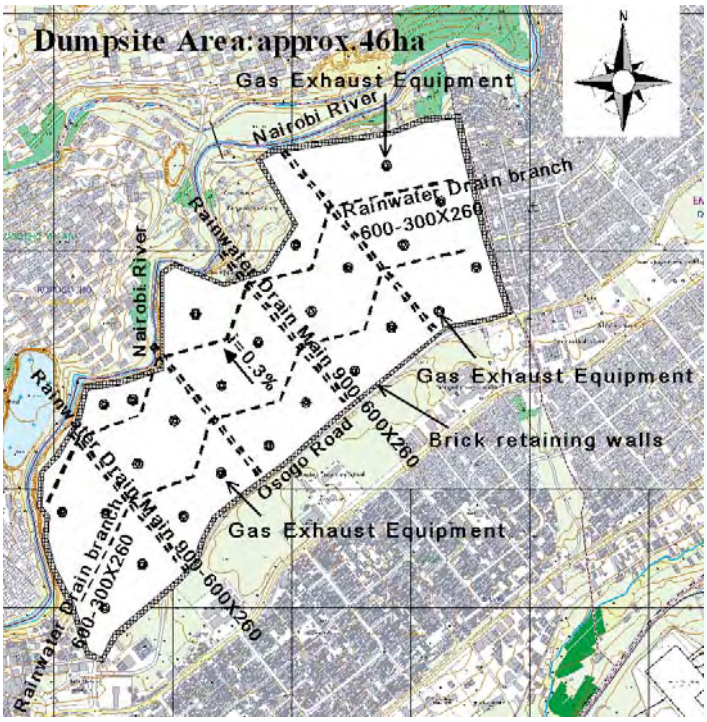


Figure 4.4.13 Layout of Closure Plan of Dandora Dumpsite

The closure works for the Dandora Dumpsite will cost approximately KSh 1.6 billion. The annual expenditure for 2011-2017 is shown in **Table 4.4.30**.

Table 4.4.30 Annual Dandora Dumpsite Expenditure (2011-2017)

(Unit: in Thousand KSh)

Year	Urgent Improvement Plan		Closure Plan		Total
	Urgent Improvement Work	O&M	Survey & Design	Closure Work	
2011	76,712	33,100	-	-	109,812
2012	78,726	43,100	-	-	121,826
2013	80,846	43,100	41,970	-	165,916
2014	82,966	43,100	-	-	126,066
2015	35,298	43,100	-	-	78,398
2016	37,842	43,100	-	-	80,942
2017	-	-	-	1,399,000	1,399,000
Sub-Total	392,390	248,600	41,970	1,399,000	2,081,960
P/C	39,239	0	4,197	139,900	183,336
Total	431,629	248,600	46,167	1,538,900	2,255,296

Note: P/C stands for "Physical Contingency" which is calculated as 10% of construction cost and engineering services cost.

(c) Post-Closure Land Use Plan

Since it will take at least 10 years for waste to become stabilised, the most feasible use for the Dandora Dumpsite will be as a park, etc. If houses and other structures are constructed, the construction should wait until the waste stabilises and subsidence ceases.

The Dandora Dumpsite is a landfill site mainly for dumping organic waste such as unburnable food waste. Since in general landfill gases composed mainly of methane gas are generated at final landfill sites for organic waste, much amount of landfill gas are also generated at the Dandora Dumpsite and fires occur.

Recently, power generation projects using landfill gas generated from landfill are being implemented in many countries. Therefore, as one of landuse options after landfill closure until the waste is stabilised, the landfill gas power generation seems to be a considerable idea for the Dandora Dumpsite.

While there is no detailed information for implementing the landfill gas power generation, it is needed to carry out a proper preliminary study including test-well drilling and gas collection tests, etc., in order to evaluate the amount of gas generated in the site before implementing the project.

At any rate, the site plan for post closure should be compiled upon incorporating the wishes and opinions of the local residents.

(3) Cleanup and Closure of Illegal Dumpsite

Figure 4.4.14 shows the location map of the illegal dumpsites in the city.

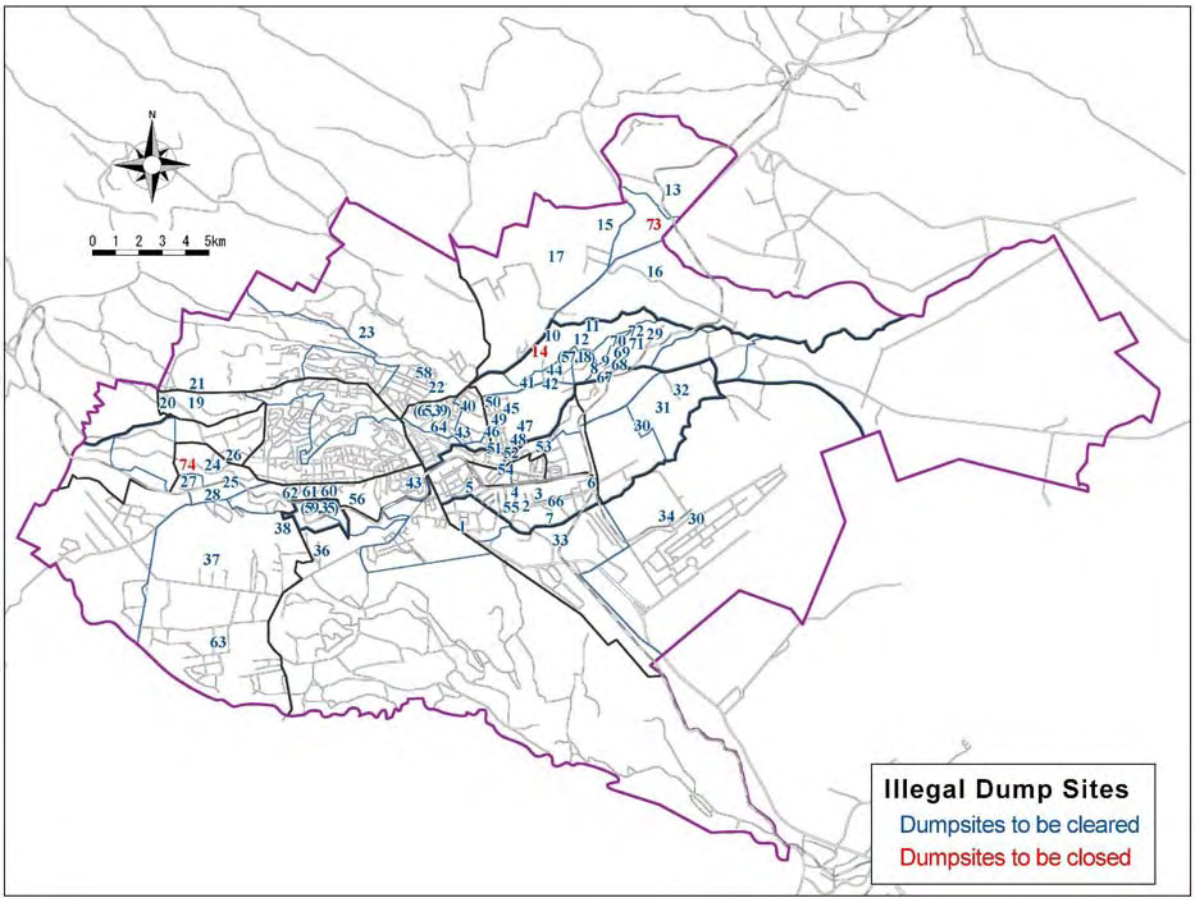


Figure 4.4.14 Location Map of Illegal Dump Sites in Nairobi

Since illegal dumpsites impart negative impacts on the local environment, it is necessary to take environmental protection measures. Illegal dumpsite countermeasures comprise two types, namely; (a) total removal; and (b) closure by earth covering, etc. The first option (a) is desirable in order to totally eliminate the negative local environmental impacts of illegally disposed waste. However, according to the field surveys, there are thought to be large quantities of waste disposed over a wide area and to a considerable depth at three sites, i.e., No. 14 Mathare North, No. 73 Zimerman, and No. 74 Gathundeki. Accordingly, the total removal option is not feasible from the viewpoint of cost, etc. Therefore, the second option (b) shall be adopted at these three sites in order to minimise impacts to the local environment.

It is desirable to implement total removal starting from the site that holds the largest amount of waste. As for timing, it should be implemented at the same time as container installation, which will be implemented as part of the effort to strengthen the collection and transportation setup. In the cleanup, it shall be planned to remove wastes with wheel loaders and to transport them to the Dandora Dumpsite in trucks. Cleanup should be implemented under the responsibility of the DoE.

The main components of closure works are soil covering and installation of gas exhaust pipes and fences. It is desirable to implement the works at the start of operation on the new landfill site. Accordingly, closure will be implemented through conducting the following works to mitigate the impacts on the local environment:

(a) Cover Soil (Thickness = 0.5 m)

In addition to preventing waste scattering and odour generation, this will prevent filtration of rainwater and reduce the generated amount of leachate.

(b) Gas Exhaust Pipes

Gas exhaust pipes as indicated below will be installed in areas of landfill gas occurrence in order to promote aeration and mitigate landfill gas generation.

(c) Net Fence (Height = 2.5 m)

Following closure, fences will be built to prevent trespassing and to prevent the flooding of waste at the site again.

Concerning costs, approximately KSh 23 million is needed to clean the illegal dumpsites in 2014, and KSh 45 million to close them in 2017. The detailed cost estimate is shown in **Tables E.6.5 and E.6.6 of Section E of Volume 3, Supporting Report**.

4.5 Action Plan of Technical Approach

4.5.1 Collection and Transportation Plan

(1) Short-Term Action Plan

(a) Formulation of Waste Collection Implementation Plan

CCN should be responsible for the task of preparing the integrated waste collection implementation plan for the approval of relevant authorities. The plan shall at least include the overall waste collection plan, the approach to monitoring of waste collection ratio, the procurement plan of collection vehicles including budgetary arrangement, the selection of type and number of collection vehicles, and the appropriate collection management in informal settlements such as low income and slum areas.

(b) Monitoring of Implementation of Collection and Transportation Plan (Phase I)

CCN has to conduct regular monitoring of the waste collection ratio and the actual operation practice of CCN, contractors and private collectors continuously up to 2015.

(c) Implementation of Urgent Waste Collection Plan

CCN should carry out the cleanup of the scattered wastes along the road sides. The monitoring of scattered wastes will be also CCN's mandate.

(d) Procurement of Waste Collection Vehicles

CCN should prepare for the procurement of waste collection vehicles through budgetary arrangements, designing and tendering. The application of a loan from foreign donors will be one of the options of financial support for the procurement. After that, CCN should carry out the actual procurement of collection vehicles.

(e) Implementation of Regular Station Collection in CCN/SWMPC Zone (Phase I)

The implementation of regular station collection consists of deployment of new collection vehicles, operation and maintenance of CCN's new collection vehicles and the monitoring/inspection of collection operation in the CCN/SWMPC zone. CCN should be responsible for this task.

(f) Construction of Access Road to Slum Areas in the CCN/SWMPC Zone (Phase I)

About 75 of the 150 slums in the city are estimated to require the construction of access roads. However, the slum areas actually requiring the construction of access roads should be selected in advance before the actual construction commences. Stakeholder meetings among residents, CBOs and CCN should be held to select the sites for access road. Detailed information is given in **Section F of Volume 3, Supporting Report.** Financial support from foreign donors will be one of the options to successfully implement this component.

(g) Implementation of Waste Collection PPP Scheme (Phase I)

Detailed information is given in **Section B, Organisational, Institutional and Human Resources Development Study, of Volume 3, Supporting Report.**

(2) Mid-Term Action Plan

(a) Monitoring of Implementation of Collection and Transportation Plan (Phase II)

CCN has to continuously conduct regular monitoring of the waste collection ratio and the actual operation practices of CCN, contractors and private collectors up to 2020. If the actual collection ratio does not reach the target collection ratio, CCN should take measures to meet the situation.

(b) Procurement of Waste Collection Vehicles for the CCN/SWMPC Zone (Phase II)

CCN should procure waste collection vehicles through budgetary arrangements. The application for a loan from foreign donors or utilisation of the SWM Capital Revolving Fund which will be created as a new funding system in the proposed zone-based operation system will be one of options of financial support for the procurement of vehicles.

(c) Implementation of Regular Station Collection in the CCN/SWMPC Zone (Phase II)

The implementation of regular station collection involves the deployment of new collection vehicles, operation and maintenance of CCN's new collection vehicles and the monitoring/inspection of collection operation in the CCN/SWMPC zone. CCN should be responsible for this task.

(d) Construction of Access Road to Slum Areas in the CCN/SWMPC Zone (Phase II)

This action should be continuously carried out, the same as the short-term plan. The target slum areas in which the access roads are required should be selected through stakeholder meetings among the residents, CBOs and CCN.

(e) Implementation of Waste Collection PPP Scheme (Phase II)

Detailed information is given in **Section B, Organisational, Institutional and Human Resources Development Study, of Volume 3, Supporting Report**.

(3) Long-Term Action Plan

(a) Monitoring of Implementation of Collection and Transportation Plan (Phase III)

CCN has to continuously conduct regular monitoring of the waste collection ratio and the actual operation practices of CCN, contractors and private collectors up to 2030. If the actual collection ratio does not reach the target collection ratio, CCN should take measures to meet the situation.

(b) Procurement of Waste Collection Vehicles for the CCN/SWMPC Zone (Phase III)

CCN should procure waste collection vehicles in 2025. The application of a loan from foreign donors or the utilisation of the SWM Capital Revolving Fund which will be created as a new funding system in the proposed zone-based operation system will be one of options of financial support for the procurement of vehicles.

(c) Implementation of Regular Station Collection in the CCN/SWMPC Zone (Phase III)

CCN has to deploy new collection vehicles through analysing local conditions of collection and transportation. CCN should also conduct operation and maintenance of CCN's new collection vehicles.

(d) Construction of Access Road to Slum Areas in the CCN/SWMPC Zone (Phase III)

In the same manner as above, the construction of access roads should be carried out.

(e) Implementation of Waste Collection PPP Scheme (Phase III)

Detailed information is given in **Section B, Organisational, Institutional and Human Resources Development Study, of Volume 3, Supporting Report**.

4.5.2 3R and Intermediate Treatment Plan

(1) Short-Term Action Plan

(a) Establishment of Task Force for 3R and Intermediate Treatment

A task force should be established in 2011 to play the primary role for implementing the 3R and Intermediate Plan.

(b) Formulation of 3R Implementation Plan

The Task Force should formulate the 3R implementation plan in 2011 and prepare the budget and the staff for implementation in the following year.

(c) Monitoring of Implementation of 3R Plan (Phase I)

The Task Force should setup a monitoring system for evaluating the target level of waste reduction ratio of 5% to the potential waste discharge amount in 2015. The Task Force should setup a monitoring system for evaluating the total resource recovery amount of about 180 tons per day or the equivalent ratio of about 10% to the potential waste collection amount in 2015.

The Task Force should review overall activities of waste reduction programmes and evaluate them in connection with the target waste reduction ratio. Outputs of the review should be stated in the Annual Activity Report.

The Task Force should review overall activities of waste recovery, reuse and recycling programmes and evaluate them in connection with the target recovery amount or the ratio. Outputs of the review should be stated in the Annual Activity Report.

(d) Monitoring of Implementation of Intermediate Treatment Plan (Phase I)

The Task Force should evaluate the progress of activities for the implementation of house composting (400 houses), community composting (4 communities), and pilot central compost

plant (1 plant) by 2015 and review the overall programmes of composting activities. Outputs of the review should be stated in the Annual Activity Report.

(e) Implementation of Waste Reduction Plan (Phase I)

The Task Force should collaborate with the Community Participation Promotion Plan to implement and promote the programmes under waste generation control and waste discharge control.

(f) Implementation of Waste Recovery, Reuse and Recycling Plan (Phase I)

The Task Force should collaborate with the Community Participation Promotion Plan to implement and promote the programmes for recovery of recyclable materials at the waste generation sources and for reuse and recycling of recyclable materials.

The Task Force should procure the engineering consultant to start the topographic survey, boring survey and design of the MRF Centre at the designated corner of the Dandora Dumpsite and prepare for the construction work in 2016 and the start of operation in 2017.

(g) Implementation of Intermediate Treatment Plan (Phase I)

(i) Home Composting

The Task Force and the facilitator should implement the programme of home composting for 100 houses per year, i.e., 400 houses in 4 years by 2015 and expand the activities to the neighbouring areas.

(ii) Community Composting in Collaboration with Environmental Education Activities

The Task Force should collaborate with the Community Participation Promotion Plan to implement and promote the construction and operation of the two 200kg per day pilot/model community compost plants in the period 2013-2015 and evaluate their effectiveness.

(iii) Central Composting

The Task Force should procure the engineering consultant and the contractor to start the design and construction of one 10-ton per day pilot compost plant in 2013 and prepare for the operation that should start in 2014.

(2) Middle-Term Action Plan

(a) Monitoring of Implementation of 3R Plan (Phase II)

The Task Force should monitor and evaluate the target level of waste reduction ratio of 10% to the potential waste discharge amount in 2020. The Task Force should monitor and evaluate the total resource recovery amount of about 270 tons per day or the equivalent ratio of about 12.5 % to the potential waste collection amount in 2020.

The Task Force should review the overall activities of waste reduction programmes and evaluate them in connection with the target waste reduction ratio. Outputs of the review should be stated in the Annual Activity Report.

The Task Force should review the verall activities of waste recovery, reuse and recycling programmes and evaluate them in connection with the target recovery amount or ratio. Outputs of the review should be stated in the Annual Activity Report.

(b) Monitoring of Implementation of Intermediate Treatment Plan (Phase II)

The Task Force should evaluate the progress of activities on the implementation of house composting (400 houses), community composting (8 communities), and pilot compost plants (4 plants) by 2020, and review the progress and overall programmes of composting activities. Outputs of the review should be stated in the Annual Activity Report.

(c) Implementation of Waste Reduction Plan (Phase II)

The Task Force should collaborate with the Community Participation Promotion Plan to implement and promote the programmes under waste generation control and waste discharge control.

(d) Implementation of Waste Recovery, Reuse and Recycling Plan (Phase II)

The Task Force should collaborate with the Community Participation Promotion Plan to implement and promote the programmes for recovery of recyclable materials at the waste generation sources and for reuse and recycling of recyclable materials.

The Task Force should procure the contractor for the construction of the MRF Centre at Dandora in 2016 and prepare for the start of operation in 2017. About 60 waste pickers may be employed for the operation staff of the MRF Centre.

(e) Implementation of Intermediate Treatment Plan (Phase II)

(i) Home Composting

The Task Force and the facilitator should continue the programme of home composting in 400 houses and expand the home composting to the neighbouring areas.

(ii) Community Composting in Collaboration with Environmental Education

The Task Force should collaborate with the Community Participation Promotion Plan to implement and promote the construction and operation of the other six (6) 200kg per day pilot/model community compost plants in the period 2016-2018 and operate the total eight (8) plants from 2019.

(iii) Central Composting

The Task Force should procure the engineering consultant and the contractor to start design and construction of another three (3) 10-ton per day pilot compost plants in the period 2016-2018 and operate four (4) plants from 2019. The pilot/model central compost plant should be evaluated for effectiveness and the possibility of expansion in the future.

(3) Long-Term Action Plan

(a) Monitoring of Implementation of 3R Plan (Phase III)

The Task Force should monitor and evaluate the target level of waste reduction ratio of 10% to the potential waste discharge amount in 2030. The Task Force should monitor and evaluate the total resource recovery amount of about 450 tons per day or the equivalent ratio of about 16% to the potential waste collection amount in 2030.

The Task Force should review overall activities of the waste reduction programmes and evaluate them in connection with the target waste reduction ratio. Outputs of the review should be stated in the Annual Activity Report.

The Task Force should review the progress and overall activities of waste recovery, reuse and recycling programmes and evaluate them in connection with the target recovery amount or ratio. Outputs of the review should be stated in the Annual Activity Report.

(b) Monitoring of Implementation Plan of Intermediate Treatment (Phase III)

The Task Force shouldreview the progress and overall programmes of composting activities for the implementation of house composting (400 houses), community composting (8 communities), and pilot compost plants (4 plants) by 2030 and review the progress and overall programmes of composting activities. Outputs of the review should be stated in the Annual Activity Report.

(c) Implementation of Waste Reduction Plan (Phase III)

The Task Force should collaborate with the Community Participation Promotion Plan to implement and promote the programmes under waste generation control and waste discharge control.

(d) Implementation of Waste Recovery, Reuse and Recycling Plan (Phase III)

The Task Force should collaborate with the Community Participation Promotion Plan to implement and promote the programmes for the recovery of recyclable materials at the waste generation sources and for reuse and recycling of recyclable materials.

The MRF Centre at Dandora should be operated and maintained continuously as the distribution centre of recyclable materials in the town area. The operation should be carried out in collaboration with CBOs, Junk Dealers and CCN. About 60 persons may be recruited by operator from the waste pickers currently working at the Dandora Dumpsite.

(e) Implementation of Intermediate Treatment Plan (Phase III)

(i) Home Composting

The Task Force and the facilitator should continue the programme of home composting in the 400 houses and expand the home composting to the neighbouring areas.

(ii) Community Composting in Collaboration with Environmental Education

The Task Force should collaborate with the Community Participation Promotion Plan to operate and maintain the eight (8) 200kg per day pilot/model community compost plants. Annual activity report on the composting operation should be prepared.

(iii) Central Composting

Four (4) 10-ton per day pilot/model central compost plants should be continuously operated and evaluate regarding the possibility for expansion of central composting in Nairobi. Annual activity report on the composting operation should be prepared. The 3R and intermediate treatment plans should be implemented with comprehensive interrelated programmes consisting of both of the software components and the hardware components to be identified in the Public Particiaption Promotion Plan in **Section 4.10**.

4.5.3 Final Disposal Plan

(1) Short-Term Action Plan

(a) Formulation of Dandora Dumpsite Closure Plan

EIA and surveys/designs geared toward the closure of Dandora Dumpsite will be carried out by 2011 and 2013. The surveys will entail surveying to confirm the landfill terrain, and simple boring survey to confirm the distribution of waste depth. Based on the survey findings, detailed design on the amount of covering soil and height of retaining walls needed for the closure will be conducted, and the cost for ordering the works will be estimated.

(b) Implementation of Dandora Dumpsite Urgent Improvement Plan (Phase I)

As urgent measures for the Dandora Dumpsite, covering soil will be purchased and onsite road construction will be carried out. The onsite road construction will be carried out over four years between 2011 and 2014. Covering soil will be purchased every year until 2016 when landfill works will be completed on the dumpsite.

As for Dandora Dumpsite itself, regular operation and maintenance will need to be carried out separately in addition to the urgent countermeasures. In conducting the operation and maintenance, it will be particularly important to efficiently use the three existing heavy equipment for levelling the waste and applying the covering soil.

(c) Formulation of New Landfill Site Construction Plan at Ruai (First Portion covered by 2025)

EIA and surveys/designs aimed to establish the new landfill site will be implemented by 2011 and 2013. The surveys will entail topographical surveying over the entire area and geological surveys for confirming the geological conditions and groundwater level existing in the site.

In the design, based on the survey findings, the facilities required for the first phase will be designed and the necessary costs for ordering the works will be estimated.

(d) Construction of New Landfill Site at Ruai (First Portion covered by 2025) (Phase I)

Construction works in the first phase of the new landfill site will commence in 2015 and will last for two (2) years.

During the works, construction supervision will be carried out to confirm the progress of the works and check on the building of important structures.

(e) Cleanup of Illegal Dumpsites

The cleanup of 71 small illegal dumpsites will be carried out in 2014. Cleanup should be carried out in tandem with the installation of containers.

(2) Mid-Term Action Plan

(a) Implementation of Dandora Dumpsite Urgent Improvement Plan (Phase II)

Operation and maintenance will be carried out on the Dandora Dumpsite. The closure works of the Dandora Dumpsite will begin from the year of its planned closure, and it will be desirable to conduct maintenance with a view to these works.

(b) Implementation of Closure Works of Dandora Dumpsite

Closure works on the Dandora Dumpsite will be implemented in 2017 following the start of operations on the new landfill site.

(c) Construction of New Landfill Site at Ruai (First Portion covered by 2025) (Phase II)

The second year of construction works in the first phase of the new landfill site, which will start in 2015, will be conducted. The new landfill site will be completed within that year.

(d) Operation and Maintenance of New Landfill Site at Ruai (Phase I)

Operation and maintenance on the new landfill site will begin in 2017. Routine operation and maintenance will entail weighing of waste, soil covering works and control of treated leachate quality.

Prior to the start of operation, the heavy machinery needed to conduct landfill works will have to be purchased in 2016.

According to the progress of the landfill, construction of the enclosure dike will be executed in 2019. Incidentally, the timing of enclosure dike construction may change according to the level of progress of the landfill works.

(e) Closure of Illegal Dumpsites

Closure works of the three large illegal dumpsites will be carried out in 2017, when the new landfill site operations begin.

(3) Long-Term Action Plan

(a) Formulation of New Landfill Site Construction Plan at Ruai (Second Portion for utilisation after 2026)

Design for the second phase of the new landfill site will be carried out in 2022. It is desirable that the design is based on considerations given to problems that may have occurred during the construction and landfill works in the first phase.

(b) Construction of New Landfill Site at Ruai (Second Portion for utilisation after 2026)

The second phase of construction works for the new landfill will be carried out during 2024 and 2025.

At this time, construction supervision will be carried out to confirm the needs and work progress, and also check the state of buildings and any other structures of importance. It is necessary to keep in mind that these works will be conducted in parallel with the landfill operations.

(c) Operation and Maintenance of New Landfill Site at Ruai (Phase II)

Operation and maintenance of the new landfill site will be conducted after the conclusion of construction works.

Additional heavy equipment required for landfill will be purchased in 2021 and 2026. Also from 2027 onwards, it will be necessary to construct enclosure dikes every year.

4.6 Organisational Restructuring and Human Resources Development Plan

4.6.1 Organisational Restructuring Plan

Due to the low priority and lack of funds for the solid waste management sector, the organisational capacity for providing the solid waste management services in Nairobi City is rather weak. The Department of Environment (DoE) of CCN is not provided with sufficient resources to fulfill its mandates, while the private sector is not successfully filling the gap between the current insufficient coverage by the DoE and the required level of services. To achieve cost-effective and sustainable solid waste management services in accordance with the PPP framework proposed in the Private Sector Involvement Plan, it is essential to build a sustainable organisational structure together with the establishment of related organisational reform.

(1) Short-Term Action Plan

(a) Establishment of the Preparatory Unit for SWMPC

In order to smoothly transfer the responsible organisation for solid waste management services from the current DoE to the ring-fenced Solid Waste Management Public Corporation (hereinafter referred to as "SWMPC"), a preparatory unit for the establishment of the SWMPC will be set up in the DoE with operations starting from 2011. The staff of the preparatory unit will be the main target of the Comprehensive Capacity Development Programme proposed in the Human Resources Development Plan. Three (3) project management units (PMUs) for a wide range of preparatory operation for the transfer to the SWMPC will be established in the Preparatory Unit. **Table 4.6.2** shows the outline of the functions of the PMUs in the preparatory unit for the SWMPC and their organisational features are as itemised below. **Figure 4.6.2** also shows the organisational structure of the preparatory unit.

- The matrix-type of organisational structure will be employed for the operation of the preparatory unit for the SWMPC. The matrix-type organisation is suitable for operating the preparatory unit in parallel with the current responsibilities of the DoE.
- The unit managers and staff in charge of the PMUs will be selected from the DoE and other related departments of CCN.
- The designated staff will be given some incentives for the additional tasks.
- The staff of the preparatory unit for the SWMPC will be the main counterpart in the external technical assistance during the implementation period of the comprehensive capacity development programme.
- The SWM Special Accounts and Revolving Fund Management Subunit will be supported by the Treasurers Department of CCN.
- The Administrative PMU will be in charge of the smooth transfer of staff, budget and assets to the SWMPC.
- The Franchise PMU will be in charge of the preparation for tendering and procurement for the zone-based franchise system.
- The Construction PMU will be in charge of the management of the construction projects of the sanitary landfill site and the intermediate treatment facilities, as well as the preparation for the tendering and procurement of private service providers.
- The NEMA staff will be seconded at the affiliate office inside the preparatory unit for the strengthening of monitoring and enforcement activities.

Table 4.6.1 Outline of the Proposed Organisational Structure of Preparatory Unit for SWMPC

PMU	Sub-Unit	Function
Administrative PMU	Budget Transfer Subunit	• To make preparations for the transfer of the SWM operating budget from the DoE/CCN to the SWMPC.
	Staff Transfer Subunit	• To make preparations for the transfer of the SWM staff from the DoE/CCN to the SWMPC
	Asset Transfer Subunit	• To make preparations for the transfer of SWM-related assets from the DoE/CCN to the SWMPC.
	Legal Reform Subunit	• To prepare the draft of the SWMPC Act and other related legal actions to be required in the Master Plan.
	Monitoring Subunit	• To strengthen the monitoring of the solid waste management activities.
	NEMA Affiliate Office	• To assist in the inspection and enforcement activities as an affiliate office of NEMA inside the SWMPC.
	SWM Special Account and Revolving Fund Management Sub-Unit	• To manage the Special Account for the solid waste management services and make preparations for the establishment of the SWM Revolving Fund.
Franchise PMU	Tender Preparation Subunit	• To make preparations for the tendering and zone-based franchise contracting for 3 franchise zones in the First Phase of the franchise system.
	Contract Subunit	• To manage the contractual process of zone-based franchise contracts in the 3 franchise zones.
	Zonal Management Subunit	• To plan the detailed guidelines for managing the franchised collection zones before starting the new franchise system.
Construction PMU	Tender Preparation Subunit	• To make preparations for the tendering related to the service contract for the management of the sanitary landfill site and the intermediate treatment facilities.
	Contract Subunit	• To manage the contracting process of the service contract for the management of the sanitary landfill site and the intermediate treatment facilities.
	Sanitary Landfill Site Construction Subunit	• To manage the construction of the sanitary landfill site.
	Intermediate Treatment Facilities Construction Subunit	• To manage the construction of the intermediate treatment facilities.

Source: JICA Survey Team

Among the functions of the Preparatory Unit for the SWMPC, the Franchise PMU as well as the Construction PMU will play important roles for the success of the new PPP scheme. It is important to have a capable PMU with ample expertise on financial, legal and technical fields.

(b) Establishment of the SWMPC

To significantly improve the efficiency and sustainability of the solid waste management services, the public-owned and ring-fenced Solid Waste Management Public Corporation (SWMPC) will be established as the fundamental organisational reformation of the solid waste management sector. The SWMPC will be established by the end of 2014, and its operations will start at the beginning of 2016. A one year preparation period is required for the tendering process for the zone-based franchise system by the SWMPC.

When the basic structure of the SWMPC was studied, the case of the water sector of the Nairobi City Water and Sewerage Company (NCWSC) was carefully referred to as a similar publicly-owned corporation.

The Nairobi City Water and Sewerage Company (NCWSC) that was created in accordance with the Water Act of 2002 sought to delineate water infrastructure management and the

provision of services in Kenya. The structure established seven (7) water service boards with separate jurisdictions.

The NCWSC was incorporated in December 2003 under the Companies Act and is wholly-owned by CCN. The NCWSC took over the provision of water and sewerage services in Nairobi and surrounding districts from the CCN's Water and Sewerage Department. The regulatory structure comprises the Water Services Regulatory Board (WSRB), whose responsibility is to enforce the Water Act. Under this Act, the Ministry of Water and Irrigation (MWI) is responsible for policy formulation through the Water Sector Reform Steering Committee (WSRSC) and the Water Sector Reform Secretariat (WSRS).

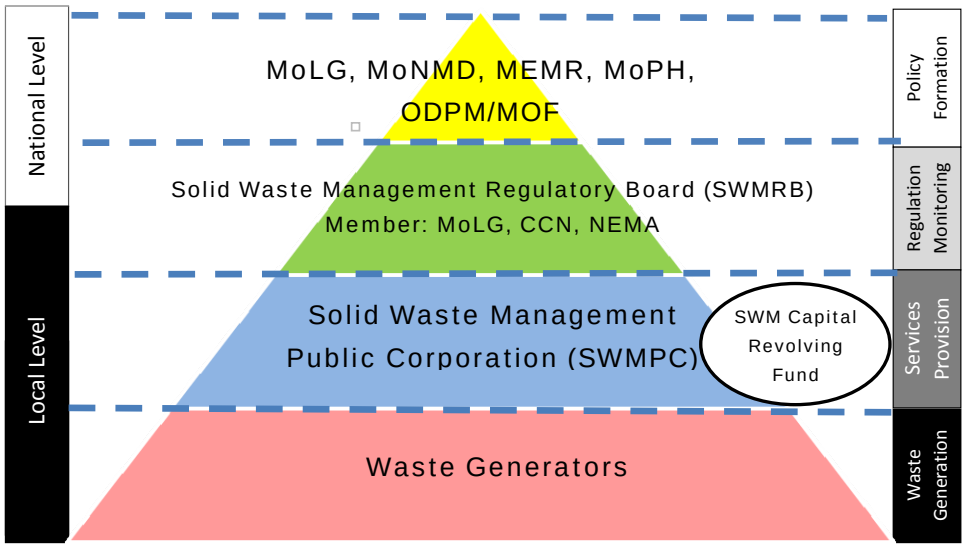
With the above organisational features of the water sector taken into consideration, the basic organisational structure of the solid waste management sector in the SWMPC was formulated, as shown in **Figure 4.6.1**. The detailed organisational structure of the SWMPC, which is composed of nine (9) departments and three (3) units, is shown in **Table 4.6.2** and given in **Figure 4.6.2**. The description of each department is as given below.

- **Auditing Unit:** This Unit will be in charge of overall auditing of performance of SWMPC, private franchisees and service providers.
- **Capital Revolving Fund Management Unit:** This Unit will be in charge of management of the SWM Capital Revolving Fund whose financial sources will be the franchise fees. The Fund will be used to subsidise the private franchisees.
- **Operating Revolving Fund Management Unit:** This Unit will be in charge of management of the SWM Operating Revolving Fund whose financial sources will be the tipping fees. The Fund will be used for the monitoring and capacity development activities of the SWMPC.
- **Administrative Department:** This Department will be in charge of administrative works and will consist of (i) the budgeting and accounting section; (ii) the human resources development section; and (iii) the legal section.
- **Strategy and Planning Department:** This Department will be in charge of strategic and financial planning and environmental appraisal works and will consist of (i) the tariff planning section; (ii) the subsidy planning and management section; and (iii) the environmental impact assessment section.
- **Zonal Management Department:** This Department will be in charge of the collection and monitoring services in the franchised zones and will consist of (i) the zonal franchise management section; (ii) the zonal monitoring section; and (iii) the zone operation offices [9 offices].
- **Disposal and Intermediate Treatment Department:** This Department will be in charge of the overall disposal and intermediate treatment services and will consist of (i) the disposal site management section; (ii) the intermediate treatment section; and (iii) the environmental monitoring section.
- **Direct Service Department:** This Department will be in charge of contracting collection services, market waste collection services and road sweeping services and will consist of (i) the contracting-out zone service section; (ii) the market waste service section; and (iii) the road sweeping service section.
- **Procurement and Contract Department:** This Department will be in charge of overall procurement, contracting and tendering procedures and will consist of (i) the franchise contract section; (ii) the contract-out section; and (iii) the licensing section.
- **Technical Department:** This Department will be in charge of overall technical, engineering and mechanical matters including repair shops, and will consist of (i) the technical support section; (ii) the mechanical section for collection vehicles; and (iii) the mechanical section for heavy-duty vehicles.

- **Monitoring and Enforcement Department:** This Department will be in charge of overall monitoring and enforcement operations and will consist of (i) the monitoring section (inspectors' office); (ii) the enforcement section; and (iii) the NEMA affiliate office.
- **Community Support Department:** This Department will be in charge of community support activities and will consist of (i) the public awareness section; (ii) the primary collection support section; and (iii) the coordination and facilitation section.

In order to effect the transfer from the preparatory unit of the SWMPC to the full-scale SWMPC smoothly, the following matters related to the operation of the organisation should be carefully taken into account:

- **Transfer of Staff:** A majority of the staff and workers of the current DoE directly in charge of the SWM services except for the policy and regulatory staff and some staff of other related administrative departments will be transferred to the SWMPC. The policy and regulating functions and other environmental services will still remain in the DoE even after the establishment of the SWMPC. All the staff and workers in the current operational zones in the DoE including the road sweepers will be transferred to the newly established Direct Service Department of the SWMPC. **There will be no lay-off due to this organisational reform.**
- **Transfer of Budget:** The SWM–related regular budget of the DoE will be transferred to the general budget of the SWMPC as the initial working capital required for the operation of the SWMPC. Since half of the franchise fees will be transferred to the general budget of the SWMPC after starting the zone-based franchise system, the financial burden of CCN will be decreasing in proportion to the increase in the collected franchise fees.
- **Transfer of Assets:** The vehicles and equipment required for the contracting of solid waste management services by the SWMPC will be transferred from CCN. The CCN workshop for repairing vehicles and equipment will not be transferred to the SWMPC; however, it will be leased for the use of SWMPC.
- **Ownership of New Assets:** Regarding the ownership of infrastructures such as the sanitary landfill site and intermediate treatment facilities to be newly constructed, one of the possible options is for those facilities to be owned by CCN and leased to the SWMPC. The ownership should be decided during the preparation period to establish the SWMPC.
- **Board Members:** The number of board members will be seven (7), consisting of a political representative and a member each from the CCN, the Ministry of Local Government (MoLG), the Ministry of Nairobi Metropolitan Development (MoNMD), the Ministry of Environment and Mineral Resources (MENR), the Ministry of Public Health (MoPH), and the Office of the Deputy Prime Minister and Ministry of Finance (ODPM/MOF).
- **Simplification of Vertical Levels:** The 18-level (18-scale) vertical organisational structure of the DoE will be significantly reduced to 12 levels in the SWMPC.
- **One-Stop and Single Window Service:** The one-stop and single window service is a customer-oriented service. Under the SWMPC, this system will be applied to the grievance and licensing service for the private service providers.
- **Establishment of NEMA Affiliate Office:** To strengthen the monitoring and inspection services under the Environmental Management and Coordination By-laws, a couple of inspectors from NEMA will be stationed regularly at the Monitoring and Enforcement Department of the SWMPC.
- **Remaining Functions of the Department of Environment:** The major remaining functions of the Department of Environment after the establishment of the SWMPC include the regulatory and licensing related to the solid waste management activities.



Source: JICA Survey Team

Figure 4.6.1 Snapshot of the Proposed Organisational Structure for SWM Sector

Table 4.6.2 Outline of the Proposed Organisational Structure of SWMPC

No.	Division/Section		Original Department of Transferred Staff	Estimated No. of Staff
1	Executive Board		● Political Representative, MoLG, CCN, MoNMD, MEMR, MoPH, ODPM/MOF	7
2	Auditing Unit		● DoE/Administrative Section ● Audit Department	5
3	Capital Revolving Fund Management Unit		● DoE/Administrative Section ● Treasurers Department	5
4	Operating Revolving Fund Management Unit		● DoE/Administrative Section ● Treasurers Department	5
5	Administrative Department	Budget and Accounting Section	● DoE/Administrative Section ● Treasurers Department ● Planning Department	10
		Human Resources Development Section	● DoE/Administrative Section ● Human Resource Department	5
		Legal Section	● Legal Affairs Department	5
6	Strategy and Planning Department	Tariff Planning Section	● DoE/Administrative Section ● Treasurers Department	5
		Investment and Subsidy Planning Section	● DoE/Administrative Section ● Treasurers Department	5
		EIA Section	● DoE/EMP Section ● NEMA/EIA Unit (Seconded from NEMA)	5
7	Zonal Management Department	Zonal Franchise Management Section	● DoE/SWM Section ● DoE/Divisional Office	20
		Zonal Performance Monitoring Section	● DoE/EPM Section ● DoE/Divisional Office	10
		Zonal Operational Offices	● DoE/SWM Section ● DoE/Divisional Office	45
8	Disposal and Intermediate Treatment Department	Disposal Site Management Section	● DoE/SWM Section	5
		Intermediate Treatment Section	● DoE/SWM Section	5
		Environmental Monitoring Section	● DoE/SWM Section	5

No.	Division/Section		Original Department of Transferred Staff	Estimated No. of Staff
9	Direct Service Department	Contracting-out Zone Service Department	● DoE/SWM Section ● Procurement Department	80
		Market Waste Service Section	● DoE/SWM Section	40
		Road Sweeping Service Section	● DoE/SWM Section	120
10	Procurement and Contract Department	Franchise Contract Section	● DoE/SWM Section ● Procurement Department	10
		Contracting-out Section	● DoE/Administrative Section ● DoE/SWM Section	10
		Licensing Section	● DoE/EPM Section ● NEMA/Licensing Unit (Seconded from NEMA)	10
11	Technical Department	Technical Support Section	● DoE/SWM Section	10
		Mechanical Section (Collection Vehicle)	● DoE/SWM Section ● Department of Engineering	20
		Mechanical Section (Heavy Duty Vehicle)	● DoE/SWM Section ● Department of Engineering	20
12	Monitoring and Enforcement Department	Monitoring and Inspection Office	● DoE/Administrative Section ● Department of Inspectorate	5
		Enforcement Section	● DoE/SWM Section	10
		NEMA Affiliate Office	● NEMA/Inspector (Seconded from NEMA)	2
13	Community Support Department	Public Awareness Section	● DoE/SWM Section	10
		Primary Collection Support Section	● DoE/SWM Section	10
		Coordination and Facilitation Section	● DoE/SWM Section	5
			Total Number of Staff	**509**

Source: JICA Survey Team

(c) Consideration of Incomplete Action Plans of the Previous Master Plan

There are some incomplete action plans in the previous 1998 Master Plan which should be partially reflected even in the new Master Plan. **Table 4.6.3** gives the outline of incomplete action plans to be partially reflected in the new Master Plan.

Table 4.6.3 Incomplete Action Plans of Previous 1998 Master Plan to be Partially Reflected upon the Creation of SWMPC

Area	Contents of Incomplete Action Plans of the 1998 Previous Master Plan	Issues to be considered Issues for the Creation of SWMPC
Organisational Restructuring of DoE	1. Reorganisation of DoE into four divisions (SWM, Environmental, Administrative and Parks)	● The function on solid waste management of the DoE will be transferred comprehensively to the SWMPC. Only policy and regulatory functions will be retained in the DoE of CCN after the establishment of the SWMPC.
	2. Reduction of number of vertical levels in the SWM Division and creation of new managerial positions	● The number of vertical level of the organisational structure of the SWMPC will be reduced from 18 in DoE to 12.
	3. Separation of disposal from collection and street cleansing	● The function on the operation of the sanitary landfill site will be separated clearly from those of collection and street cleansing services in the SWMPC. ● The function on the operation of the sanitary landfill site will belong to the disposal and intermediate treatment department of the SWMPC, those on collection and street cleansing services will belong to the direct service department of the SWMPC.
	4. Separation of daily management of	● The function on the daily management of collection

Area	Contents of Incomplete Action Plans of the 1998 Previous Master Plan	Issues to be considered Issues for the Creation of SWMPC
	waste collection from that of street cleansing	services will be separated clearly from that of street cleansing services in SWMPC. ● In SWMPC, while the function on the daily management of collection services will belong to the zonal management department in the case of franchised areas, that on street cleansing services will belong to the direct service department.
	5. Assignment responsibilities in all DoE divisions	● Assignment responsibilities in all the departments of SWMPC will be described clearly in the job descriptions.
Establishment of New Function	6. Establishment of Community Development Section in the SWM Division	● The new function of community support will belong to the Community Support Department of the SWMPC.
	7. Establishment of Contract Management Section in SWM Division	● The new function of contracts management will belong to the Procurement and Contract Department of the SWMPC.
	8. Establishment of Environmental Planning and Management Division	● The functions of the Environmental Planning and Management Section of the DoE will remain the same, but they will be strengthened.
	9. Establishment of the Finance Section in the Administrative Division	● The new function on financial management will belong to the Administrative Department of the SWMPC.
	10. Establishment of the Human Resources Section in the Administrative Division	● The new function on human resources development will belong to the Administrative Department of the SWMPC.
	11. Establishment of MIS Section under the Office of the Director of Environment	● The new function on the management information system will belong to the Strategy and Planning Department of the SWMPC.
	12. Establishment of Logistics Section in the Administrative Division	● The new function on logistics support will belong to the Technical Department of the SWMPC.

Source: JICA Survey Team

(d) Rectification of Remaining Functions of DoE

In parallel with the establishment of the preparatory unit for the Solid Waste Management Public Corporation (SWMPC) until the formal creation of the SWMPC, the remaining functions on licensing and contracting activities for the current private sector involvement will be rectified also in the following ways during the transition period to the new zone-based franchise system:

(i) Improvement of licensing to the private sector

- Strengthening of performance monitoring of licensed private waste collectors
- Strict zone management for licensed private waste collectors
- Single and one-stop services for obtaining licenses
- Extension of license period from 1 year to 2 years

(ii) Improvement of contracting to the private sector

- Strengthening of performance monitoring of licensed private waste collectors together with the obligations of submitting annual and monthly activity and financial reports
- Strict zone management for private contractors
- Single and one-stop services for obtaining licenses

- Extension of contract period from 1 year to 2 years
- Introduction of monthly work plans for private contractors

(e) Creation of SWM Special Account

The general accounts budget, commonly referred to as "the budget," is the basic account of the CCN. The expenditures in the general account of CCN are classified according to departmental programmes such as the provision of a wide range of local public services and public investments required for Nairobi City. As the preparatory and autonomous budgetary structure for SWMPC, a special account will be created apart from the general account of CCN. The special account under the preparatory unit of the DoE will be transferred to the special account of SWMPC at the beginning of 2014, when the SWMPC is formally established.

Figure 4.6.2 illustrates the transition of the organisational structure of the current Department of Environment, the transitional SWMPC Preparatory Unit and the SWMPC, which are explained above.

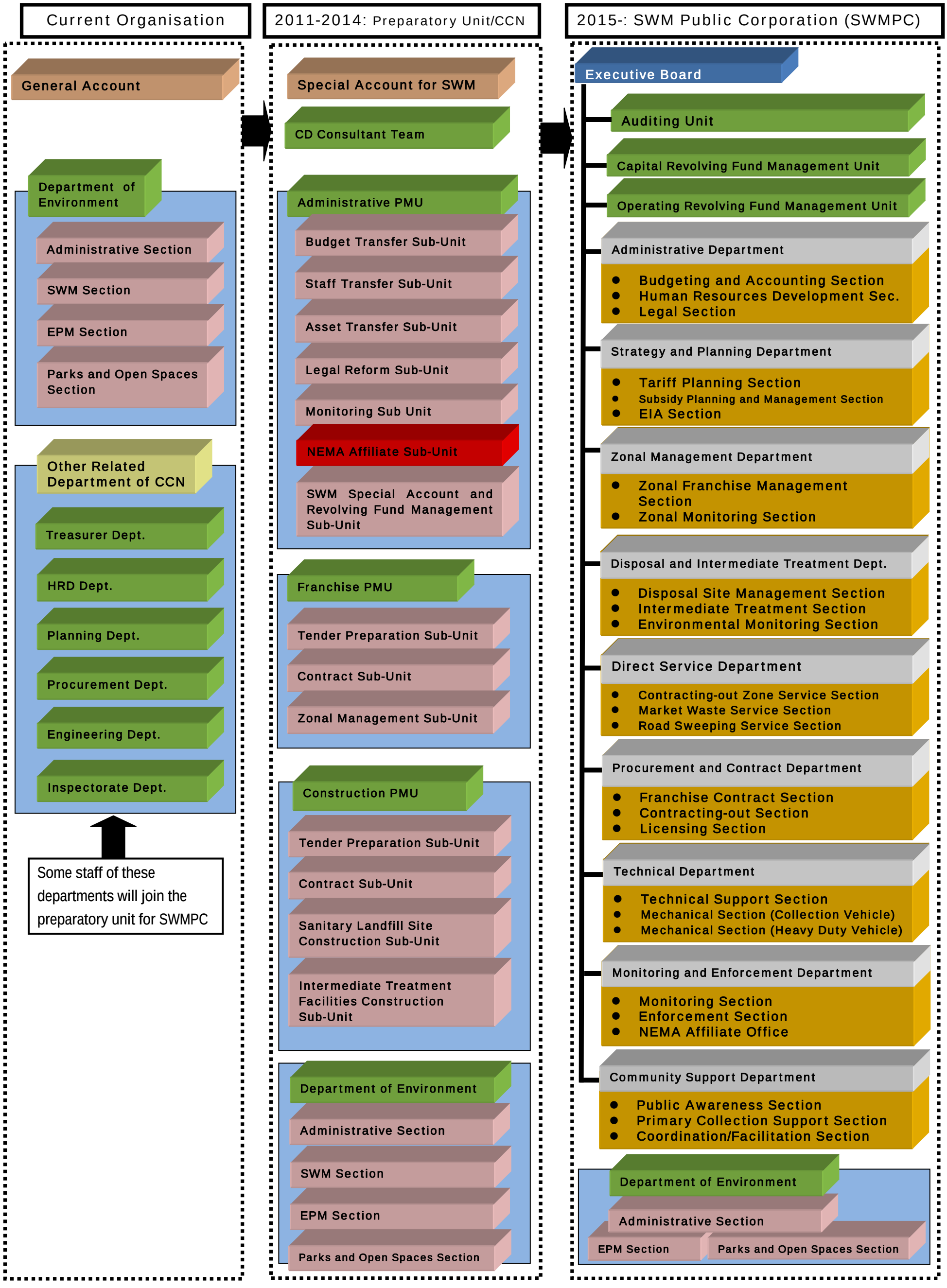


Figure 4.6.2 Organisational Chart of Current DoE, Transitional SWMPC Preparatory Unit and Proposed SWMPC

(2) Mid-Term Action Plan

(a) Start of Operations of Revolving Funds and Provision of Subsidies

(i) Start of Operations of SWM Capital Revolving Fund and Provision of Subsidies

In line with the guidelines of the SWM Capital Revolving Fund (SWMCRF) proposed in the private sector involvement plan, the operations of the SWMCRF will be started by the capital revolving fund management unit of the SWMPC. At the same time, the subsidy provision under the SWMCRF for the private franchisees will be started by the subsidy planning and management section of the strategy and planning department of the SWMPC.

(ii) Start of Operations of SWM Operating Revolving Fund

In line with the guidelines of the SWM Operating Revolving Fund (SWMORF) proposed in the private sector involvement plan, the operations of the SWMORF will be started by the operating revolving fund management unit of the special account of the SWMPC.

(b) Mid-Term Organisational Assessment and Feedback to SWMPC

The mid-term organisational assessment of the SWMPC on the achieved level is essential for accurately assessing the impacts on the improvement of the capacities at the timing of the mid-term stage after the implantation of the first 5-year franchise contract with the private sector. The ex-post monitoring system will significantly contribute to the feedback mechanisms for rectifying the performances of the awarded franchisees in 3 zones for the First Phase.

(c) Mid-Term Organisational Restructuring of SWMPC

After the First Phase of the franchise system, the mid-term organisational restructuring of the SWMPC is also required for the improvement of the SWMPC to meet the increasing demand for solid waste management services for the Second Phase. The continuously tuned organisation based on the periodical organisational assessment of the SWMPC will be required, thereby leading to exploring organisational restructuring options in the following areas:

- Basic organisational structures (hierarchy-type, project-type and matrix-type) required for the mid-term time frame
- Functions and responsibilities of departments and units
- Number of staff for mid-term prospect
- Number of vertical levels and span of control
- Directing functions and controlling responsibilities
- Organisational responsiveness to the introduction of the franchise system

(3) Long-Term Action Plan

(a) Continuous Management of Revolving Funds and Provision of Subsidies

(i) Continuous Management of SWM Capital Revolving Fund and Subsidies

The SWM Capital Revolving Fund (SWMCRF) will be managed continuously by the capital revolving fund management unit of the Solid Waste Management Public Corporation (SWMPC). At the same time, the subsidy provision under the SWMCDR for

the private franchisees will be managed continuously by the subsidy planning and management section of the strategy and planning department of the SWMPC.

(ii) Continuous Management of SWM Operating Revolving Fund

The SWM Operating Revolving Fund (SWMORF) will be managed continuously by the operating revolving fund management unit of the SWMPC.

(b) Long-Term and Continuous Organisational Assessment and Feedback to SWMPC

The long-term organisational assessment of the achieved level of the SWMPC is essential for accurately assessing the impacts on the improvement of the organisational capacities at the timing of the long-term stage after the implementation of the second 5-year franchise contract with the private franshisees. The long-term ex-post monitoring system will significantly contribute to the feedback mechanisms for rectifying the performances of the awarded franchisees in the six (6) zones for the Third Phase.

(c) Long-Term and Continuous Organisational Restructuring of SWMPC

After the Second Phase of the franchise system, the long-term organisational restructuring of the SWMPC is also required for the improvement of the SWMPC to meet the growing demand for solid waste management services for the Third Phase. The continuously tuned organisation based on the periodical organisational assessment of the SWMPC will be required, thereby leading to exploring organisational restructuring options in the following areas:

- Basic organisational structures (hierarchy-type, project-type and matrix-type)
- Functions and responsibilities of departments and units
- Number of staff required for long-term prospect
- Number of vertical levels and span of control
- Directing functions and controlling responsibilities

4.6.2 Human Resources Development Plan

The human resources development is an integral part of the supporting factors for a sustainable solid waste management services. For the development of human resources with ample and broad range of technical expertise in the field of solid waste management services, there are 3 strategically important groups: (i) key personnel in SWMPC in charge of providing the solid waste management services; (ii) operational managers of private franchisees and service providers; and (iii) staff of community-based organisations. Among these target groups, the strengthening of human resources for the SWMPC will be the first priority.

(1) Short-Term Action Plan

(a) Implementation of Comprehensive Capacity Development Programme (CCDP)

The major challenge of the human resources development plan in the new Master Plan is how to incorporate the improvement of individual capacities into the organisational capacities of the SWMPC which will be established at the beginning of 2014 as a new organisational framework required for providing the zone-based franchise system. Another challenge is how to upgrade the capacities and to motivate the candidate staff of SWMPC in response to the massive human resources development demand of the said new organisation. Based on a wide range of the capacity gap assessment on human resources for the improvement of the current solid waste management system, the human resources development plan has been identified as

a comprehensive capacity development programme required for the establishment of the SWMPC, thereby identifying the eight (8) modular human resources development projects shown in the table below.

However, it is acknowledged that the ***"human resources development project approach"*** based on a single human resource development project alone does not comprehensively solve the constraints of the solid waste management services. Since ***"human resources development programme approach"*** is the process of managing a portfolio of multiple inter-dependent projects, the programme approach can be used for the management of the identified multiple modular projects. The programme approach provides the human resources development plan with a common platform to implement these modular projects under the Comprehensive Capacity Development Programme (CCDP). The CCDP acts as the key pre-condition to maximise the sustainability of the city-wide solid waste management services.

Regarding the time frame required for the CCDP, it might be noted that the implementation of the multi-modular CCDP will take a long-term period. In parallel with the preparation for establishing the SWMPC, the long-term CCDP will be required. It might take approximately five (5) years to complete the CCDP, when the establishment of the SWMPC is synchronically prepared under the new PPP scheme. At the same time, the long-term CCDP will also require the full-scale technical assistance from an external donor organisation. Based on this recognition, the implementation period for the CCDP will substantially start from 2011 and complete in 2015, while the financial year 2010 is regarded as the preparation period for the CCDP.

The proposed CCDP should be implemented under the full-scale technical assistance by an external donor organisation. To smoothly transfer the responsible organisation for the solid waste management services from the current Department of Environment (DoE) to the proposed SWMPC, the creation of the preparatory unit of the SWMPC inside the DoE, which will start operations from the middle of 2011, is separately proposed. The staff of the said preparatory unit will be engaged in a wide range of preparatory operations for the establishment of the SWMPC, and the overall goals of the proposed CCDP is to create the organisational structure of the SWMPC as well as to upgrade the technical and managerial capacities for the candidate staff of the SWMPC, thereby upgrading the comprehensive capacity to implement the updated Master Plan. To start the preparation for the establishment of SWMPC, some urgent actions, such as the setup of the preparatory unit in DoE, will be required to be carried out by DoE/CCN by the middle of 2011. The detailed actions required are shown in **Section 4.11.2.**

The major outputs of the proposed CCDP include the following:

(i) Establishment of SWMPC

The organisation for the proposed SWMPC with 9 departments and 3 units should be established by the end of 2014.

(ii) Capacity Development of Candidate Staff of SWMPC

A wide range of capacities required for the candidate staff of SWMPC should be upgraded in parallel with the establishment of the SWMPC.

- Capacity for Public-Private Partnership and institutional reform
- Capacity for Establishment of SWMPC and Financial Management
- Capacity for operating 3R, intermediate treatment and collection/transportation
- Capacity for operating the new sanitary landfill site
- Capacity for planning and operating community participation and public awareness

The outline of the proposed 5-year Comprehensive Capacity Development Programme (CCDP) is shown **Table 4.6.4**. The detailed modular training projects under the CCDP are given in **Section B of Volume 3, Supporting Report**, and the urgent actions for establishment of the SWMPC are described in **Section 4.11** of this report.

Table 4.6.4 Outline of Comprehensive Capacity Development Programme

No.	Modular HRD Project	Train-ing No.	Specific Subjects for Human Resources Development (HRD)	Target			Old Master Plan	Pilot Project	Follow-up
				SWMPC Staff	Private Sector	CBOs			
1	Overall Management	1-a	Overall capacity for SWM	●			●		
		1-b	Capacity for SWM information system	●			●		
2	Collection and Transport	2-a	Capacity to efficiently operate collection and transport services	●			●		
		2-b	Capacity to maintain collection vehicles and equipment	●			●		
3	Intermediate Treatment	3-a	Capacity to implement 3Rs	●	●	●			
		3-b	Capacity to operate intermediate treatment facilities	●					
		3-c	Capacity to maintain intermediate treatment facilities	●					
4	Sanitary Landfill Site	4-a	Capacity to select candidate sanitary landfill sites	●			●		
		4-b	Capacity to operate sanitary landfill sites	●			●		
		4-c	Capacity to implement EIA and monitor environment for sanitary landfill sites	●			●		
		4-d	Capacity to design sanitary landfill sites	●			●		
5	PPP Contractual Management	5-a	Capacity to manage PPP tender and procurement procedures	●	●		●		●
		5-b	Capacity to provide franchised collection services	●	●				
		5-c	Capacity to provide service contracts for sanitary landfill management	●					
6	Financial Management	6-a	Capacity to implement proper financial management	●			●		
		6-b	Capacity to finance SWM projects	●					
		6-c	Capacity to collect and manage service fees	●					
		6-d	Capacity to manage SWM special account and revolving funds	●					
7	Organisational and Legal Improvement	7-a	Capacity to improve organisation for SWM	●			●		
		7-b	Capacity to improve legal system for SWM	●			●		
		7-c	Capacity to monitor and enforce SWM regulations						●
8	Community Participation	8-a	Capacity to primary collection at community	●	●	●	●	●	

Source: JICA Survey Team

(b) Consideration of Incomplete Action Plans of the Previous Master Plan

There are some incomplete action plans in the previous 1998 Master Plan which should be reflected even in the new Master Plan. **Table 4.6.5** summarises the outline of the incomplete action plans to be considered in the CCDP.

Table 4.6.5 Incomplete Action Plans of Previous 1998 Master Plan to be included in the CCDP

No.	Provision	Detailed Actions Recommended in New Master Plan
1	**Development of Key Management Capabilities** Assistance in establishing the Management Team, planning capability, procedures for objective setting and performance measurement, MIS setup and improving managers' effectiveness	● The development of key management capacities will be merged into the comprehensive capacity development programme of the new Master Plan. ● The contents of the training programme are included in **Module Number 1-a and 1-b of the comprehensive capacity development programme**, and the target is the candidate staff of the administrative department of the SWMPC as well as the managers of all PMUs of the preparatory unit for the SWMPC. ● The monitoring for the performance assessment on the capacity improvement will be regularly conducted.
2	**Financial Management Capacities** Assistance in establishing financial systems in the Finance Section including implementation of computerised financial system	● The development of financial management capacities will be merged into the comprehensive capacity development programme of the new Master Plan. ● The contents of financial management capacities are included in **Module Number 6-a, 6-b, 6-c and 6-d of the comprehensive capacity development programme**, and the target is the candidate staff of the budgeting and accounting section of the administrative department of the SWMPC as well as the staff of the administrative PMU of the preparatory unit for the SWMPC. ● The monitoring for the performance assessment on the capacity improvement will be regularly conducted.
3	**Environmental Regulation** Assistance in establishing the Environmental Division's monitoring methodologies and systems and procedures for handling non-municipal wastes	● The development of environmental regulation capacities will be merged into the comprehensive capacity development programme of the new Master Plan. ● The contents of the training programme are included in **Module Number 4-c of the comprehensive capacity development programme**, and the target is the candidate staff of the EIA section of the strategy and planning department as well as the environmental monitoring section of the disposal and intermediate treatment department of the SWMPC. ● The monitoring for the performance assessment on the capacity improvement will be regularly conducted.
4	**Formatting and Drafting SWM By-laws** Assistance in the formatting, drafting and enactment of SWM By-laws	● The development of legal capacities will be merged into the comprehensive capacity development programme of the new Master Plan. ● The contents of the training programme are included in **Module Number 7-b and 7-c of the comprehensive capacity development programme**, and the target is the candidate staff of the administrative department as well as the monitoring and enforcement department of the SWMPC. ● The monitoring for the performance assessment on the capacity improvement will be regularly conducted.
5	**Contract Management** Assistance in establishing the Contract Management Section's functions and procedures for both pre-contract award and post-contract award	● The development of contract management capacities will be merged into the comprehensive capacity development programme of the new Master Plan. ● The contents of the training programme are included in **Module Number 5-a, 5-b and 5-c of the comprehensive capacity development programme**, and the target is the staff of the franchise PMU of the preparatory unit for SWMPC as well as the candidate staff of the EIA section of the strategy and planning department as well as the procurement and contract department of the SWMPC. ● The monitoring for the performance assessment on the capacity improvement will be regularly conducted.

No.	Provision	Detailed Actions Recommended in New Master Plan
6	**Human Resource Management and Development** Assistance in establishing the Human Resource Section's functions covering personnel functions, HR planning, improving employee performance and occupational health	● The development of human resources management capacities will be merged into the comprehensive capacity development programme of the new Master Plan. ● The contents of the training programme are included in **Module Number 7-a of the comprehensive capacity development programme**, and the target is the candidate staff of the human resources development section of the administrative department of SWMPC. ● The monitoring for the performance assessment on the capacity improvement will be conducted regularly.
7	**Community Development** Assistance in establishing the Community Development Section	● The development of community supporting capacities will be merged into the comprehensive capacity development programme of the new Master Plan. ● The contents of the training programme are included in **Module Number 8-a and 8-b of the comprehensive capacity development programme**, and the target is the candidate staff of the community support department of the SWMPC. ● The monitoring for the performance assessment on the capacity improvement will be conducted regularly.
8	**Development of Technical Capability (Collection and Transportation)** -Planning, Scheduling, Staffing & Vehicle Management Assistance in establishing operations management staff's planning methodologies and functions covering arrangement, routing for collection, scheduling, staffing and reviewing systems. Also, assistance in establishing Vehicle Management subunit's functions covering procurement of spare parts and tools, store methods and inventory management. -Maintenance Assistance in establishing Maintenance subunit's functions focusing on improvement of craftsman's skills based on the job training.	● The development of technical capacities for collection and transportation will be merged into the comprehensive capacity development programme of the new Master Plan. ● The contents of the training programme are included in **Module Number 2-a and 2-b of the comprehensive capacity development programme**, and the target is the candidate staff of the direct service department and the zonal management department of the SWMPC. ● The monitoring for the performance assessment on the capacity improvement will be conducted regularly.
9	**Development of Technical Capability (Final Disposal)** -Planning, Scheduling, Staffing & Maintenance Assistance in developing operations management staff's planning, operating and reviewing systems.	● The development of technical capacities for sanitary landfill management will be merged into the comprehensive capacity development programme of the new Master Plan. ● The contents of the training programme are included in **Module Number 4-a, 4-b, 4-c and 4-d of the comprehensive capacity development programme**, and the target is the candidate staff of the disposal site management section of the disposal and intermediate treatment department of the SWMPC. ● The monitoring for the performance assessment on the capacity improvement will be conducted regularly.

Source: JICA Survey Team

(c) Formulation of Standard Working Procedures and Manuals

In order to standardise the working procedures for SWMPC, the following manuals in the field of the SWM operations, PPP, financial management and community support manuals will be formulated and continuously updated. **Table 4.6.6** gives an outline of working procedure manuals to be formulated.

Table 4.6.6 Outline of Working Procedure Manuals to be Formulated

No.	Area	Manual
1	SWM Operations Manual	Collection and Transport Manual for Franchise Zone
		Collection and Transport Manual for Contracting-out Zone
		Intermediate Treatment Manual
		Sanitary Landfill Operation Manual
		Monitoring and Enforcement Manual
2	PPP Manual	Tender and Contract Manual
		Tender and Contract Manual
3	Financial Management Manual	SWM Special Account Management Manual
		SWM Capital Revolving Fund Management Manual
		SWM Operating Revolving Fund Management Manual
		Capital Subsidy Management Manual
4	Community Support Manual	Community Support Manual
		Public Awareness Raising Manual

Source: JICA Survey Team

(2) Mid-Term Action Plan

(a) Implementation of Ex-post Mid-Term Performance Monitoring and Assessment

Ex-post performance monitoring of the achieved level of capacity development is essential for accurately assessing the impacts on the improvement of the capacities at the timing of the mid-term stage after the implantation of the 5-year CCDP. The ex-post monitoring system will significantly contribute to the feedback mechanisms for rectifying poor performance of the targeted staff of the CCDP, thereby sustainably upgrading the level of staff to meet the requirements of SWMPC.

Performance monitoring is a complicated assessment of capacities involving qualitative rather than quantitative performance indicators. Benchmarks as performance indicators for monitoring and assessment should be developed for the continuous feedbacks to the capacity development activities. Since the capacity development is a continuous process from ***learning by doing*** in parallel with the starting of operations of SWMPC, feedback mechanisms to the human resources development are absolutely required. The results of the ex-post mid-term monitoring should be utilised for designing the follow-up skill-targeted training programme which should be implemented after the 5-year CCDP.

There are different methods of monitoring as shown below. The method applied for the ex-post mid-term performance monitoring should be outcome-based monitoring. The monitoring subunit of the administrative PMU should be in charge of the outcome-based monitoring.

- Continuous Monitoring
- Random (Sample) Monitoring
- Planned and Scheduled Monitoring
- Outcome-based Monitoring
- Complaints-based Monitoring
- Self-Monitoring

(b) Implementation of Skill-Targeted Follow-up Training Programme

Since the capacity development is a transformational change through an accumulated incremental process, the performance assessment on the implementation of the first 5-year

CCDP based on the mid-term performance monitoring should be utilised for studying the further necessities for the follow-up skill training programme for the staff of SWMPC. The follow-up programme would be supplementary to the CCDP and the specific skill-targeted training for the selected expertise specially required for the further trainings. The duration of the programme would be another 2 or 3 years in addition to the 5-year CCDP. The candidate targeted expertise for the training would be as below.

(i) Skill Training for PPP Management Capacity

Since the new PPP scheme such as the introduction of the zone-based franchise system is under the control of the SWMPC, the following skills should be further trained in addition to the capacity development under the CCDP. The targeted staff of the training would be the manager and deputy managers and section chiefs of the Procurement and Contract Department of the SWMPC.

- Basic tendering process for the franchise contract and the collection services
  - (i) Preparation for Expression of Interests and Pre-qualification of Bidders
  - (ii) Preparation of Tender Documents
  - (iii) Preparation of the Bid
  - (iv) Clarifications and Feedbacks to Tender Documents
  - (v) Bid Bond
  - (vi) Submission of Bids
- Evaluation of franchisees and management service providers
- Types of public-private partnership and long-term risks
- Contractual provisions for franchise contract
- Contractual provisions for management service contract
- Calculation and estimate for value for money of public-private partnership projects

(ii) Skill Training for Monitoring and Enforcement Capacity

The training for monitoring inspectors who are in charge of monitoring and inspection of the solid waste management services is critical for the successful enforcement of the By-laws. The shortage of such inspectors is one of the major constraints for the proper solid waste management.

- Clear-cut understanding of legal framework and legal steps required for monitoring and enforcement
- Understanding on detailed monitoring and enforcement measures
- Well-managed consultation and communications with the private sector and communities

(3) Long-Term Action Plan

(a) Implementation of Long-Term Performance Monitoring and Establishment of Feedback System

In addition to the ad-hoc mid-term performance monitoring and assessment, the long-term and periodical performance monitoring and assessment on the capacity development is required for the sustainable human resources development. While the mid-term review after the 5-year CCDP is absolutely necessary for the rapid feedback to the short-term rectification of the human resources development, the long-term and periodical performance monitoring and

assessment should highlight a wide range of feedback mechanisms such as an incentive system.

Incentive systems are closely related with the acquired skills and job performances. Furthermore, incentives and motivation also are linked as key inter-related ingredients of successful capacity development activities in addition to tangible aspects such as skills and organisational structures. Monetary and non-monetary forms of incentives contribute to enhancing the staff's willingness to further improve the capacities by ensuring that effective capacities are transformed into good performance of individuals. The feedback system links those incentives with the actual performance of the staff, and the feedback system of the SWMPC should be established through utilising the improvement of the following current feedback mechanisms of CCN.

- Performance Contract: The performance contract is annually being entered into between the town clerk and each department of CCN. The contract includes, vision, mission, objective of each department, commitment and responsibilities of each department and CCN, and frequency of monitoring and information flow together with the quantitative indicators.
- Staff Performance Appraisal Report: The staff performance appraisal report intends to manage and improve the performance of the staff in providing the public services by enabling a higher level of staff participation and involvement in planning.
- Results-Based Management (RBM): The results-based management (RBM) is being prepared by each department of CCN to assess the performance results of the annual operations together with performance indicators for the purpose improving the performances of the public services.

In addition to the improvement of the current feedback mechanisms, meritocracy in the SWMPC should be established as one of the feedback mechanisms. Meritocracy should be the guiding principle for the staff recruitment and promotion inside SWMPC, ensuring that the staff recruitment as well as the promotion takes the following conditions:

- The candidates for promotion should be selected on the basis of meritocracy;
- Fulfillment of the required level of knowledge, skills, experiences and attitude for the positions should be taken into account; and
- Transparency should be applied in the selection process during the entry and promotion.

(b) Long-Term and Continuous Staff Deployment and Redeployment

For the sustainable provision of the solid waste management services, the long-term and continuous staff deployment and redeployment based on the continuous performance assessment of the staff of the SWMPC will be required. To streamline staff deployment and redeployment guidelines in the SWMPC, the SWMPC is required:

- To formulate comprehensive guidelines for staff deployment and promotion;
- To establish appropriate staff assessment system; and
- To establish appropriate procedures and mechanisms on the selection of staff to be promoted.

4.7 Legal and Institutional Reform Plan

The lack of effective legal framework as well as the institutional capacity to enforce the acts, regulations and by-laws in the field of solid waste management is also one of the major constraints. At the same time, the institutional issues such as the zoning system of the service areas for collection services are

also critical. Without the proper legal and institutional reform, the SWMPC will not be provided with clear mandates and legal framework to fulfill its responsibilities. The proper enforcement of the regulatory and statutory provisions of the SWM-related regulations can lead to necessary actions to correct violations such as illegal dumping and so forth. Hence, the effective legal and institutional reform is a key to the sustainable provision of the solid waste management services.

4.7.1 Short-Term Action Plan

(1) Improvement of Monitoring and Enforcement in the CCN Solid Waste Management By-law 2007

One of the major legal constraints to be removed is the lack of monitoring and enforcement of the By-law. The current statements on the monitoring and enforcement described in the following sections of the By-law alone are not adequate for the proper enforcement of the solid waste management. A clear-cut process of monitoring and enforcement of the By-law is required to be added to the By-law.

- **Section 11 (1):** CCN shall establish and implement a system of monitoring, inspections and enforcement of waste management activities and shall regularly inform waste generators of the procedures to implement and improve waste management within the City.
- **Section 11 (2):** Any officer or agent of CCN duly authorised in that behalf, may at all reasonable times, enter any residential dwelling or trade premises within the area of jurisdiction of CCN for the purpose of conducting any inspection, inquiry or the execution of works under the provisions of these By-laws.
- **Section 11 (3):** In addition to such penalties for non-payment as may be stipulated in the directions issued by CCN for non-payment of charges for waste management services, any waste management charge payable under the By-laws shall be a debt due and owing to collector and may be recovered as a civil debt at the instance of the collector or any person authorised by the collector to collect on its behalf.
- **Section 11 (4):** Any power or function conferred on CCN under these By-laws may be exercised or performed by a third party and shall be deemed to have been exercised or performed under the authority of these By-laws.
- **Section 12:** Any person who refuses or fails to comply with any provision of these By-laws or gives false information in relation to any requirements of these By-laws shall be guilty of an offence, and , in addition to any other penalty which may lawfully be available, shall be liable on conviction to a fine not exceeding three thousand shillings or to imprisonment for a term not exceeding six months or to both such fine and imprisonment.

More specifically, the following two contents for the improvement of monitoring and enforcement should be included in the By-law in more concrete terms.

Step 1: Strengthening functions of monitoring and inspection

An important component of the enforcement process is the authority to monitor and inspect related facilities regularly or on random basis in accordance with the By-law. Especially, an inspection is a formal visit by an inspector to a facility to review records, take samples, and observe facility operation. More detailed roles, responsibilities and empowerment regarding the inspection should be specified.

Step 2: Strengthening administrative actions

An administrative action is a non judicial enforcement action taken by the authority. These actions can be broken down into 3 categories: informal, formal and penalty actions.

(i) Informal Actions

Offenders will be informally given notice of its noncompliance and the steps to take to correct the violations. Informal actions are most appropriate where the violations are minor threats to human health and the environment. A warning letter, sometimes referred to as a notice of violation, may be sent, which lays out the specific actions that need to be taken by the offenders to correct the violations.

(ii) Formal Actions

In cases of a serious offender who has failed to respond to an informal action, the SWMPC together with the assistance of the proposed NEMA affiliate office in the SWMPC can issue an administrative order with the following varieties:

- Orders to mandatory inspection and warning letter
- Corrective action order
- Compliance order and warning of penalties

(iii) Penalty Actions

Possible penalty actions include permit revocations, facility closure, and criminal prosecutions. If a private operator is engaged by means of a contract that specifies financial penalties for failures to achieve good operating standards, persistent failures could result in the cancellation of the contract by the SWMPC.

(2) Improvement of Monitoring and Enforcement in Other Related Legal Framework

In the same manner as the improvement of enforcement and monitoring in CCN Solid Waste Management By-laws of 2007, the following other related legal framework will be modified. **Table 4.7.1** shows the improvement of enforcement and monitoring in other related legal framework.

Table 4.7.1 Outline of Minor Modifications of Other Related Legal Framework

No.	Related Section	Actions Recommended in New Master Plan
1	**Occupation Safety and Health Act, 2007:** **Section 108 (1):** In the event of any contravention in connection with or in relation to a workplace of the Sections of this Act, the occupier, or if the contravention is one in respect of which the owner is by or under this Act made responsible, the owner of the workplace shall, subject to this Act be guilty of an offence. **Section 109 (1):** Any person who commits an offence under this Act for which no express penalty is provided shall on conviction be liable to a fine not exceeding three hundred thousand shillings or to imprisonment for a term not exceeding three months or to both.	**In relation to Section 55 of Occupation Safety and Health Act which regulates the operation of incinerators, more concrete steps for monitoring, inspection and administrative actions should be included in the Act.**
2	**Public Health Act, 1986:** **Section 121 (1):** Any person who fails to obey an order to comply with the requirements of the medical officer of health or otherwise to remove the nuisance shall, unless he satisfies the court that he has used all diligence to carry out such order, be guilty of an offence and liable to a fine not exceeding eighty shillings for every day during which the default continues; and any person willfully acting in contravention of a closing order issued under Section 120 shall be guilty of an offence and liable to a fine not exceeding eighty shillings for every day during with the contravention continues. **Section 121(2):** The medical officer of health may in such case enter the premises to which any such case enter the premises to which any such order relates, and remove the nuisance and do whatever may be	**In relation to the sections which regulate the treatment of wastes, more concrete steps for monitoring, inspection and administrative actions should be included in the Act.**

No.	Related Section	Actions Recommended in New Master Plan
	necessary in the execution of such order, and recover in any competent court the expenses incurred from the person on whom the order is made.	
3	**Scrap Metal Act, 1993:** **Section 17 (1):** Any police officer not below the rank of Sub-Inspector or the appropriate licensing officer may at any time enter upon any premises in respect of which a license has been issued under this Act, or in respect of which he has reasonable cause to believe an offence under this Act or under any rules made thereunder has been or is about to be committed, and may inspect such premises and any scrap metal, book, account, register, record, document or thing found therein and may require any person appearing to be in control thereof or employed therein or who has been employed therein within the last preceding three months to give such information as will enable the police officer or licensing officer to determine whether or not the Sections of this Act are being or have been complied with. **Section 18 (2)**: Any scrap metal found without an apparent owner may be seized by a police officer or a licensing officer and shall as soon as possible be taken before a magistrate, who, if satisfied that the owner cannot be found, shall declare it to be forfeited. **Section 19 (1):** When any licensed dealer is convicted of an offence under this Act or of an offence involving fraud or dishonesty or stolen property, his license shall, unless the court for special reasons thinks fit to order otherwise, be cancelled forthwith, and the court may order that no license shall be granted to him for such period as it shall think fit.	**In relation to Section 22 (2) of Scrap Metal Act which regulates the export of scrap metal, more concrete steps for monitoring, inspection and administrative actions should be included in the Act.**
4	**Traffic Act, 1993:** **Section 67 (1):** Any person who contravenes or fails to comply with any of the Sections of this Part shall be guilty of an offence and liable, where no penalty is specifically provided, on first conviction to a fine not exceeding two thousand shillings or to imprisonment for a term not exceeding three months, and on each subsequent conviction to a fine not exceeding five thousand shillings or to imprisonment for a term not exceeding six months or to both. **Section 99 (1):** Any license issued under this Part may be cancelled at any time by the Registrar if he is satisfied that, by reason of the conduct of the holder of such license or the condition of any vehicle in respect of which the license is issued, such cancellation would be in the public interest; and upon receipt of a notice of such cancellation, the license holder shall forthwith deliver up such license to the Registrar.	**In relation to Section 55 (1) and 56 (1) of Traffic Act which regulates the overloading on trucks, more concrete steps for monitoring, inspection and administrative actions should be included in the Act.**
5	**Transport Licensing Act, 1993:** **Section 13 (1):** A license of any class may be revoked or suspended by the Licensing Authority on the ground that any of the conditions of the license have not been complied with or that the authorised vehicle has not been used for a period of three months.	**In relation to Section Section 26 of Transport Licensing Act which regulates the conditions of vehicles on roads, more concrete steps for monitoring, inspection and administrative actions shpuld be included in the Act.**

Source: JICA Survey Team

(3) Minor Modifications of the CCN Solid Waste Management By-Law 2007

Although some legal reforms on the solid waste management were proposed in the previous Master Plan, a majority of them have not been well reflected even in the current CCN Solid Waste Management By-laws, 2007. These incomplete legal reforms should be completed by the minor modifications of the By-laws. **Table 4.7.2** shows the outline of the required minor modifications of the CCN Solid Waste Management By-laws.

Table 4.7.2 Outline of Required Minor Modifications of CCN Solid Waste Management By-Laws

No.	Related Section	Actions Recommended in New Master Plan
1.	The By-law should clearly stipulate the policies and objectives to be achieved by SWM and state that NCC has the primary Duty of Care for SWM in Nairobi City.	● **CCN Solid Waste Management By-laws 2007, Section 4(1)** stipulates that CCN has the primary duty to regulate waste and its management within the area of jurisdiction of the City, and for this purpose all wastes generated or otherwise arising within the area of the City shall be managed and regulated in accordance with these By-laws. ● **Modification: This section should be changed to mean that CCN and SWMPC have the primary duties to regulate waste and its management within the area of jurisdiction of the City.**
2.	The By-law should categorise solid wastes according to the characteristics presented by each category of waste.	● **CCN Solid Waste Management By-laws of 2007, Section 3** defines "domestic waste", "hazardous waste", "municipal waste" and "solid waste". It also defines municipal waste as waste, which is the responsibility of the Council whether under the By-laws or under any other law, to be collected, treated or otherwise disposed and includes refuse. ● **Modification: This section should be more concretely expressed by adding a table on the clear-cut categories of wastes in the ANNEX to the By-law.**
3	The By-law should impose a statutory requirement for solid waste management planning on CCN.	● **CCN Solid Waste Management By-laws 2007, Section 4(2)** stipulates that CCN shall prepare a waste management plan of its arrangements for managing waste arising within its area of jurisdiction and **Section 4(3)** defines the contents of a waste management plan. ● **Modification: The outline of the Integrated Solid Waste Management Master Plan, which is currently being formulated, should be attached as ANNEX to the By-law.**
4	The By-law should impose a Duty of Care on the generators of waste to handle all wastes in their charge in an environmentally sound manner and, in any case, to dispose them only by giving them to an authorised collector of waste.	● **CCN Solid Waste Management By-laws 2007, Section 8(3), (4), (5), (6), (7), (8), (9) and (10)** stipulate a duty of care on the generators on proper handling of wastes. ● **Modification: Detailed guidelines on 3R should be attached as ANNEX to the By-law.**
5	The By-law should impose a Duty of Care on all waste operators to handle all wastes in their charge in an environmentally sound manner and to dispose of them only at a licensed landfill facility.	● **CCN Solid Waste Management By-laws 2007, Section 9(1)** stipulates that no person shall dispose waste other than in permitted disposal areas or at an approved disposal facility, and **Section 9(2)** also stipulates that it shall be the duty of CCN to provide places at which to deposit waste before its transfer to any other place for its final disposal and places at which to dispose waste and plant and equipment for processing or other disposal thereof. ● **Modification: Detailed guidelines on the final disposal at sanitary landfill sites should be attached as ANNEX to the By-law.**

No.	Related Section	Actions Recommended in New Master Plan
6	The By-law should set standards for collecting, treating and transporting solid waste and for the proper management of sanitary landfills.	● **ANNEX 1 of Policy on Private Sector Involvement in Solid Waste Management** issued by CCN in 2001 stipulates CCN's guidelines to the private sector involvement on solid waste management in the field of collection and transport. ● **CCN Solid Waste Management By-law of 2007, Section 9(1)** stipulates that no person shall dispose of waste other than in permitted disposal areas or at an approved disposal facility, and **Section 9(2)** also stipulates that it shall be the duty of CCN to provide places at which to deposit waste before its transfer to any other place for its final disposal and places at which to dispose of waste and plant and equipment for processing or other disposal thereof. However, there are no clear-cut standards for the proper management of sanitary landfills. ● Although **Environmental Management and Co-ordination (Waste Management) Regulations of 2006, which are applied to the CCN Solid Waste Management By-laws of 2007, Third Schedule** stipulates the detailed technical standards for treatment and disposal of wastes, the CCN Solid Waste Management By-laws of 2007 does not have an ANNEX which shows the technical standards for collecting, treating and transporting solid wastes and for the proper management of sanitary landfills. ● **Modification: With reference to Environmental Management and Co-ordination (Waste Management) Regulations of 2006, detailed technical standards for collecting, treating and transporting solid wastes and for the proper management of sanitary landfills should be attached as ANNEX to the By-law.**
7	The By-law should impose a requirement for private sector SWM operators and landfill operators to be licensed by the CCN.	● **ANNEX 1 of Policy on Private Sector Involvement in Solid Waste Management** issued by CCN in 2001 stipulates CCN's guidelines for private sector involvement on solid waste management in the field of collection and transport. ● **CCN Solid Waste Management By-laws 2007, Section 9(1)** stipulates that no person shall dispose waste other than in permitted disposal areas or at an approved disposal facility, and **Section 9(2)** also stipulates that it shall be the duty of CCN to provide places at which to deposit waste before its transfer to any other places for its final disposal and places at which to dispose waste and plant and equipment for processing or other disposal thereof. However, there are no clear-cut standards for the proper management of sanitary landfills. ● Although the **Environmental Management and Co-ordination (Waste Management) Regulations of 2006, which are applied to CCN Solid Waste Management By-laws 2007, Third Schedule** stipulates the detailed technical standards for treatment and disposal of wastes, the CCN Solid Waste Management By-laws of 2007 does not have an ANNEX which shows the technical standards for collecting, treating and transporting solid

No.	Related Section	Actions Recommended in New Master Plan
		wastes and for the proper management of sanitary landfills. ● **Modification: With reference to the Environmental Management and Co-ordination (Waste Management) Regulations of 2006, detailed technical standards for collecting, treating and transporting solid wastes and for the proper management of sanitary landfills should be attached as ANNEX to the By-law.**
8	The By-law should specify the technical and financial qualifications to be met by waste operators including landfill operators.	● **Section 3 of Policy on Private Sector Involvement in Solid Waste Management** issued by CCN in 2001 stipulates CCN's regulations and general qualifications of private operators. ● **CCN Solid Waste Management By-law of 2007, Section 5(1)** stipulates that CCN shall issue a permit to waste operators who satisfy such requirements as to technical and financial capability as it shall stipulate, and **Section 9(1)** also stipulates that no person shall dispose of waste other than in permitted disposal areas or at an approved disposal facility. ● **Environmental Management and Co-ordination (Waste Management) Regulations of 2006, which are applied to the CCN Solid Waste Management By-law of 2007, Section 7 and Section 10** stipulate the general qualifications required for the waste transportation license and for the disposal facility license, respectively, CCN Solid Waste Management By-laws of 2007 does not have an ANNEX which shows the detailed technical and financial qualifications to be met by waste operators including landfill operators. ● **Modification: With reference to Environmental Management and Co-ordination (Waste Management) Regulations of 2006, detailed technical and financial qualifications required for the waste transportation license and for the disposal facility license should be attached as ANNEX to the By-laws.**
9	The By-law should impose a requirement for Environmental Impact Assessment to be carried out and approved by the CCN before the licensing of any landfill site.	● Although **CCN Solid Waste Management By-law of 2007, Section 9(1)** stipulates that no person shall dispose waste other than in permitted disposal areas or at an approved disposal facility, there is no clear statement on the requirement for EIA before licensing of any sanitary landfill site. ● **Modification: This section should be more concretely expressed by adding the requirements for EIA before licensing of any sanitary landfill site.**
10	The By-law should provide for "restraint notices" to be served by NCC to empower CCN to prevent situations of waste mismanagement which threaten the environment or public health.	● **CCN Solid Waste Management By-law of 2007, Section 11(2)** stipulates that any officer or agent of CCN duly authorised in that behalf, may at all reasonable times, enter any residential dwelling or trade premises within the area of jurisdiction of the Council for the purpose of conducting any inspection, inquiry or the execution of works under the provisions of these By-laws. However, this section does not have a statement on "restraint notices" to be served by CCN.

No.	Related Section	Actions Recommended in New Master Plan
		● **Modification: This section should be more concretely expressed by adding the requirements of "restraint notices" to be served by CCN to prevent waste mis-management.**

Source: JICA Survey Team

(4) Legalisation of the Act for the Establishment of the SWMPC

(a) Outline

In order to establish the ring-fenced SWMPC by the end of 2014, legal arrangements for its establishment are required. Since the establishment of SWMPC will not be applied to the solid waste management services in municipalities nationwide, the legal action to establish SWMPC in Nairobi City should not be carried out only by a National Act but also by the CCN's By-law. The Act for the Establishment of Solid Waste Management Public Corporation (SWMPC) as well as the related By-law shall stipulate the missions and institutional framework of the SWMPC which will be in charge of the solid waste management services in Nairobi City.

(b) References to Water Act

In order to provide the basic legal framework for the establishment of the SWMPC, the case of the establishment of the Nairobi City Water and Sewerage Company (NSWSC) which was created in the Water Act of 2002 under the water sector reform is referred to as a similar case of the public utilities sector. The water sector reform under the Water Act 2002 includes the following five agenda: (i) the establishment of ring-fenced companies in charge of providing water services; (ii) the separation of management of water resources from the provision of water services; (iii) the separation of policy-making from day-to-day administration and regulation; (iv) the decentralisation of functions to lower-level state organs; and (v) the involvement of non-governmental entities in both the management of water resources and the provision of water services. As the basic regulatory framework for the water sector, the Water Act of 2002 established the Water Services Regulatory Board (WSRB) whose core responsibilities include licensing of providers of water services and determining the standards for the provision of water services to water consumers.

(c) Major Contents of the Act for the Establishment of SWMPC

The Act for the Establishment of SWMPC as well as the relevant By-laws should be enacted not later than 2014, since the SWMPC must be established by the end of 2014 to secure a one-year preparation period for the tendering process to start the zone-wise franchise system by the beginning of 2016. The Act is designed to provide SWMPC with authorities and powers to enforce and monitor the solid waste management services in the whole city. In accordance with the organisational structure proposed in the Organisational and Human Resources development plan, the Act for the Establishment of SWMPC should be created with reference to the Water Act which stipulates the organisational structure of the Nairobi City Water and Sewerage Company (NCWSC). The major contents of the Act would be as follows:

- Organisational Structure of SWM Public Corporation (SWMPC)
- Board Members of SWMPC
- Functions of SWMPC
- Transfer of Budgets, Assets and Employees from the DoE
- Provisions related to Officers and Employees

- Finance
- Outsourcing and Procurement

(5) Amendment of the Procurement and Disposal Act 2005

Since Section 3 of the Procurement and Disposal Act of 2005 demands that public organisations must comply with the complicated tendering procedures stipulated by the Act, Section 3 is also applicable to the SWMPC. In order to simplify the procurement procedure and achieve the procurement efficiency of the SWMPC, a special arrangement to exempt public utility corporations such as the SWMPC from the said Section 3 of the Procurement and Disposal Act is proposed. Section 3 of the Act defines a public organisation as below.

- Provision 3(a): Any body that uses public assets in any form of contractual undertaking including public private partnership
- Provision 3(b): A company owned by a public entity to carry out functions that would have otherwise been performed by the public entity
- Provision 3(c): Any body in which the Government has a controlling interest

After exempting the procurement procedures of the SWMPC from the Procurement and Disposal Act, the procurement procedures by the SWMPC should be legalised in the contractual provisions in the Act for the Establishment of SWMPC. In this case, the following two provisions should be modified to improve the efficiency of the tendering and procurement procedures.

(a) Unification of Committees in Tendering and Procurement Process

The complicated functions of the tendering committee, procurement committee, evaluation committee and inspection and acceptance committee should be simplified and unified to the new tendering committee which will function as the unified procurement and tendering committee for public organisations. The following sections include the complicated procedures for the procurement committee under the current Procurement and Disposal Act.

- Section 12(1): The accounting officer or the head of the procuring entity shall appoint an alternative member for each member of the tender committee and only the alternative shall attend meetings of the tender committee whenever the member is unable to attend.
- Section 12(2): The quorum of the tender committee shall be five members including the chairman.
- Section 12(3): Decisions of the tender committee shall be by consensus and where there is no consensus, the decision shall be through voting by simple majority and where there is a tie, the chairman shall have a second or casting vote.
- Section 12(4): Where any member of the tender committee has a direct or indirect interest in any matter, he or she shall declare his or her interest in the matter and shall not participate in the deliberations or decision-making process of the committee in relation to that particular matter.
- Section 12(5): Members of the tender committee may be paid such honoraria as the procuring entity may determine.
- Section 12(6): The tender committee shall cause to be prepared minutes of all its meetings and such records shall include:
  - (i) a register of attendance
  - (ii) date of meeting
  - (iii) list of all matters considered

(iv) the decision made for each matter, including all major issues discussed, the reasons for rejection and clarification or minor amendments to which the approval is subject

(v) a note on the basis of interest declared by members

(vi) all conflicts of interest declared by members

(vii) all dissenting opinions among tender committee members

(viii) such other records as many be necessary

- Section 12(7): The tender committee may invite independent advisers or members of the procurement unit to explain submission or provide technical advice, where required.
- Section 12(8): To enhance transparency of the procurement process, the procuring entity shall invite in addition to the representative of various departments, at least two observers to attend its meetings in cases where the value of the contract is estimated to be above fifty million shillings.
- Section 12(9): At least one of the observers invited under Provision 12 (8) shall come from a duly recognised private sector organisation or discipline relevant to the procurement under consideration.
- Section 12(10): The failure of an invited observer to attend a meeting shall not nullify the procurement proceedings.

(b) Simplification of Thresholds for Categories of Procurement

The complicated threshold for the categories of procurement under the current Procurement and Disposal Act in which the SWMPC must comply should be more simplified.

(6) Legalisation of Establishment of SWM Special Account

Currently, the solid waste management services are provided under the general-account budget of CCN. The waste collection fees go to the general budget of CCN. **Section 220 (1)** of the Local Government Fund Act stipulates that a municipal council, county council or town council may, in accordance with rules made by it with the approval of the Minister, establish a capital fund for the purpose of defraying capital expenditure and reducing outstanding debts.

This section in the Local Government Fund Act only stipulates the setting up of the special account for capital investment. Therefore, this section is required to be modified so that CCN will be able to establish the special account for the operational budget for solid waste management.

(7) Legalisation of Establishment of the SWM Capital Revolving Fund (SWMCRF) and SWM Operating Revolving Fund (SWMORF)

The establishment of the SWM Capital Revolving Fund (SWMCRF) and the SWM Operating Fund (SWMORF) should be legally documented in the provisions of the Act for the establishment of SWMPC. The SWMORF will be set up to fund the monitoring system as well as the capacity development for the ultimate purpose of improving the enforcement of the solid waste management services (Detailed explanation of the SWMORF is made in page 4-140 of this report). These funds should be positioned legally as a sort of public trust fund.

(8) Legalisation of Franchise Fee

The collection of a franchise fee from the franchisee in each zone should be legalised in the relevant section of the Act for the establishment of SWMPC. In case of developed countries, the franchise

fee ranges from 18% to 25% of the collected charges of wastes. However, taking into account the tariff level and the beneficiaries' willingness to pay in Nairobi City, the level of franchise fee is tentatively set at 15% of the collected charges of wastes. In the section of the Act, the initial level of franchise fee of 15% as well as the mechanism of updating the level of franchise fee should be stipulated.

(9) Legalisation of Operational Regulations on Subsidy Provision to Franchisees

The operational regulations on the subsidy provision to the franchisees also should be legalised in the relevant section of the Act for the establishment of SWMPC. The contents of the regulations include the target, the operational guidelines and the eligibility of the subsidy.

(a) Target of Subsidy

The SWM Capital Revolving Fund shall be designed to assist private franchisees by subsidising their investment on collection vehicles to replace the unserviceable ones and those to be additionally procured. The fund is to be allotted for investments on collection vehicles for the purpose of improving the collection and transport services in the franchised zones. Fifty percent (50%) of the franchise fees (7.5 percent of the collected charges) to be paid by the franchisees will go to the SWM Capital Revolving Fund.

(b) Operational Guidelines of Subsidy

There are several options for the operation of the SWM Capital Revolving Fund as mentioned below. Option 1 is recommendable as the optimum operational option on the use of subsidy.

Option 1: In proportion to the accumulated amount of franchise fees paid by the awarded franchisees, the cost for additional procurement and replacement of collection vehicles will be directly subsidised by SWMPC based on the application of the franchisee. (In this case, the ownership of collection vehicles belongs to the private operator.)

Option 2: To promote investment on vehicles by the private franchisee, public assistance to guarantee fees as well as interests of commercial loans for the procurement of collection vehicles will be provided to private franchisee. (In this case, the ownership of collection vehicles belongs to the private operator.)

Option 3: By utilising the SWM Capital Revolving Fund, collection vehicles will be leased out by SWMPC to private franchisees at a lower lease fee during the contract term. The lease fees paid by franchisees will be deposited in the revolving fund for future reinvestments. (In this case, the ownership of collection vehicles belongs to SWMPC.)

Figure 4.7.1 illustrates the operational flow of the SWM Capital Revolving Fund (Option 1). In addition to the operational guidelines on the subsidy provision to the private sector, the requirements to be met by a private franchisee should be stated clearly in the subsidy clauses of the SWMPC Act. These requirements should include:

- To have experience in providing collection services on any of the service zones;
- To properly pay the franchise fees in accordance with the relevant regulations;
- To submit regular performance and financial reports;
- To meet the performance requirements set by SWMPC during the contract term;
- To receive proper auditing; and
- To submit its vehicle procurement plan.

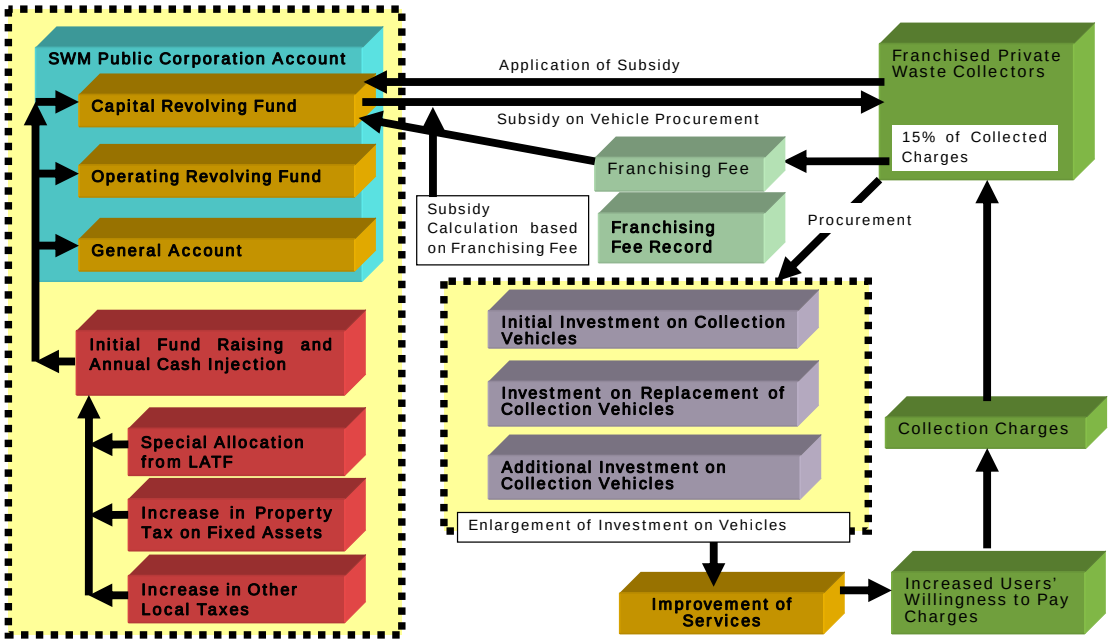


Figure 4.7.1 Proposed Workflow of the SWM Capital Revolving Fund (Option 1)

4.7.2 Mid-Term Action Plan

(1) Legalisation of the PPP Act

(a) Requirements for the Legal Framework of PPP

The Guidelines on Public-Private Partnership issued by the Public-Private Partnership Steering Committee under the Ministry of Finance in 2006 is the basic policy framework for PPP projects. Based on the understanding of the PPP Guidelines, the Department of Environment of CCN prepared the document named "Towards an Integrated Solid Waste Management System for Nairobi through Private-Public Partnership (PPP) Framework." However, the PPP guidelines as well as this document does not stipulate any specific requirement and procedure for detailed long-term PPP schemes such as concession, BOT and its related variations. In order to provide the regulatory framework for PPP projects, the Guidelines should be upgraded to the comprehensive PPP Act.

(b) Inclusion of Franchise Contract Guidelines on Collection and Transport in the Current PPP Guidelines

After selecting the franchisees for the collection services in the tendering process, the SWMPC should prepare a clear-cut contract document which would define the terms and conditions for the services. The franchise contract should basically explain the rights and obligations of the authority and the private franchisees. The franchise guidelines should include the following items.

- Contents of Services to be Rendered
- Zones and Service Coverage

- Tariff and Payment to Franchisees
- Franchise Fee
- Subsidies to Franchisees
- Performance Security
- Regulatory Framework
- Identification, Uniform and Corporate Logo
- Liability and Indemnity
- Performance Monitoring
- Auditing
- Vehicles and Equipment
- Arbitration
- Termination of Contract

(c) Inclusion of Service Contract Guidelines in the Current PPP Guidelines

After selecting the private service provider to manage of sanitary landfill site and intermediate treatment facilities in the tendering process, the SWMPC should prepare a clear-cut service contract document which should define the terms and conditions on the operational services of the facilities. The service contract should basically explain the rights and obligations of the authority and the private service providers. The guidelines for the service contract should include the following items:

- Contents of Services to be Rendered
- Payment to Service Provider
- Tipping Fee
- Performance Security
- Regulatory Framework
- Liability and Indemnity
- Performance Monitoring
- Auditing
- Vehicles and Equipment
- Arbitration
- Termination of Contract

(d) Legalisation of the Comprehensive PPP Act

The PPP guidelines as well as the document named "Towards an Integrated Solid Waste Management System for Nairobi through Private-Public Partnership (PPP) Framework" prepared by the DoE does not stipulate any specific requirement and procedure for the detailed long-term PPP schemes such as concession, BOT and its related variations.

The current PPP guidelines contain the following:

- Definitions
- Basic Procedures for Entering into Public-Private Partnership
- PPP Steering Committee
- Price of Services
- Security of Supplies
- Minimum Revenue Guarantee

- Government Guarantee
- Duration of the Public-Private Partnership
- Steps in PPP Approval
- Planning for PPP
- Transparency
- Procurement Procedures
- Contractual Provisions
- Contract Administration
- Unsolicited Bids

The above contents should be upgraded to the new PPP Act by adding the following missing provisions required for the successful implementation of PPP projects.

(i) Identification and Allocation of Risks

It is commonly said that, in a PPP contract, risks should be allocated to the party most capable of managing those risks. However, risks to the public and private sectors, including the payment mechanism based on satisfactory performance levels, should be properly defined and allocated between the contracting parties. PPP contracts related to concessions, BOT and its related variations should have a mechanism to allocate the wide range of risks among both the public sector and the private sector.

Provisions on the identification and allocation of risks should be clearly stipulated in the new PPP Act or the upgraded PPP guidelines. More specifically, the new PPP Act should include provisions in relation to the identification and allocation of risks, as follows:

- The new PPP Act should define the different risks existing in the contract and to establish the extent to which the public sector and the private sector will be held responsible for the risk;
- The Act should clearly specify which risks may cause modification of the economic terms of the contract in order to rebalance the financial terms of the contract so as to make the bidders know, at the time of preparing their offers, which specific cases may lead to changes in the contract conditions initially stated;
- The Act should conatin a provision to help avoid future renegotiations between the private contractors and the public sector arising from offers that were initially too optimistic and is an incentive to the bidders to prepare offers as realistically as possible;
- The Act should contain a provision on the reduction of demand risk by estimating, depending on the accumulated present value of the revenues finally obtained by the private contractors, the future changes in the economic conditions of the contract; and
- The Act should contain a provision regarding permission to use variables, such as the contract term, which are easy to modify in an automatic way to reestablish the economics of the contract once the bonds have been surpassed.

(ii) Reasonable Concession Term

The methodologies to determine the concession term should be clarified in the contractual provision of the new PPP Act. In case of concession, the key determinant of the concession term is the minimisation of lifecycle cost of facilities being delivered in the PPP contract. The ideal methodology is that the term should be long enough so that the concessionaire is incentivised to make efforts to keep the total costs down in designing,

operating and maintaining those facilities. Therefore, a concession term matching the useful economic life of the facilities is recommended in the new PPP Act. On the other hand, the concession term should not be so long that it adversely impacts the flexibility of the public sector in managing the facilities such as sanitary landfill sites and intermediate treatment facilities.

(iii) Clear-cut Termination Clause

A clear-cut contract termination clause is an essential prerequisite for avoiding an early termination risk of long-term PPP projects such as concessions, BOT and its variations. Therefore, the methodologies to determine the conditions of the contract termination clause should be clarified in the contract provision of the new PPP Act.

(iv) Detailed Methodology of Value for Money Analysis

The Value for Money (VfM) test or assessment is an integral part of the measurement of the cost performance of long-term PPP projects such as concessions, BOT and its variations in comparison with the implementation by the conventional public sector. Without the clear-cut methodologies of the VfM test or assessment, there would be no criteria to choose the optimum PPP option from a wide range of PPP options. The clause to stipulate the clear-cut methodologies for the VfM test or assessment should be also included in the contractual provision of the new PPP Act.

(2) Legal Arrangement of Auditing for the SWMPC and Revolving Funds

The accountability and transparency of the SWMPC as well as the revolving funds kept in the special account of SWMPC is a key to the sustainable provision of the solid waste management services. In this connection, the auditing and monitoring by the relevant authorities should be clearly stated in the provision of the SWMPC Act, and should be continuously carried out for the long period.

The Kenya National Audit Office (KENAO) is a constitutional body mandated to audit the central government, local authorities and state corporations. The KENAO is a statutory agency to provide audit services for keeping the accountability and transparency in using the public resources.

The Department of State Corporations normally carries out financial audits for state corporations. Sections 12 to 20 of the Public Audit Act stipulate the auditing of state corporations by KENAO. Since the newly established SWMPC is a sort of public corporation, KENAO is basically in a position to periodically audit the SWMPC itself. In the SWMPC Act, the acceptance of the auditing by KENAO should be indicatively stipulated. Under the same legal framework, the auditing should be also conducted for the management of the SWM Capital and Operating Revolving funds in the special account of SWMPC.

On the other hand, the Specialised Audit Department of KENAO is in charge of the auditing of other organisations in which public sources are injected. Since the private franchisees will be subsidised by the public sources, the franchisees should be also audited by the Specialised Audit Department of KENAO in terms of the subsidy utilisation and fee collections.

4.7.3 Long-Term Action Plan

(1) Legalisation of Consolidated SWM Act

The currently fragmented SWM-related acts, regulations and by-laws of the relevant authorities should be consolidated. The following organisations are to be required to form a joint committee for the formulation of the consolidated SWM Act:

- MoLG
- CCN
- MENR/NEMA
- ODPM/MOF
- MoPH
- Other Relevant Line Ministries

(2) Long-Term Monitoring and Enforcement of SWM-related Acts, Regulations and By-Laws

A long-term and periodical performance monitoring and assessment on the enforcement status of the SWM-related acts, regulations and by-laws is required for the sustainable legal and institutional reform. The long-term review of these monitoring processes on the enforcement status of the SWM-related legal framework should have a feedback mechanism to modify the SWM-related Acts, Regulations and By-laws.

4.8 Financial Management Plan

4.8.1 Financial Analysis on the Solid Waste Management Public Corporation

(1) Setup of Alternatives

As mentioned in **Subsection 4.5.2**, two alternatives are set up for the financial simulation regarding the final landfill site and waste collection system, as follows:

Case-A: The final landfill site (Ruai) and the direct haul system for waste collection/transportation

Case-B: The final landfill site (Ruai) and the transfer transport system for waste collection/transportation.

(2) Basic Assumptions

The basic conditions are set up for the cases, as follows:

(a) Waste Charge Level of Households

The proposed waste charging system for households will be established in 2016. **Table 4.8.1** shows the relationship among the O&M cost and the total cost of the project, willingness to pay (WTP) and the affordability to pay (ATP). The O&M cost and total cost of the collection/transportation system of the project are converted to cost per month and per household. WTP and ATP are based on the Public Awareness Survey by the JICA Survey Team and the existing conditions of private companies are based on the interview survey by the JICA Survey Team. Three scenarios of waste charge level by income level are set up by taking account of the willingness to Pay (WTP), the affordability to pay (ATP), the existing conditions of private companies. WTP and ATP are based on the Public Awareness Survey by

JICA Survey Team and the existing conditions of private companies are based on the interview survey by the JICA Survey Team.

Table 4.8.1 Relationship among O&M Cost, Total Cost of the Project, and the WTP and ATP

Transportation System	Income Level	O&M Cost of the Project (KSh/HH/month)	Total Cost of the Project (KSh/HH/month)	WTP (KSh/HH/month)	ATP (KSh/HH/month)
Direct Haul	Low	31	56	20	293
	Middle	41	75	35	329
	High	83	151	145	906
Transfer Station	Low	33	81	20	293
	Middle	44	108	35	329
	High	89	217	145	906
Average	Low	32	68	20	293
	Middle	43	91	35	329
	High	86	184	145	906

Source: 1 WTP and ATP are based on the Public Awareness Survey by the JICA Survey Team.
2. O&M cost and total cost of the project are based on the project cost by the collection/transportation system and total collected waste amounts during 2010~2030 and amounts waste generation per capita per day.

Table 4.8.2 Scenarios of Waste Charge for Households by Income Level

Scenario	Income Level	Waste Charge Level (KSh/Household)	Collection Rate (%)
Low	Low	60	30
	Middle	150	40
	High	300	50
Medium	Low	120	40
	Middle	250	50
	High	500	60
High	Low	170	50
	Middle	300	60
	High	650	70
Existing Charge Level of Private Companies	Slum	7 to 100	30 to 90
	Low	100 to 200	
	Middle	200 to 300	
	High	300 to 700	

Note: 1. Existing charge level of private companies is based on the survey conducted by the CCN.
2. Collection rate of existing charge is assumed by the JICA Survey Team.
Source: JICA Survey Team

(b) Waste Charge Level of Business Establishments

No data on willingness to pay and affordability to pay was available for the business establishment awareness survey conducted by the JICA Survey Team. Therefore, the willingness to pay and the affordability to pay are not considered for business establishments. The waste charge level of business establishments is set up on the basis of the operation and maintenance per ton. This waste charge level is assumed to increase at the same rate of 5% per annum per capita GRDP of Nairobi City.

(c) Tipping Fees

It is assumed that the average unit rate of existing tipping fees is assumed to be KSh 35 per ton of disposed waste during 2011 to 2016. After the Ruai landfill site is completed in the year 2017, tipping fees are estimated to be 164 KSh/ton on the basis of total amount of disposed

waste (9.5 million tons) and the O&M cost of the Ruai landfill site during the period from 2017 to 2030.

(d) Financial Sources

The financial sources of investment on the final disposal site, transfer station and trucks, the replacement and purchase of new trucks for the CCN/SWMPC, and the intermediate treatment facilities and the closure of Dandora Dumpsite including illegal dumping sites during 2015 to 2019 are assumed to be a loan from an international financial institution with the following conditions:

- Repayment Period : 40 years
- Grace Period : 10 years
- Interest Rate : 0.55% per year

(e) Depreciation

The depreciation of assets to be invested is calculated by the straight line method based on the economic life of the asset.

- Intermediate Treatment Facilities : 26 years (3.8%)
- Transfer Station : 26 years (3.8%)
- Final Disposal Site : 15 years (6.7%)
- Heavy Machine : 5 years (10%)
- Truck : 10 years (10%)
- Container : 5 years (20%)

The residual values of fixed assets mentioned above are considered to be zero in accordance with the accounting system of CCN. In the accounting system in Japan, 10% of fixed assets are considered to be the residual values, but the residual values acquired after 2007 were abolished by amendment of the Tax Law in 2007. In the project evaluation, residual values which are not yet depreciated in the last year of project evaluation period (2011 to 2030) for calculation of EIRR and FIRR are considered to be negligible and is not included in the project cost, because these residual values are discounted for the present value.

(f) Capital Revolving Fund

The Capital Revolving Fund is to be established to finance the investments on trucks by the private companies, to replace the trucks after 2016, and to purchase new trucks to cope with the increase of collected wastes by 2030. The source of funds may be the following three:

(i) The Franchise Fees (15% of revenues from waste charges to be collected by the private companies)

Fifty percent (50%) of Franchise Fees will finance the cash shortages of private companies and other 50% will finance the cash shortages of the CCN/SWMPC.

(ii) Subsidies from the Central Government such as the Local Authority Transfer Funds (LATF) and the Constituency Development Fund (CDF)

(iii) Taxes or Funds from the CCN such as the land and building taxes

(3) Simulation of Financial Viability of the SWMPC

(a) Case of Simulation

The simulation was conducted for six cases as shown in the following table.

Table 4.8.3 Cases of Financial Simulation for SWMPC

Case No.	Final Landfill Site and Waste Collection &Transportation System		Waste Charge Level				Financial Sources for Initial Investment
	Case-A	Case-B	Household			Business Establishment	
			Low	Medium	High	O&M Cost	Loan
A.1	●		●			●	●
A.2	●			●		●	●
A.3	●				●	●	●
B.1		●	●			●	●
B.2		●		●		●	●
B.3		●			●	●	●

Source: JICA Survey Team

(b) Result of Simulation

(i) CCN/SWMPC

The summary of simulation for CCN/SWMPC is shown in **Table 4.8.3**. From the comparison mentioned above, Case-A, or the direct haul to the final landfill site at Ruai, shows a slightly less deficit than Case-B, or the construction of a transfer station, in the profit and loss, and has definitely less shortage of cash than Case-B.

Tables 4.8.4 and 4.8.5, and Figures 4.8.1 and 4.8.2 show the results of simulation of cash flow for both Case-A.2 and Case-B.2. As shown in **Table 4.8.5**, the surplus is figured out mainly before the commencement of the SWMPC from 2011 to 2015. During this period, the cash shortages will increase from KSh 299 million to KSh 602 million, which is after 50% subsidisation from the franchise fees paid by the private companies.

Most expenses are occupied by the investments, which is around KSh 115 million to KSh 2,089 million, followed by the contractout payables to private companies of KSh 179 million to KSh 237 million. However, the contractout payables to private companies are budgeted every year by the CCN and the amounts of this item would not increase to more than KSh 200 million because the waste collection area of the SWMPC or the CCN/SWMPC Zone and the waste collection area of the private companies as the franchisees are projected not to increase in the preceding five years even if the collection rate would increase to 100% at the target year 2030. On the other hand, the most of the investments from 2011 to 2015 would be offsetted by the loan and the net cash shortages, therefore, woud be reduced accordingly.

Besides, amounts from the Local Authority Transfer Fund (LATF) are subsidised regularly every year to the CCN. The amounts from the LATF to the CCN are from KSh 1.4 billion in 2007-2008 to KSh 1.5 billion in 2008-2009, a slight increase, and the amount would not drastically decrease in the future. Based on the budget for 2010/2011, the capital expenditure must be at least 65% of the LATF service delivery amount, i.e., at least Ksh 870 million. Since sixty-five percent (65%) of KSh 870 million would be

KSh 565 million, the amounts of cash shortages except the contractout payables to private companies would range from KSh 119 million to KSh 365 million.

If the cash shortages are to be subsidised from the LATF, around 21% to 65% of the LATF could cover the cash shortages. If the total cash shortages could not be subsidised from the LATF, the other sources that could be considered are the revenues from property rates or the land rates (taxes) that occupy around 20% to 35% of the revenue of CCN and estimated to be KSh 1.9 billion in 2007-2008 and KSh 2.4 billion in 2011-2012. If 50% of the annual cash shortages of KSh 60 million to KSh 180 million could be subsidised from the the above revenue from the property rates or land rates, the amounts that could be subsidised are from around 3.2% (KSh 0.06 billion/KSh 1.9 billion) to 7.5% (KSh 0.18 billion/ KSh 2.4 billion).

On the other hand, if the LATF would not have enough allowance to subsidise the cash shortages of the CCN/SWMPC because of other departments having higher subsidisation priority, the CTF (Constituency Development Fund) could be another option as the source of subsidisation for the cash shortages of the CCN/SWMPC.

Based on the above explanations, it is concluded that it is definitely possible to subsidise the cash shortages of the CCN/SWMPC during the period from 2011 to 2015 from the central and local sources.

After 2015, the cash shortages are figured out as less than KSh 200 million except 2025 as Ksh 727 million. These cash shortages except 2025 could be also reduced by offsetting from the SWMPC budget for contractout payables. Then, the net cash shortages would be KSh 508 million in 2025 which could be subsidised from the central source such as the LATF and the local source of the CCN such as the property rates or land rates.

It is projected that there will still be a deficit in 2030, the last year of the new Master Plan. However, after 2030, the deficit would decrease mainly because the revenue from waste charges, tipping fees and franchise fees would continue to increase and would be more than the increase of the investment and O&M cost. Besides, the contractout payables to private companies would not much increase due to the decrease of waste collection area to only the CCN/SWMPC zone, and the loan repayment would not also increase to more than KSh 229 million.

Table 4.8.6 shows the result of projection of cash flow for Case-B.2, the transfer-transport system. In this case the cash flow would be negative showing cash shortages in almost every year mainly because of increase of cost such as investment, O&M and loan repayment. The subsidies after offsetting of the contractout payables to private companies by the budget of the CCN/SWMPC would be financed from the LATF and the revenue from property rates or land rates of the CCN. The net cash shortages after offsetting of the contractout payables would range from KSh 40 million to KSh 890 million during the period from 2011 to 2030. The maximum cash shortage of KSh 890 million is around two times of that of Case-A.2 and would be over the total amount of the LATF of KSh 565 million which is 65% of the LATF service delivery amount, i.e., KSh 870 million, at least. Therefore, other sources of subsidy will be indispensable, such as the revenue from property rates (land rates) of the CCN. It is possible to subsidise the cash shortages from the CCN budget but the financial burden of CCN would be more than in Case-A.2. Therefore, from the viewpoint of less financial burden to the LATF or the CCN, Case-A.2 could be more effective and financially viable than Case-B.2.

The results of projection of profit and loss statements for Case-A.1~3, and Case-B.1~3 are shown in **Table 1.1.1~1.1.3** and **Table 1.2.1~1.2.3** and the cash flow for Case-A.1 and

A.3 and Case-B.1~3 are shown in **Table 1.3.1~1.3.2** and **Table 1.4.1~.1.4.3** in **Section H of Volume 4, Data Book**, respectively.

Table 4.8.4 Summary of Cash Flow Simulation for CCN/SWMPC

(Unit: in Million KSh)

Case No.	P&L (Profit & Loss)		Cash Flow	
	Net Profit/Loss after Depreciation	Accumulated Net Profit/ Loss after Depreciation	Surplus/Deficit	Accumulated Surplus/Deficit
A.1	Deficit: 2011-2030	2030: -8,844	2023: Deficit	2030: -10,832
A.2	Deficit: 2011-2015, 2026-2028	2030: 762	2017-2018, 2020, 2022-2023, 2026, 2029-2030: Surplus	2030: -1,226
A.3	Deficit: 2011-2015	2030: 11,301	2011-2015: Shortage	2030: 9,314
B.1	Deficit: 2011-2030	2030: -19,535	2011-2030: Shortage	2030: -16,264
B.2	Deficit: 2011-2030	2030: -9,930	2017-2018, 2020, 2022-2023: Surplus	2030: -6,659
B.3	Deficit: 2011-2015, 2017-2018, 2021, 2026-2027	2030: 609	2011-2015, 2021, 2025: Shortage	2030: 3,880

Source: JICA Survey Team

Table 4.8.5 Projection of Cash Flow of CCN/SWMPC: Medium Scenario for Case-A (Case-A.2)

(Unit : in Million KSh)

Year	Cash Inflow						Cash Outflow						Surplus	Accumulated Surplus
	Loan	Waste Charges		Tipping Fees	Franchi-se Fees	Total	Invest-ment	O&M Cost	Loan Repay-ment	Loan Interests	Contract-Out Payables to Private Company	Total		
		House-hold	Business Establish-ment											
2011	0	0	21	8	0	29	115	33	0	0	179	328	-299	-299
2012	3	0	22	9	0	34	159	43	0	0	193	396	-361	-660
2013	247	0	24	9	0	280	594	44	0	0	207	845	-565	-1,225
2014	31	0	25	10	0	66	186	143	0	1	221	552	-486	-1,710
2015	1,839	0	27	11	0	1,877	2,089	151	0	2	237	2,479	-602	-2,312
2016	2,794	549	15	50	23	3,431	2,986	307	0	12	142	3,447	-16	-2,328
2017	1,631	657	16	54	27	2,385	1,813	208	0	27	156	2,205	180	-2,148
2018	234	768	17	59	30	1,108	271	231	0	36	171	709	399	-1,749
2019	99	895	18	63	34	1,110	648	251	0	37	186	1,122	-12	-1,761
2020	0	1,037	20	68	39	1,164	232	270	0	38	202	742	422	-1,339
2021	0	745	17	79	91	932	510	347	0	38	153	1,048	-116	-1,455
2022	0	876	18	86	104	1,084	81	308	0	38	169	596	488	-967
2023	0	1,022	19	93	119	1,254	573	326	8	38	185	1,130	124	-843
2024	0	1,190	21	101	136	1,448	1,025	346	9	38	201	1,619	-171	-1,014
2025	0	1,379	22	109	155	1,665	1,700	366	71	38	219	2,392	-727	-1,742
2026	0	775	19	122	253	1,169	7	460	164	37	158	827	342	-1,399
2027	0	902	20	131	286	1,339	334	712	218	36	171	1,471	-132	-1,531
2028	0	1,044	22	139	321	1,526	377	754	226	35	185	1,576	-50	-1,581
2029	0	1,206	23	148	361	1,738	335	798	229	34	199	1,595	143	-1,439
2030	0	1,390	24	158	406	1,978	445	845	229	33	214	1,766	212	-1,226

Source: JICA Survey Team

Table 4.8.6 Projection of Cash Flow of CCN/SWMPC: Medium Scenario for Case-B (Case-B.2)

(Unit : in Million KSh)

Year	Cash Inflow						Cash Outflow						Surplus	Accumulated Surplus
	Loan	Waste Charges		Tipping Fees	Franchi-se Fees	Total	Invest-ment	O&M Cost	Loan Repay-ment	Loan Interests	Contract-Out Payables to Private Company	Total		
		House-hold	Business Establish-ment											
2011	0	0	22	8	0	31	115	33	0	0	179	328	-297	-297
2012	3	0	24	9	0	36	159	43	0	0	193	396	-360	-657
2013	353	0	25	9	0	388	710	44	0	2	207	963	-576	-1,232
2014	137	0	27	10	0	174	302	140	0	3	221	666	-492	-1,725
2015	3,138	0	28	11	0	3,177	3,518	148	0	20	237	3,922	-744	-2,469
2016	4,990	549	16	50	23	5,627	5,401	303	0	47	142	5,893	-266	-2,735
2017	1,631	657	17	54	27	2,386	1,813	269	0	56	156	2,295	91	-2,644
2018	234	768	18	59	30	1,110	271	297	0	58	171	796	313	-2,330
2019	99	895	20	63	34	1,112	647	321	0	58	186	1,213	-101	-2,432
2020	0	1,037	21	68	39	1,165	292	347	0	58	202	899	267	-2,165
2021	0	745	18	79	91	933	1,170	431	0	58	153	1,813	-880	-3,045
2022	0	876	19	86	105	1,086	81	398	12	58	169	718	368	-2,677
2023	0	1,022	21	93	119	1,256	571	425	16	58	185	1,255	1	-2,676
2024	0	1,190	22	101	136	1,449	1,023	452	121	58	201	1,856	-406	-3,082
2025	0	1,379	24	109	155	1,667	1,733	480	287	57	219	2,777	-1,110	-4,192
2026	0	775	20	122	254	1,171	701	581	342	56	158	1,838	-667	-4,859
2027	0	902	22	131	286	1,341	367	841	350	54	171	1,782	-441	-5,300
2028	0	1,044	23	139	322	1,528	410	891	353	52	185	1,890	-362	-5,662
2029	0	1,206	24	148	362	1,740	433	945	353	50	199	1,980	-239	-5,901
2030	0	1,390	26	158	406	1,981	1,123	1,000	353	48	214	2,738	-758	-6,659

Source : JICA Survey Team

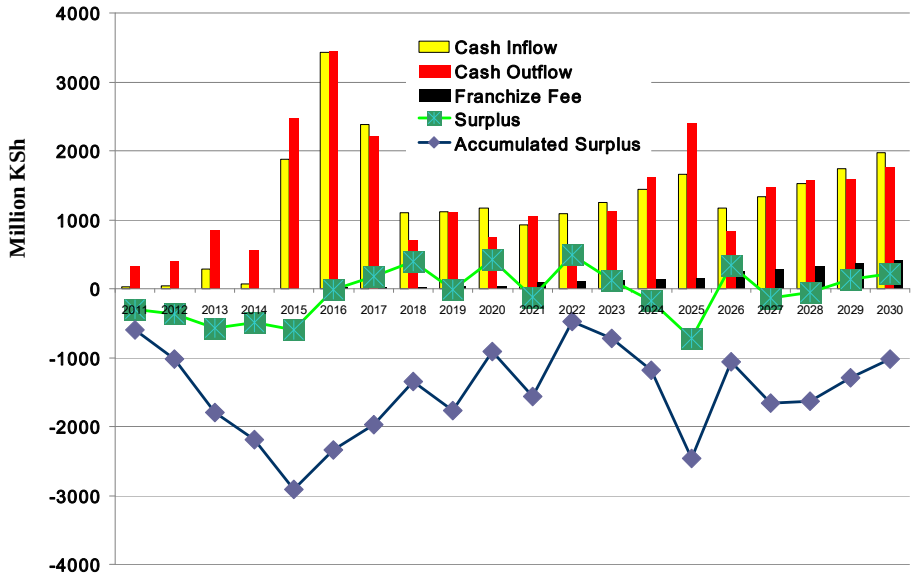


Figure 4.8.1 Projection of Cash Flow of CCN/SWMPC: Medium Scenario for Case-A (Case-A.2)

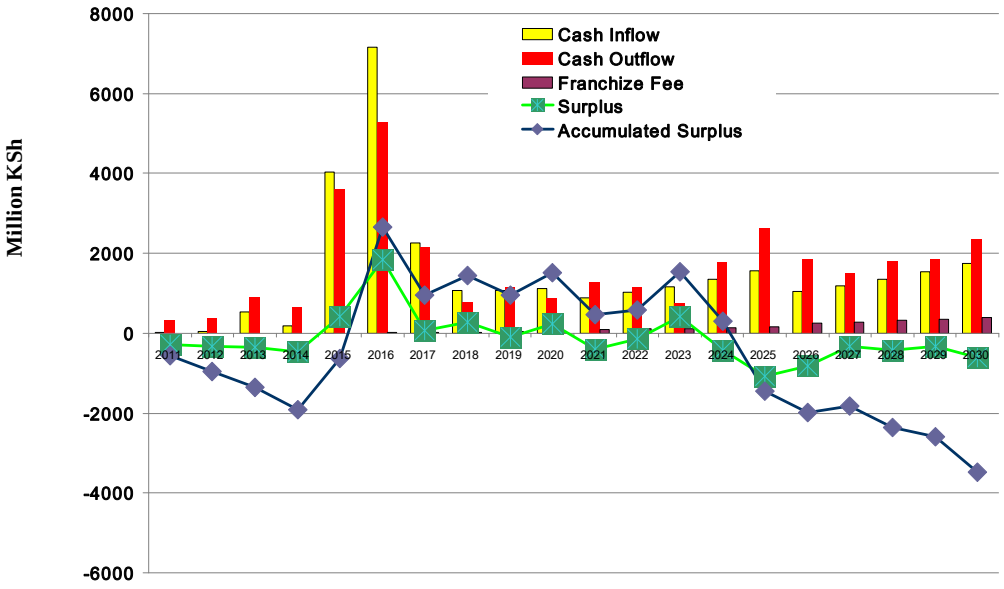


Figure 4.8.2 Projection of Cash Flow of CCN/SWMPC: Medium Scenario for Case-B (Case-B.2)

(ii) Private Company

The summary of the simulation for private companies is shown in **Table 4.8.7**. For private companies, the projection of profit and loss shows that the net profit after depreciation for all cases would be generated during the whole period from 2016 to 2030 and the accumulated net profit after depreciation are generated as big amounts from around KSh 7 billion to KSh 34 billion. All cases of Case-B have relatively higher accumulated net profits after depreciation than all cases of Case-A. With regard to cash flow, the amounts of cash shortages of Case-B are relatively less than those of Case-A. The accumulated surplus of all cases of Case-B is also more than those of Case-A.

Regarding cross-subsidisation between income level for intrazone, Zones 1, 5, 7 and 9 of Case-A.1, Case-A-2, Case-B.1 and Case-B.2 show many years for subsidisation, especially, if Zones 1 and 9 will be integrated into the franchise system in the first year of establishment of the SWMPC in 2016 and hence the collection rate of wastes will be lower than the years after 2016. Therefore, the revenue from waste charges is not enough to recover the O&M cost. However, as long as the collection rate of waste would increase, cross-subsidisation is expected to be minimised. Case-A.3 shows that there is no need for subsidisation, but Case-B.3 shows that cross-subsidisation is needed in 2017 for Zone 1.

From the comparison mentioned above, Case-B shows a relatively better financial performance than Case-A both for profit and loss and cash flow. However, this difference is neither significant nor decisive to select one of the two alternatives. The main reason of the relatively better performance of Case-B could be the less O&M and investment costs than in Case-A.

The results of projection of the profit and loss statement for Case-A.1~3 and Case-B.1~3 are shown in **Table 1.1.4~1.1.6** and **Table 1.2.4~1.2.6** and the cash flow for Case-A.1~3 and Case-B.1~3 are shown in **Table 1.3.3~1.3.5**, and **Table 1.4.4~1.4.6**. The results of projection for the cross-subsidy intrazone are shown in **Table 1.5.1~1.5.3** for Case-A.2

and in **Table 1.6.1~1.6.3** for Case-B.2 in **Section H of Volume 4, Data Book**, respectively.

Table 4.8.7 Summary of Simulation for Private Companies (9 Zones)

(Unit: in Million KSh)

Case No.	P&L (Profit & Loss)		Cash Flow		Years of Cross Subsidy
	Net Profit after Depreciation	Accumulated Net Profit after Depreciation	Surplus/Deficit	Accumulated Surplus	
A.1	2016-2030: Net Profit	2016-2030: 7,579	2015: -207 2020: -148 2025: -234	2030: 7,394	Zone 1: 2016-2017, 019-2023 Zone 5 : 2021-2022 Zone 7: 2021-2022 Zone 9: 2016-2022
A.2	2016-2030: Net Profit	2016-2030: 20,750	2015: -207	2030: 16,436	Zone 1: 2016-2017 Zone 5: 2021 Zone 7: 2021-2023 Zone 9: 2018-2019
A.3	2016-2030: Net Profit	2016-2030: 33,566	2015: -207	2030: 20,565	No Need to Subsidies
B.1	2016-2030: Net Profit	2016-2030: 8,497	2015: -187 2020: -87 2025: -115	2030: 8,188	Zone 1: 2016-2023 Zone 5: 2021-2022 Zone 7: 2021-2023 Zone 9: 2016-2023
B.2	2016-2030: Net Profit	2016-2030: 21,668	2015: -187	2030: 21,398	Zone 1: 2016-2017 Zone 9: 2018-2022
B.3	2016-2030: Net Profit	2016-2030: 34,484	2015: -187	2030: 34,247	Zone 1: 2017

Source : JICA Survey Team

4.8.2 Value for Money (VfM) Analysis

(1) Basic Conditions

(a) Alternative Forms of SWM

The following three alternative forms of solid waste management have been studied based on the Value for Money (VfM) method:

(i) Direct SWM by the CCN (the Public Sector Comparator: PSC)

(ii) Existing Solid Waste Management (Direct SWM by the CCN and Contractout)

(iii) Solid Waste Management Public Corporation (SWMPC)

(b) Unit Rate of O&M Cost

In this survey, the operation and maintenance (O&M) cost is compared among the three forms of SWM as presented in **Table 4.8.8**. The unit cost of O&M is estimated at KSh 1,303 per ton for contractout, KSh 1,384 for SWMPC and KSh 2,064 for CCN. The O&M unit cost for CCN is about 1.6 times that of the contractout option.

Table 4.8.8 Unit Cost of O&M by Form of SWM

(Unit: KSh)

Items		CCN Direct	Contract-out	SWMPC
1)	**Direct Costs**			
	Driver's salary per day	1,300	1,000	1,100
	Labourer's salary per day 4 Labourer	3,780	2,000	2,200
	Fuel per day	700	700	700
	Average service & maintenance costs (per day)	1,000	1,000	1,000
	Insurance per day	100	100	100
	Total direct costs	6,880	4,800	5,100
	Average tonnage per trip	5	7	7
	Average No. of trips per day	2	2	2
	Average tonnage per day	10	14	14
	Total direct costs per ton	688	343	364
2)	**Indirect Costs**			
	Administrative costs: 20% of direct costs	1376	960	1020
	Total indirect costs per ton	2,064	1,303	1,384

Source: Solid Waste Management Section of Department of Environment and Private Companies

(c) Waste Charge Level and Collection Rate of Waste Charge

The waste charge level is set by income level in the Medium Scenario for the new zones in the franchise system in the simulation analysis for the CCN/SWMPC, as shown in **Table 4.8.9**.

Table 4.8.9 Waste Charge Level and Collection Rate of Waste Charge

Income Level	Waste Charge (KSh/month/HH)	Collection Rate of Waste Charge (%)
Low	100	30
Middle	300	40
High	500	50

Source : JICA Survey Team

(d) Tipping Fees

Tipping fees is assumed as KSh 35 per ton of carried waste in 2016 and KSh 164 per ton from 2017 to 2030, the same as in the simulation analysis for the CCN/SWMPC.

(2) Result of Analysis

(a) Comparison of Operating Ratio

The projections of cash flow of each alternative form are given in **Tables 4.8.10, 4.8.11 and 4.8.12**. The operating ratio (OR) indicates the O&M cost of KSh 100 to get revenue.

Therefore, the lesser is the ratio, the lesser is the cost to get the revenue of KSh 100. In other words, the less operating ratio is more profitable.

As for the OR of the CCN (Direct) as the public sector comparator, the OR would decrease from 92 in 2016 to 43 in 2030, as shown in **Table 4.8.10**. On the other hand, as presented in **Table 4.8.11**, the OR of the existing SWM would decrease from 57 in 2016 to 28 in 2030 and then indicates the less O&M cost than that of the CCN (Direct) as the PSC.

However, the OR of SWMPC is more than the other two forms of SWM. One of the main reasons is that the private companies would be integrated into new zones (three zones in 2016) and into nine zones in 2030, and then the waste collection area of the CCN would be limited to the CCN Zone which is mostly occupied by the low income area where revenue from waste is relatively less.

(b) Comparison of O&M Cost

Table 4.8.13 shows the comparison of indices of O&M cost among the three forms of SWM to set up the indices of the CCN (Direct) as 100.0 of PSC. Indices of the existing SWM would be constant at 51.0 during the whole period because its collection area would not change and the increase rate of waste would be the same. However, the indices of SWMPC would gradually fall because the collection area would be limited to the CCN Zone, so that the O&M cost for waste collection is projected to decrease.

It could be concluded that the cost efficiency of SWMPC is less than the other forms of SWM but its O&M costs are less. Therefore, the form of public corporation would mitigate the financial burden of SWMPC and the Central Government as the agency to subsidise the cash shortage of SWMPC.

Table 4.8.10 Projection of Cash Flow of CCN (Direct) as PSC

(Unit: in Million KSh)

Year	Revenue			O&M Cost	Surplus	Accumulated Surplus	Operating Ratio(%) O&M Cost/Revenue)
	Waste Charges		Total				
	Household	Business Establishment					
2016	728.0	88.6	816.6	752.3	64.3	64.3	92
2017	844.6	95.3	939.9	820.4	119.6	183.9	87
2018	973.8	102.2	1,076.0	890.7	185.3	369.2	83
2019	1,121.6	109.6	1,231.2	965.4	265.8	635.0	78
2020	1,285.0	116.9	1,401.9	1,040.1	361.8	996.8	74
2021	1,487.8	126.1	1,613.8	1,135.5	478.3	1,475.1	70
2022	1,719.8	135.8	1,855.7	1,237.4	618.3	2,093.4	67
2023	1,977.1	145.7	2,122.8	1,340.5	782.3	2,875.7	63
2024	2,270.6	156.2	2,426.7	1,450.3	976.5	3,852.2	60
2025	2,599.9	167.0	2,766.9	1,564.0	1,202.9	5,055.1	57
2026	2,944.0	177.5	3,121.5	1,673.7	1,447.8	6,502.9	54
2027	3,333.4	188.6	3,522.0	1,790.3	1,731.7	8,234.6	51
2028	3,760.4	199.7	3,960.2	1,907.4	2,052.8	10,287.3	48
2029	4,242.4	211.6	4,454.0	2,031.8	2,422.2	12,709.6	46
2030	4,786.2	224.1	5,010.3	2,163.7	2,846.7	15,556.2	43

Source : JICA Survey Team

Table 4.8.11 Projection of Cash Flow of Existing SWM: CCN (Direct & Contractout)

(Unit: in Million KSh)

Year	Revenue				O&M Cost	Surplus	Accumulated Surplus	Operating Ratio (O&M Cost/Revenue) x 100
	Waste Charges		Tipping Fees	Total				
	Household	Business Establishment						
2016	570.0	88.6	11.9	670.5	385.4	285.1	285.1	57
2017	661.3	95.3	13.0	769.6	420.3	349.3	634.4	55
2018	762.4	102.2	14.1	878.8	456.3	422.4	1,056.9	52
2019	878.2	109.6	15.3	1,003.1	494.6	508.5	1,565.4	49
2020	1,006.2	116.9	16.4	1,139.5	532.9	606.7	2,172.0	47
2021	1,164.9	126.1	17.9	1,308.9	581.8	727.1	2,899.2	44
2022	1,346.6	135.8	19.6	1,502.0	633.9	868.1	3,767.2	42
2023	1,548.1	145.7	21.2	1,715.0	686.8	1,028.2	4,795.4	40
2024	1,777.9	156.2	22.9	1,956.9	743.0	1,213.9	6,009.4	38
2025	2,035.7	167.0	24.7	2,227.5	801.3	1,426.2	7,435.6	36
2026	2,305.1	177.5	26.5	2,509.1	857.5	1,651.6	9,087.2	34
2027	2,610.0	188.6	28.3	2,826.9	917.2	1,909.7	10,996.9	32
2028	2,944.4	199.7	30.1	3,174.3	977.2	2,197.1	13,194.0	31
2029	3,321.8	211.6	32.1	3,565.5	1,040.9	2,524.6	15,718.6	29
2030	3,747.6	224.1	34.2	4,005.9	1,108.5	2,897.4	18,616.0	28

Source : JICA Survey Team

Table 4.8.12 Projection of Cash Flow of SWMPC

(Unit: in Million KSh)

Year	Revenue				O&M Cost	Surplus	Accumulated Surplus	Operating Ratio (O&M Cost/Revenue) x 100
	Waste Charges		Tipping Fees	Total				
	Household	Business Establishment						
2016	401.8	33.4	49.6	484.8	270.2	214.6	214.6	56
2017	469.1	35.9	54.1	559.1	296.9	262.2	476.8	53
2018	542.8	38.5	58.6	639.9	324.5	315.4	792.2	51
2019	627.3	41.3	63.5	732.0	353.9	378.1	1,170.3	48
2020	720.8	44.0	68.3	833.1	383.3	449.8	1,620.0	46
2021	445.9	47.5	79.4	572.7	291.5	281.3	1,901.3	51
2022	518.6	51.2	86.4	656.1	320.8	335.3	2,236.6	49
2023	599.4	54.9	93.5	747.8	350.7	397.1	2,633.7	47
2024	691.8	58.8	101.0	851.6	382.5	469.1	3,102.8	45
2025	795.7	62.9	108.8	967.4	415.5	551.9	3,654.7	43
2026	143.8	66.8	122.0	332.6	299.4	33.2	3,687.9	90
2027	167.5	71.0	131.0	369.6	324.8	44.7	3,732.6	88
2028	193.8	75.2	139.5	408.5	350.6	58.0	3,790.6	86
2029	223.9	79.7	148.5	452.0	377.9	74.1	3,864.7	84
2030	258.1	84.4	158.0	500.4	406.8	93.6	3,958.3	81

Source : JICA Survey Team

Table 4.8.13 Comparison of O&M Cost by Form of SWM

Year	PSC (CCN: Direct)	Existing SWM	SWMPC
2016	100.0	51.2	35.9
2017	100.0	51.2	36.2
2018	100.0	51.2	36.4
2019	100.0	51.2	36.7
2020	100.0	51.2	36.9
2021	100.0	51.2	25.7
2022	100.0	51.2	25.9
2023	100.0	51.2	26.2
2024	100.0	51.2	26.4
2025	100.0	51.2	26.6
2026	100.0	51.2	17.9
2027	100.0	51.2	18.1
2028	100.0	51.2	18.4
2029	100.0	51.2	18.6
2030	100.0	51.2	18.8

Source : JICA Survey Team

4.8.3 Improvement of Waste Charge System

(1) Alternatives of Waste Charge System

The waste charge level is closely related to the waste charge system. The representative alternatives of waste charging system are as described below.

(a) Fixed Pricing

Fixed pricing system is simple and easy for the collection of waste charges. It is also better for the slum and low income areas in order to eradicate illegal dumping as long as the charge level is appropriate by taking higher priority on the willingness to pay and the affordability to pay.

(b) Unit Pricing

Unit pricing is called the marginal pricing or variable-rate pricing and is applied by many countries including Japan and the USA. According to the survey in the year 2009, 384 out of the 418 cities of Japan (91.8%) are adopting the unit pricing system. In the USA, many cities have been adopting this system. This system is well known as “Pay-As-You-Throw” (PAYT).

(c) Fixed and Unit Pricing

This system has both the characteristics of fixed pricing and unit pricing. It has both the merits of stability of revenue by the fixed system and of the increase of revenue by the variable rate system.

(d) Free and Unit Pricing

This system also has both characteristics of the fixed pricing and the unit pricing, but this system has an advantage in that the charge is free for some amounts of waste. This system is effective for the lower income inhabitants including the slum inhabitants.

(e) Two-Step Unit Pricing

This system is the advanced system of unit pricing because the unit rate is set higher for some amounts of waste. As long as the waste will increase by approximately proportional to the income level, the low income inhabitants will pay the lower unit rate of waste charge and the fairness of charge by income level is likewise secured.

(2) Waste Charge Level

(a) Household

(i) Slum Area

The level of waste charge in the slum area would be set up basically on the basis of the fixed pricing system which is referred to the willingness to pay because the affordability to pay is very low and it is possible to stop illegal dumping by setting the waste charge based on the willingness to pay (WTP). According to the public awareness survey conducted by the JICA Survey Team, the average WTP of slum areas is KSh 8 per month and the average affordability to pay (ATP) is KSh 90 per month, i.e., the ATP is much higher than the WTP. The actual waste charge should be based on the results of a detailed survey for each zone. The shortage of revenue for the O&M cost would be subsidised by revenue from the higher income area.

(ii) Low Income Area

The level of waste charge in the low income area would be set up on the basis the fixed pricing system which is referred to the WTP and the ATP. According to the public awareness survey, the average WTP and the average ATP of the low income area are KSh 32 per month and KSh 153 per month respectively. The actual waste charge would be set up between the WTP and the ATP based on the detailed survey for each zone. The shortage of revenue for the O&M cost would be subsidised by the revenue from the higher income area.

(iii) Middle Income Area

The level of waste charge in the middle income area would be set up basically on the basis of the unit pricing system which is referred to the O&M cost but is necessary to compare or refer to the WTP and the ATP. The public awareness survey shows the average WTP is KSh 96 per month and KSh 769 per month respectively. If the WTP or the ATP is higher than the O&M cost, the waste charge should be set up on the basis of the WTP or the ATP. The actual waste charge would be set up on the basis of the detailed survey for each zone. The surplus of revenue to the O&M cost would be subsidised to the lower income area in each zone.

(iv) High Income Area

The level of waste charge in the high income area would be set up on the basis of the unit pricing system which is referred to the O&M cost and if the WTP or the ATP is higher than the O&M cost, the WTP or the ATP must be set up as the waste charge. The result of the public awareness survey shows that the average WTP and the average ATP are KSh 193 per month and KSh 1,017 per month respectively. The surplus of revenue to the O&M cost would be subsidised to the lower income area in each zone.

It may be possible to identify the income level of an area by referring to the survey result of the World Bank and the opinions of staffs of CCN. The appropriate charging system

would then be selected on the basis of observation of the actual condition of residential areas to be charged.

(b) Business Establishment

The waste charge for establishments including markets and institutions would be set up on the basis of the O&M cost. The willingness to pay (WTP) is unusual for the waste charge because the WTP is estimated on the basis of the individual will and it is also difficult to estimate the establishments' willingness to pay of because a business entity is composed of a group of workers. On the other hand, their ATP is tangible by the estimate of their disposable income. Therefore, the ATP would be estimated on the basis of survey on the structure of monthly expenditure by main item including obligatory expenditures such as tax, social insurance and so on. ATP would be estimated by comparison with other public charges for water, sewerage, gas and electricity. It is assumed that business establishments might have the ATP to cover the O&M cost. The surplus of revenue to the O&M cost would be subsidised to the lower income area in each zone.

(3) Collection Method of Waste Charge

(a) Alternatives of Collection Method of Waste Charge

(i) Slum and Low Income Areas

The collection method of waste is closely related to the waste charging system. The collection method of waste charge for households varies with the income level. The detailed comparison of each collection method alternative is described in **Section E of Volume 3, Supporting Report**. For the slum areas, especially, the collection method must be established carefully because the population and households are mostly concentrated in the slum areas and they have a lower level of willingness to pay and affordability to pay. Therefore, to maximise revenue and to set the waste charge that would stop illegal dumping, the most effective collection method should be selected by setting a fixed and lower level of waste charge in order to collect from more inhabitants in the slum areas. In this context, the collection method is mostly oriented towards the fixed pricing system and the more adoptable method might be the fixed and unit pricing method. The collection method for low income areas is mostly the same as of that of the slum areas.

(ii) Middle and High Income Areas

It would be better to adopt mostly the unit pricing system for the collection method in middle and high income areas because these areas have a higher WTP and ATP than the slum and low income areas. Generally, the amounts of waste generated are proportional to the income level and the waste charge might increase proportionately to the amounts of waste discharged under the unit pricing system.

The three methods of collecting waste charges are compared as follows:

Tagging System

Tags containing the unit price are set for each kind of waste collection device (bags, cans, bins, etc.) and per category of waste, if possible. The waste charge is collected based on the issued and distributed tag containing the unit price and only wastes placed in collection devices with tags will be collected. Therefore, packed or non-packed wastes without tags will not be collected, in principle. This system has the following advantages: (i) there is no need to contract with households in advance to collect wastes and charges; (ii) there is no need to estimate the amount of waste to be collected for the next month as

the basis of the contract; and (iii) there is no need for persons to visit households and to collect charges thereby saving personnel and transportation expenses for these works. Its disadvantages are: (i) there is a need to spend for the material of tags such as paper or plastics, and for printing the price on each tag; (ii) there is a need to establish the distribution system of tags to the households; (iii) there is a need to spend for personnel and transportation expenses or for the distribution of tags to households; (iv) the material of packaging bag is not designated, so that it is impossible to identify the contents of the wastes in a bag such as toxic or flammable ones from the outside if the bag is made of non-transparent material and it is also more expensive to treat such harmful and dangerous wastes; (v) it is more expensive than the designated plastic bag system if the cost of bag is added to the cost of the tag; and (vi) there is a need for careful treatment of plastic bags if the plastic bags are not biodegradable such as polyethylene. For wrapping wastes, it is better to use materials such as paper bags or boxes, banana leaves, hemp sacks, etc., which are considered to be environmentally friendly.

Designated Plastic Bag System

The waste charge is collected based on the unit price indicated according to the capacity of the plastic bag and only the wastes packed in such plastic bags will be collected. This system has almost the same advantages as those of the tagging system. The difference is the packaging material which is limited to plastic bags in the designated plastic bag system while the material is not limited to plastic bags in the tagging system. Its disadvantages are also mostly the same as those of the tagging system except the packaging material. However, the designated plastic bag system has more advantages than the tagging system as long as the plastic material is polyethylene. The main characteristics of polyethylene are: (i) lighter than water (its specific gravity is less than 0.94); (ii) excellent electrical insulation and water and chemical repellence; (ii) especially, low density polyethylene is biodegradable and there is no serious impact on the environment even if it is not incinerated; (iii) the weight is one-fourth of that of paper bags and cost for waste collection and transportation could be saved when treated as waste; (iv) not bulky like bottles or cans when buried on the ground; (v) no generation of ash which is troublesome for land-filling; (vi) no generation of fluorocarbon as the cause of destruction of the ozone layer; and (vii) no generation of dioxin and environmental hormone (official definition: Endocrine Disrupting Chemicals, or Endocrine Disruptors).

Periodical Payment System by Setting the Unit Price per Kilogramme

This system is already being executed by the private companies based on their contract with the households. The specified data or period is essential to the collection of waste charge for setting the unit price per kilogramme of disposed wastes by estimating the weight of wastes as accurately as possible based on past experiences. This system has the following advantages: (i) secured collection of wastes and charges; (ii) no need to issue and distribute tags and no need to designate the plastic bags; and (iii) no need to spend for materials of tags/plastic bags and for printing the price on tags. It has the following disadvantages: (i) need personnel and transportation costs to visit and execute contracts with households; (ii) need personnel and transportation costs to visit the households to collect the waste charges; and (iii) need to specify the bank account of the households and the private companies for paying the charges.

The free and unit pricing system and the two-step unit pricing system are more sophisticated than the single unit pricing system. These two systems are also adoptable but the unit rate or price and the amounts of waste for some amounts of waste must be set suitably by taking high priority on the O&M cost and the ATP because the level of unit rate or price would change for some amounts of waste.

(iii) Business Establishment

The CCN had introduced a new waste charging system since 2008. This system is based on the unit pricing per ton by category of business establishment and by the characteristics of waste. This method is basically suitable because the amount of waste charge might increase proportionately to the amount of waste and can generate stable revenue for the CCN. However, the problem is that the accuracy of weight of the collected waste is not always assured because the weight is approximated by the driver through visual observation of the waste loaded on his truck. The charge is mostly collected monthly by issuing an invoice stating the amount of charges and is paid in cash to the CCN.

The other collection method recommended for business establishments is to utilise effectively the conventional payment system of the CCN. Especially, the business permit fee system may be used to collect waste charges by the fixed pricing system. The problem is the date of collection and the amount of charge. The business permit fees are paid annually and the amount of waste charges for the whole year would be a large amount which is assumed to be a big financial burden to small-sized establishments. Therefore, the payment is necessary to be divided into two times a year or quarterly or monthly and may be conducted by depositing it to the bank account of the CCN.

(4) Recommendations

(a) Slum and Low Income Areas

The level of charge should be based on the fixed pricing system based on the willingness to pay (WTP), because the affordability to pay (ATP) is extremely lower than in the other income levels. However, the tagging system is considered to be difficult to implement in these areas judging from the discussions within the JICA Survey Team and the opinions of the attendees at the workshop.

Therefore, the JICA Survey Team proposes that the most appropriate system of waste charge collection should be carried out in a pilot project on the precondition that the collection will be carried out by the CBOs. In this connection, the JICA Survey Team proposes the necessity of taking into consideration the policy that a certain amount from the revenue on waste charges shall be distributed to the CBOs to give them some incentive to improve the collection of waste charges.

(b) Middle and High Income Areas

The level of charges and the method of charge collection should be based on the unit pricing system. The more practical and realisable collection system must be selected from among the three alternatives mentioned above which have their own advantages and disadvantages. The former two systems are more suitable for the SWMPC than the periodical payment system because of: (i) the process or procedure for collecting charges in the two systems is more effective and cost-saving because there is no need to visit the households to execute a contract and collect charges considering that the SWMPC does not have enough personnel for these works; (ii) the SWMPC might only collect the tagged waste bags or designated plastic bags; and (iii) there will be no need to determine the amounts of wastes in advance of the collection of wastes for the executing a contract.

However, from the viewpoint of environment impact, it is obvious that the designated plastic bag system is more advantageous than the tagging system. Therefore, the designated plastic bag system is recommended to be more suitable than the tagging system for the collection of waste charge from the CCN/SWMPC Zone. Besides, the environmental considerations must

have a higher priority than the expenditure for personnel and transportation costs to the issue tags and to distribute tags or the designated plastic bags.

The practical level of waste charge for households could be set based on the WTP, the ATP by another public awareness survey, and the O&M cost, including the administration cost for the SWM service by the newly established cost accounting system during the Short-Term Operation Program. Therefore, in this survey, the range of waste charge level by the income level is recommended, taking into account the results of the simulation for the CCN/SWMPC in **Subsection 4.8.1**, the WTP, ATP, O&M and total cost of the Master Plan in this survey, and the existing charge level of private companies, as follows:

- Slum Area: 80 to 100 KSh/month/HH
- Low Income Area: 100 to 170 KSh/month/HH
- Middle Income Area: 170 to 300 KSh/month/HH
- High Income Area: 300 to 650 KSh/month/HH

(c) Business Establishments

As mentioned before, the existing waste charging system for businees establishments is based on the unit pricing system. There are some problems in the current system, but if it is improved, there is no need to change to the tagging system. However, the existing system must be checked on whether or not the O&M cost is recovered by the rate of charge per ton per category of business establishment.

(d) Incentives for Payment

The CCN has been collecting wastes from the low income and slum areas but it has not collected waste charges because it is very difficult to collect charges from these areas. The incentives for these areas to pay the charges may be as follows:

- Strengthening of public awareness on the negative impact of waste to their daily environment;
- Award to habitants who positively cooperate in paying the charges; and
- Strengthening of the understanding that the CCN has expended much amounts for the low income and slum areas from the budget for SWM which come from the taxes paid by the residents who have not directly benefitted from the SWM service.

4.8.4 Short-Term Action Plan

(1) Establishment of SWM Cost Accounting System

A cost accounting system has yet to be established. Therefore, a task force for its establishment in the SWM is indispensable and an urgent matter for the Accounting Office of DoE. The members of the Task Force shall be composed of the Director of DoE, the Chief of the Department of Treasurers (DoT), the Chief of the Accounting Office of DoE, other related staffs of DoE, and some experts on cost accounting from outside of the CCN.

A review on the existing cost structure of SWM should be conducted through the initiative of the Task Force. The cost structure must be reviewed in relation to the procedures of waste treatment such as collection, transportation, intermediate treatment, and treatment at final disposal in the final landfill site where the trucks loaded with collected wastes are weighed at the entrance and pay the tipping fees except the trucks to be directly operated by CCN. Since a common cost or the

administrative cost must be allocated to each component of waste treatment, the cost accounting system should be established and should actually function for the SWM.

(2) Establishment of Waste Charging System for Households

The waste charging system for households should be established and the waste charge should be collected. The level of waste charge is most closely related to the financial improvement of DoE.

There are many considerations for setting the level of charge such as the ATP, the WTP, the waste treatment cost and the O&M cost. Therefore, a more detailed study on the relationship of these considerations with the level of waste charge is indispensable. Since the CCN has not collected any waste charge from households after 2002 when the water supply and sewerage services were privatised, it is urgent to study a more suitable and fair waste charging system for households.

(3) Revision of Waste Charging System for Business Establishments

The CCN has been collecting waste charges from the business establishments. However, the level of charge is not related to the cost of waste treatment. Therefore, a detailed analysis of the relationship between the waste level and the waste treatment cost is indispensable in order to revise the existing waste charging system for business establishments.

4.8.5 Mid-Term Action Plan

(1) Financial Review of Revolving Funds (Phase I)

The franchise system would start from 2016 and then the SWM Capital Revolving Fund (SWMCRF) and the SWM Operating Fund (SWMORF) would be established. The source of funds for the SWMCRF would be the franchise fees that have to be paid by the private companies as the franchisees. Fifty percent (50%) of the franchise fees (7.5% of 15%) would be financed to the private companies and another 50% would be financed to the SWMPC. The source of the SWMORF is the tipping fee to be paid by the waste collectors in order to dispose waste to the Ruai.sanitary landfill site. The first three private companies would be the franchisees in Zone Nos. 1, 8 and 9. The investment and replacement costs for trucks by these companies would be financed from their own reserved funds which are considered to be accumulated revenue from the waste charges. It is therefore necessary for SWMPC to review the amounts of these revolving funds and supervise the financially appropriate management through the auditing report of the Kenyan National Audit Office (KENAO) on the companies' financial statements.

(2) Financial Review on Level of Franchise Fees (Phase I)

The financial situation in the profit and loss statement and cash flow of the private companies as the franchisees and of the SWMPC would change year by year resulting in a shorter cash flow in some years because of business fluctuation or the necessity of procurement of new trucks to meet the increased waste amount to be collected. In such a situation, when they need funds from the SWMCRF but the amount is not sufficient, they give up on procuring new trucks. To avoid this situation, the level of franchise fee must be increased from 15% to 20% or 25% of the revenue from the private companies.

(3) Execution of New Waste Charging System (SWMPC)

Through the initiative of the Task Force, a detailed analysis should be conducted on the relationship among the cost of SWM and the WTP and ATP for the new household waste charging system and on the relationship between the waste charge level and the cost for business establishments, in order

to establish a new waste charging system and to revise the existing waste charging system for business establishments in the Short-Term Action Plan. Then the new waste charging system and the revised charge system should be implemented in the Mid-Term Action Plan.

(4) Review of the SWMPC Cost Accounting System (Phase I)

The cost for SWM may change due to technical advancement. The inflation of materials, characteristics of wastes, and change of waste collection area of the existing CCN and the private companies may also change so that the relationship between the cost for SWM and the amounts of waste would also change. Therefore, a review on the cost accounting system of the SWMPC would be indispensable for the review on the waste charging system. The review should be conducted on the composite costs of SWM such as costs for collection & transportation, 3R and Intermediate treatment, and the final disposal waste treatment.

(5) Review of the SWMPC Waste Charging System (Phase I)

The review of the cost accounting system of SWMPC is closely related to that of the waste charging system. Therefore, the review on waste charging system should be conducted for households and business establishments. The relationship among the waste charge level, ATP, WTP and the cost for SWM by income level of households, as well as the relationship between the waste charging system and cost for SWM by business category should be also reviewed.

(6) Revision of the SWMPC Waste Charging System (Phase I)

Based of the results of the review on waste charging system for households and business establishments, the waste charging system should be revised to form a more suitable system.

(7) Monitoring and Supervision of the SWMPC Waste Charging System for All SWM Service Providers (Phase I)

For the provision of more effective and harmonious SWM services and for fair competition among the SWM service providers, monitoring and supervision of the level and collection method of waste charge by all SWM service providers are indispensable. Monitoring and supervision should be conducted on the relationship among the waste charge level and the collection method, ATP, WTP and the cost for SWM by household income level, as well as the relationship between the waste charge level and collection method by business category respectively.

4.8.6 Long-Term Action Plan

(1) Financial Review of Revolving Funds (Phase II)

In the year 2021, three other private companies will be the franchisees in Zone Nos. 4, 5 and 7, and in the year 2026, three other private companies will be the franchisees in Zone Nos. 2, 3 and 6. From the year 2021, the SWM in all the 9 zones will be executed by the private companies and the SWMPC will provide SWM services for only the CCN/SWMPC zone.

More funds for investment and replacement of trucks (SWMCRF) and for the operation and maintenance fund (SWMORF) will be required by the private companies. To secure a sustainable and stable subsidy for the investment on new trucks or the replacement of trucks, and for the O&M cost of private companies and the SWMPC for these two years, the SWMPC must continuously review the amounts of these funds and supervise the appropriate financial management of these funds based on the auditing report on the financial statements to be prepared by the Kenyan National Audit Office (KENAO).

(2) Financial Review of Level of Franchise Fees (Phase II)

During the ten years from 2021 to 2030, the financial situations, especially under the profit and loss and cash flow, are projected to change more than those of the five years of the mid-term and because of business fluctuation or the necessity of procurement of new trucks to meet the increased waste amounts to be collected. In such a situation, when there is a need for funds from the SWMCRF but the amount is insufficient, the procurement of new trucks is cancelled. To avoid these situations, the level of franchise fee may be increased from the level of the mid-term period.

(3) Execution of Revised SWMPC Waste Charging System

Through the initiative of the Task Force, a detailed analysis on the relationship among the cost for SWM and the WTP and ATP for the revised household waste charging system and on the relationship between the waste charge level and the cost for business establishments should be continuously executed, and then the revised waste charge system for both households and business establishments are to be revised again in the Mid-Term Action Plan. Then the revised waste charging system will be executed in the Long-Term Action Plan.

(4) Review of the SWMPC Cost Accounting System (Phase II)

For the same reason as the Review of Cost Accounting System of SWMPC (I) for the Mid-Term Plan, a continuous review of the cost accounting system of SWMPC is indispensable for the review on the waste charging system. A continuous review should be conducted for the composite costs of SWM such as the costs for collection and transportation, 3R and Intermediate treatment and final disposal waste treatment.

(5) Review of the SWMPC Waste Charging System (Phase II)

The review of the cost accounting system of SWMPC is closely related to the waste charging system. Therefore, a continuous review of the waste charging system should be conducted for households and business establishments. The relationship among the waste charge level, ATP, WTP and the cost of SWM by income level for households should be reviewed. The relationship between the waste charging system and the cost of SWM by business category should be also reviewed.

(6) Revision of the SWMPC Waste Charging System (Phase II)

Based on the results of the review on waste charging system for households and business establishments, the waste charging system should be revised to form a more suitable system.

(7) Monitoring and Supervision of the SWMPC Waste Charging System for All SWM Service Providers (Phase II)

For the provision of more effective and harmonious SWM services and for fair competition among the SWM service providers, continuous monitoring and supervision of the level and the collection method of waste charge for all SWM service providers are indispensable. Then continuous monitoring and supervision should be conducted on the relationship among the waste charge level and collection method, ATP, WTP and the cost of SWM by income level for households and on the relationship between the waste charge level and collection method by business category respectively.

(8) Application of the SWMPC Waste Charging System to All SWM Service Providers

The waste charging system in the Action Plan is basically applied to the SWMPC. The waste charging system for private companies as the franchisees is based on the contracts between the private companies and the households/business establishments. However, in the long term, the waste charging systems of the SWMPC and the private companies should be based on the same concept, in principle, for more fair competition and the provision of harmonious and sustainable SWM services through stable financial condition in view of the suitable waste charging system. In this context, the basic concept of the waste charging system of the SWMPC is better to be applied to the private companies because the waste charging system including the level and collection method of the SWMPC would have been continuously reviewed and revised by careful and detailed study through the initiative of the Task Force in this action plan. However, the fairness and suitability of the waste charging system including the level and collection method of the private companies is not always assured because their waste charging systems are based on their contracts and not on the detailed reviews and revision.

4.9 Private Sector Involvement Promotion Plan

4.9.1 Short-Term Action Plan

(1) Establishment of Optimum PPP Scheme

(a) Possible PPP Options

There is a wide variety of Public-Private-Partnership (PPP) option which can be implemented to make maximum use of the private sector involvement scheme. Out of the following various options, the optimum private sector involvement plan shall be selected.

Licensing (Private Subscription): Licensing or private subscription allows qualified private service providers licensed by an authority to compete for the delivery of solid waste management collection services in a specific zone. Under this arrangement, waste generators make contracts with individual private service providers. The authority licenses private firms to compete with each other in providing solid waste collection services. No firm has the monopoly in a specific zone, and each firm collects service charges from its customers or subscribers. CCN currently adopts this system in the entire city. The license is utilised to guarantee that a licensed service provider operates in accordance with the operational standards, and might be withdrawn if the service provider's performance is poor.

Service Contract: Service contract is also a finite-term contract for a private firm to provide solid waste services, and an authority pays the firm for charges in response to the services to be delivered. Part of solid waste management services such as collection and transportation of wastes and management of a sanitary landfill site can be contracted out to a private operator for a certain period. In case of a service contract, collection vehicles are basically owned by an outsourced private firm, and a guaranteed payment from the authority to the service provider is clearly defined in the contract document. While the authority is responsible for charge collections, the service provider has to bear the operational risks.

Franchise: Franchise is a contract through competition in a finite-term to grant a private firm an exclusive monopoly to deliver a specific type of solid waste services within a specific zone. The awarded private franchisee directly collects its own revenue from waste generators within the designated zone. The franchisee pays a franchise fee to cover the authorities' costs of managing and monitoring the performance of the solid waste management services.

Management Contract: Management contract is a contract entrusting a specific solid waste management service under private management for a certain period of time, for which a management fee is paid to the management contractor. The management fee could be paid in accordance with the performance of the management contractor. Although a management contract could be an attractive first step to the full-scale private sector involvement, it does not directly lead to the investment on the improvement of solid waste management services due to the relatively shorter contract term. A management contractor is required to mainly focus on improving its services to existing customers rather than on enlarging the service coverage such as delivering the services to the lower-income area.

Lease Contract: Lease contract grants a private operator full control over delivering specific solid waste management services in exchange for use of the fixed assets whose ownership and responsibilities belong to the authority. Under an enhanced lease, while partial improvements of the leased facilities are the responsibility of the private operator, major investments remain the responsibility of the authority.

Concession: Concession is a long-term contractual arrangement in which a private operator is awarded an official license to provide specific solid waste management services over a longer period of time in exchange for a negotiated fee. A concession agreement stipulates the rights and obligations of the awarded concessionaire who retains ownership of the principal assets. Normally, during an average period of 25 years, the concession contract transfers all responsibilities for capital investment and operation and maintenance to a private concessionaire. While the fixed assets legally remain the property of the authority, the concessionaire might pay a fee to use them.

In the case of solid waste management services, concession contracts typically involve constructions of large-scale facilities such as a sanitary landfill site and intermediate treatment facilities. The authority may pay a tipping fee or service charge to use those facilities. The concession for a sanitary landfill site is subject to be operated on a “take or pay” basis, where tipping fees are paid even if the guaranteed minimum daily amount of wastes to be dumped of waste is not provided.

Build-Operate-Transfer (BOT) Contract and Its Variations: Build-Operate-Transfer (BOT) contract and its variations are options which are similar to concession and are primarily suitable for large-scale investments on facilities such as sanitary landfill sites. During a relatively longer period of up to 30 years, depending upon the size of the investment which has to be amortised, a BOT operator provides a wide range of solid waste management services in exchange for guaranteed service fees in the contract, although the operator accepts the risk to design, build and operate the facilities at the agreed standards of services in exchange for a guaranteed cash flow.

Full Privatisation: Full privatisation is the most radical form of private sector involvement in which existing operations and assets for the solid waste management services are sold to the private sector, in some cases, with a limited term license.

Table 4.9.1 shows varieties of possible PPP options with the comparison of asset ownership, operations and maintenance, capital investment, commercial risks and duration of contract.

Table 4.9.1 Comparison of Possible PPP Options

Option	Asset Ownership	Operations and Maintenance	Capital Investment	Commercial Risks	Duration of Contract
Service Contract	Public	Public and Private	Public	Public	1-2 years
Franchise	Public	Public and Private	Public	Public	1-5 years
Management Contract	Public	Private	Public	Public	3-5 years
Lease Contract	Public	Private	Public	Public and Private	8-15 years
Concession	Public	Private	Private	Private	25-30 years
BOT and Its Variations	Public and Private	Private	Private	Private	20-30 years
Full Privatisation	Private or Private and Public	Private	Private	Private	Indefinite

Source: Ministry of Finance, Singapore: Public-Private Partnership Handbook, 2004

(b) Criteria for Selecting Optimum PPP Scheme

The following criteria are employed in an attempt to select the best and optimum option of private sector involvement scheme in providing the solid waste management services. However, when applying these criteria, the current site-specific conditions of Nairobi City should be carefully taken into account. Choosing the optimum private sector involvement option is one of the most crucial decisions before formulating the organisational and legal contents of the Master Plan as it indicatively defines the major conditions between the public sector and private sector. However, as the decision-making process depends on various factors, no almighty solution can be applied. A broad range of past experiences indicate that a mere copying of approaches that have been successful in other countries will tend to fail when they are not properly adapted to the local and site-specific situation.

Effectiveness: Effectiveness is the quantitative degree of increasing the service coverage and qualitative significance of improving the quality of services through involving the private sector.

Competition and Efficiency: Compared with an inefficient public waste management services, the private sector involvement through a competitive bidding can improve the efficiency of solid waste management services. By using the private sector's cost-saving expertise, the private sector involvement will significantly reduce the financial burden on the authority. The efficiency will be normally measured by the value for money analysis. If the efficiency of the solid waste management services through competition is significantly improved, the tariff level will eventually be reduced due to the further rationalised private sector, thereby benefitting the whole society.

Accessibility to Capital Investment: The involvement of the private sector can enlarge the access to capital or financial resources for procurement of collection vehicles as well as the access to human capital for expertise and skills. The degree of the accessibility to those financial and human capitals by the public sector is one of the important motivations for the private sector involvement.

Accountability and Transparency: Accountability and transparency under the private sector involvement depends on the degree to which the procurement process is open to competitive market forces and the extent to which corruption distorts the process. On the other hand, accountability and transparency in the implementation phase depends on the performance monitoring.

Risks and Sustainability: The risks in the private sector involvement are important factors for sustainably providing the solid waste management services. By sharing the risk factors between the public sector and the private sector, the regulatory framework which removes the risk factors will protect the private sector, thereby making the private sector involvement for the solid waste management services functions sustainable.

Equity: The private sector involvement will not necessarily benefit the whole population. The level of equity in universally providing fair solid waste management services to all beneficiaries under the private sector involvement is also one of the important evaluation criteria.

(c) International Experiences

While there have been a number of successful experiences on private sector involvement in the major cities of developed countries, there have been also a considerable number of failure cases especially in terms of long-term sustainability. The private sector participation in the field of solid waste management services has been involving a broad spectrum of options. "Private Sector Participation in Municipal Solid Waste Management, Part I: Executive Overview" by the World Bank listed a variety of major international experiences on private sector participation as below. However, it is not advisable to directly apply these international experiences to other countries, and country-specific or site-specific conditions should be carefully taken into account.

- Provision of vehicles or heavy equipment: **by lease or rental agreement with equipment owners**
- Pre-collection of residential solid waste: **by private subscription**
- Pre-collection of residential solid waste: **by franchise**
- Pre-collection of residential solid waste: **by service contract**
- Collection of construction and demolition debris: **by private subscription**
- Collection of industrial wastes from large factories: **by private subscription**
- Collection of commercial wastes from hotels, offices, markets or stores: **by private subscription**
- Collection and final disposal of infectious healthcare wastes from hospitals and clinics: **by private subscription**
- Collection of general municipal wastes from entire neighborhoods: **by service contract or franchise, or by management contract**
- Sweeping or cleaning of streets and open areas: **by service contract**
- Repair of municipal solid waste equipment: **by service contract on an as-needed basis**
- Repair of municipal solid waste equipment: **by service contract on a long-term basis**
- Conversion of waste to compost: **by service contract or concession**
- Operation of a transfer station and long distance hauling system: **by service contract or concession**
- Operation of a disposal site: **by service contract or concession**
- Collection of user charges or waste taxes: **by franchise with bill collection agents, water authority, or electricity utility**

(d) Factors to Consider for Designing Optimum PPP Scheme

The following factors should be carefully taken into account in case of designing a full-scale private sector involvement plan.

Duration of Contract: The duration of a contract is a cardinal issue to be taken into account for the access to capital investment by the private sector. If the duration of a contract is relatively short, a private service provider would not have sufficient time to repay a loan for the procured collection vehicles as well as the acquisition and construction of facilities. As a result, the private service provider will not be able to properly replace its collection vehicle fleets and equipment. On the other hand, it is widely recognised that the economic life of a typical collection vehicle is approximately 5 to 10 years. Therefore, the minimum contractual interval for the solid waste collection services which require the purchase of the vehicle fleet should be at least 5 years to allow the service provider to repay the loan for those vehicles. In other words, the contract period should be in such a term which allows the depreciation of vehicles and equipment used to achieve the service level in the contract. A limited contract period would be a disincentive for the service provider to make investment on new and replaced vehicles as it feels the risk of termination of the contract before depreciating vehicles and repayment of its loans.

Mitigation of Long-Term Risk: Although the duration of a contract should be reasonably long, another risk on the contract term to be considered would be the long-term contract risk. If a private service provider is awarded a long-term contract, it might put the private company into a monopoly position so that there will be no alternative service providers where it is rather difficult for the authority to keep the service level satisfactory.

Step-wise Approach: It is not advisable to entrust the entire service area to the private sector from the initial phase of private sector involvement. In other words, it is better to start the private sector involvement with a step-wise approach, and expand the degree of the involvement of private companies in a gradual manner, so that the financial and service-quality risks by the private sector involvement can be minimised and subsequent contractual arrangements can be modified to improve the performance of the private operator.

More specifically, in case the of waste collection services, it may be possible to start with a small number of service zones and to extend service zones city-wide based on the experiences. In such a situation, a step-wise involvement of the private sector can significantly mitigate the risks of the private sector involvement. On the other hand, in thcase of e operation services for a sanitary landfill site and intermediate treatment facilities, a step-wise approach can be also applied and it may still be possible to start with the construction of the downsized scale of facilities rather than the large-sized facilities.

Continuous Competition: Competition is widely regarded as a key to successful private sector involvement. Continuous competition in the tendering process ensures competitively-priced services by the private service provider. It is beneficial to divide a large-scale city-wide service into several zone-based contracts so that there will be competition among the private service providers. If private service providers compete with each other in different zones, the performance and level of services can be compared, and if one service provider fails, others can take over the service.

Size of Zone: It is also important to take into account the size of the service zone to be outsourced to a private service operator.

(2) Selection of General Framework of PPP

(a) Franchise System for Collection and Transport

The continuation of private subscription which is currently adopted in Nairobi City is not recommended for the waste collection services, because it does not utilise the economies of contiguity. The efficiency can be achieved only when one collection vehicle delivers collection services through a continuous collection route. Furthermore, since private subscription is the most common method of collecting wastes from large generators such as

large hotels, restaurants, large apartments and commercial complexes, it could not be a solution for increasing the service coverage by extending the services in low-income areas.

On the other hand, the franchise system is one of the preferred methods to privatise solid waste collection services in lower-income cities with limited financial sources. In such low-income cities, beneficiaries may prefer the franchise method for solid waste collection services, since the beneficiaries expect that the private franchisees will be motivated to deliver the services in return for fees.

Table 4.9.2 shows the three-grade evaluation results of PPP options for collection and transport services, taking into account the special conditions in Kenya in which there is no clear-cut regulatory framework for the long-term PPP schemes.

Table 4.9.2 Comparison of Three-grade Evaluation of PPP Option (Collection and Transport)

Evaluation Criteria	PPP Option							
	Licensing	Franchise	Service Contract	Management Contract	Lease	Concession	BOT and Variations	Full Privatisation
Effectiveness	B	A	B	A	B	B	B	B
Efficiency and Competition	B	B	B	B	B	B	B	A
Access to Capital	B	B	C	B	C	A	A	A
Accountability	B	A	B	B	B	B	B	C
Risks and Sustainability	A	A	A	B	B	C	C	C
Equity	B	B	B	B	C	C	C	C

Note: A; Good, B; Moderate, C: Not Good
Source: JICA Survey Team

There are some experiences in the introduction of the franchise system to other developing countries. The typical experiences include the cases of Ghana and Tanzania. The main type of collection service in the three major cities (Accra, Kumasi and Tema) of Ghana are communal collection and house-to-house. Communal collection is a system of solid waste collection where individuals bring their solid waste directly to communal skip containers at secondary collection points from where the waste is collected and transported to the disposal site by private companies. Communal solid waste collection services are provided under service contract arrangements between the Municipal Authority and the private companies. The Municipal Authority pays the companies for the services delivered[24].

The house-to-house service is provided to residents in the high and middle income areas. Another form of house-to-house solid waste collection called 'block collection' is a predominant mode of solid waste collection. The house-to-house solid waste collection services are provided under franchise contract arrangements between the Municipal Authority and the private companies. Under the franchise contract, the companies collect revenue from the users and subsidy from the Municipal Authority for some areas. For the purpose of waste collection, the city is divided into waste collection districts where a company is contracted by the public sector to collect waste in one or two districts. Fifteen (15) waste collection companies have been contracted. On the franchise basis, a house-to-house collection is done in high income areas and the contractors charge the households some fees with weekly collection frequency. The main constraints include inadequate logistics, inadequate funding, and a low charge collection rate in low-income areas. There is no mechanism of the cross-subsidy system under this franchise to provide the services in low-income areas.

On the other hand, the waste collection services of Dar es Salaam which is the capital of Tanzania is covered by the combination of direct services by the Dar es Salaam City Council and the contractout to private contractors in major residential areas, market places, open

spaces, roads and streets. In addition, community-based waste collection services involving CBOs are rendered in the lower-income areas. However, in the same situation as Ghana, there is also no mechanism of the cross-subsidy system to utilise the revenue from the collection charges generated in the higher-income areas in the current combined services in Dar es Salaam[25].

(b) Disposal Site and Intermediate Treatment Facilities

There are sizable risks on the long-term PPP options such as concession, BOT and its variations. Private sector involvement requires a clear regulatory framework to mitigate and control the long-term contractual risks. It also requires that careful studies on the risk allocations should be conducted in advance, so that the best technical systems are selected and specified. The major risks are as described below.

Economies of Scale

Bidders for concession, BOT and other long-term PPP variations are required to bear higher bidding costs due to the complicated tendering process. Hence, only large-scale PPP projects can generate sufficient cost performance to offset the higher bidding costs from the PPP procurement. It is generally argued that a large-scale PPP project such as concession, BOT and other variations should be used on projects which involve the construction of assets with a capital value above USD50 million. Since the amount of the sanitary landfill site or the intermediate treatment facilities in the Master Plan is slightly less than this threshold, the economies of scale will not function in case of concession, BOT and other long-term PPP variations.

Service Discontinuity

If the awarded private service provider encounters financial difficulties during the contract period, there would be a risk that SWMPC will not be able to immediately take over the operation, which will eventually result in the termination of the services. This long-term risk of failure by the private sector involvement exists if the service is outsourced for a relatively longer period under PPP arrangements such as concession, BOT and other long-term variations. To remove the risks of suspending the services, the long-term PPP options should include provisions for SWMPC to intervene into and takeover the operation to continue delivering the services. Nevertheless, in some cases, service contracts for the management of sanitary landfill sites have no penalty clauses. Even if a penalty clause is included in the contract, the SWMPC has little capacities to immediately take over the operation of the facilities.

Downsized Demand Risk

Before a concessionaire agrees to a concession for the construction and operation of a sanitary landfill site and intermediate treatment facilities, a concession contract will guarantee minimum revenue, which is provided by means of a minimum tonnage agreement. This type of long-term agreement in the concession contract is frequently cited as “put or pay agreement” or “off-take purchase agreement”, which defines a minimum tonnage of wastes regardless of the actual amount of wastes to be disposed or treated in those facilities. Without proper risk management, the authority cannot respond to these demand risks. This kind of downsised demand risk belongs to the SWMPC.

Since investment on the new sanitary landfill site as well as the intermediate treatment facilities requires large-scale financial resources with long-term risks, the most realistic financial option is to seek funding from a concessional loan provided by an international lending institution together with a service contract for the efficient use of the private sector. A

concessional loan from an international lending institution is designed to financially support developing countries by providing long-term and low-interest loans for development projects of large-scale facilities. This type of concessional loan has a longer repayment period together with a low and preferential interest rate as well as a longer grace period.

Table 4.9.3 shows the three-grade evaluation results of PPP options for sanitary landfill site and intermediate treatment facilities, taking into account the special conditions in Kenya in which there is no clear-cut regulatory framework for long-term PPP schemes.

Table 4.9.3 Comparison of Three-grade Evaluation on PPP Options (Sanitary Landfill Site and Intermediate Treatment Facilities)

Evaluation Criteria	PPP Option							
	Licensing	Franchise	Service Contract	Management Contract	Lease	Concession	BOT and Variations	Full Privatisation
Effectiveness	Not relevant (n.r.)	n.r.	A	A	B	B	B	B
Efficiency and Competition	n.r.	n.r.	B	B	B	B	B	A
Access to Capital	n.r.	n.r.	C	B	C	A	A	A
Accountability	n.r.	n.r.	B	B	B	B	B	C
Risks and Sustainability	n.r.	n.r.	A	B	B	C	C	C
Equity	n.r.	n.r.	B	B	C	C	C	C

Note: A; Good, B; Moderate, C: Not Good
Source: JICA Survey Team

(3) Formation of Detailed PPP Structure for PPP

(a) Establishment of PPP Structure for Collection and Transport

(i) Streamlining of Zoning System by Socio-Economic Type

It is widely recognised that a large collection zone enables a private service provider to increase efficiency through economies of scale. The economies of scale include an integrated large-scale workshop for the operation and maintenance of collection vehicles, and the reduction of indirect overhead cost. On the other hand, the award of a large-scale contract to one bidder might create a monopoly with negative long-term effects such as increasing prices and decreasing performance quality.

The zone-based division of a large-sized service area and the award of contract to the separated service zones can guarantee long-term competition within the city-wide service area and also provide opportunities to replace a service provider which does not fulfill its contractual requirements. However, even in the case of separated service areas, the smallest unit to be operated by a private service provider should ideally involve at least 100,000 beneficiaries in order to achieve economies of scale and flexibility.

It is generally argued that the zones should at least have approximately 400,000 beneficiaries to attract international investors. In order to attract experienced international service providers, even much larger collection zones or the procurement packages which combine the services of waste collection, transfer and disposal should be considered. Therefore, the feasible size of collection service zones for local private franchisees ranges from 100,000 to 400,000 beneficiaries.

Apart from the size of zone, the zoning system for the solid waste collection services is streamlined in accordance with the following basic principles:

- The internal cross-subsidy system where revenue from high-income areas is transferred to the fund for the provision of solid waste management services in low-income areas is introduced.
- In order to establish the cross-subsidy system between the high-income areas and the low-income areas in the city, the current zoning system based on the administrative borders will be reviewed comprehensively and the new zoning system based on the economic level will be explored.
- The new zoning system is carefully decided by adopting the following socio-economic categories of areas in accordance with the results of the poverty map prepared by the World Bank. **Figure 4.9.1** illustrates the city-wide map showing 3 categories of socio-economic areas. These 3 categories of socio-economic areas are based on the poverty rate of each area which is the rate of households under the poverty line defined by the World Bank as below. Out of these 3 categories, a majority of the slums which belong to the lowest income group category is included in the red-coloured area.

Blue-colored Area:

High-income areas with relatively higher willingness to pay for charges which can independently cover their SWM services and generate the fund for low-income zones (Poverty Rate: less than 25%)

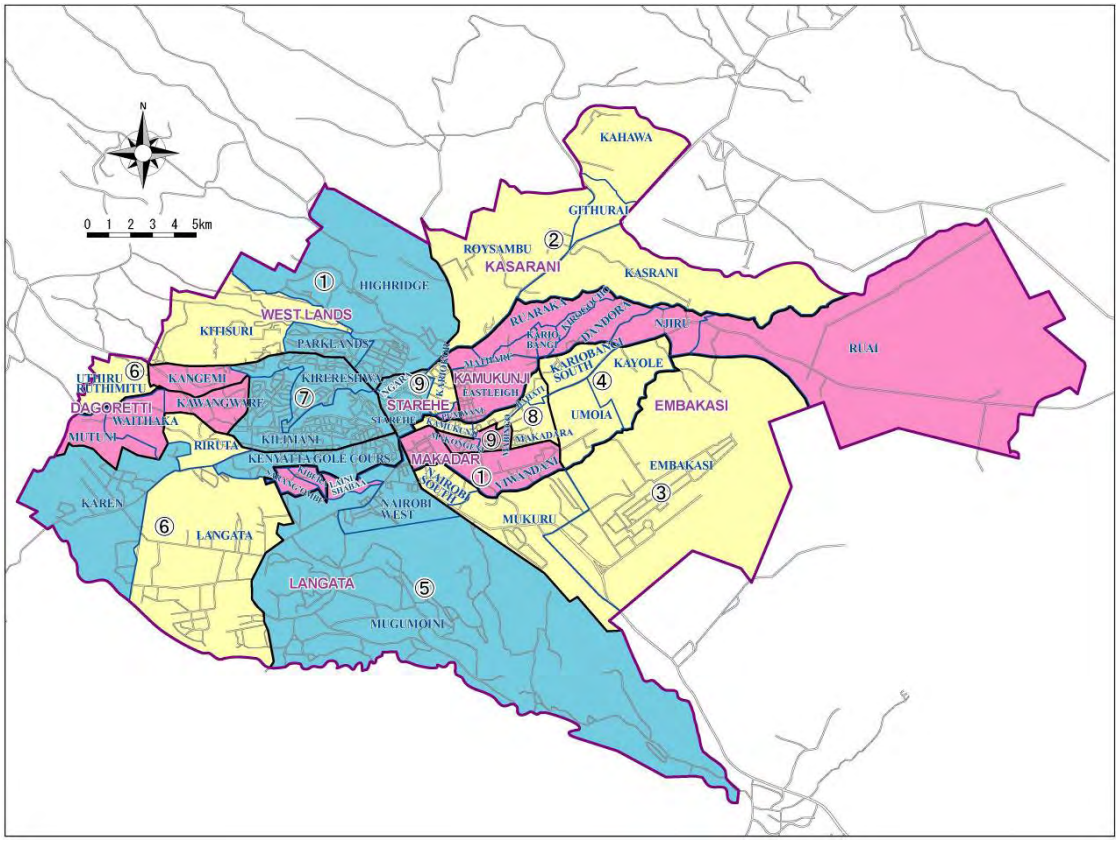
Yellow-colored Area:

Middle-income areas with average-level willingness to pay for charges which can independently cover their SWM services (Poverty Rate: 25% to 50%); and

Red-colored Area:

Low-income areas with relatively lower willingness to pay which require the subsidies from high-income zones (Poverty Rate: more than 50%).

- The new zoning system is designed to assure reasonable profit of private service providers in the long-term even under the cross-subsidy system so that “Win-Win” situation between the SWMPC and the private service providers will function well.



Source: JICA Study Team

Figure 4.9.1 City-wide Map by Category of Socio-Economic Area

(ii) Establishment of Sustainable Operational Zones based on Cross-Subsidy

By combination the above socio-economic zones, new operational zones with sustainability of delivering collection services based on cross-subsidisation are established. **Table 4.9.4** shows the outline of the new zones for collection services based on the cross-subsidy concept.

Table 4.9.4 Outline of New Zones for Collection Services

Zone	High-income Area	Middle-income Area	Low-income Area	Total
Zone 1	80,421	38,020	82,081	200,512
Zone 2	0	200,280	0	200,280
Zone 3	0	167,597	0	167,597
Zone 4	0	289,725	0	289,725
Zone 5	107,408	0	72,006	179,414
Zone 6	55,393	145,472	0	200,865
Zone 7	86,881	0	82,068	168,949
Zone 8	0	152,292	0	152,292
Zone 9	57,685	47,327	98,125	203,137
Zone Total	387,788	1,040,703	334,280	1,762,771
Direct Contracting-Out by SWMPC	0	0	1,203,993	1,203,993
Total	387,788	1,040,703	1,538,273	2,966,764

Note: The number of population in each zone is estimated for 2010 by the JICA Survey Team based on the population forecast calculated from the Census in 1999.
Source: JICA Survey Team's Estimate

The major concepts of the new zoning system are as stated below:

- High-income areas are combined with low-income areas to make the private sector keep providing the services.
- Middle-income areas are clustered as financially independent zones.
- The number of zones is 9, which is the same as the current number of administrative operational zones.
- The approximate number of beneficiaries in each zone is 200,000.
- The major slums such as Kibera and Mathare belong to the low-income areas, since those slums cannot afford to pay the charges and the private sector alone cannot deliver the collection services.
- The direct contractout zone in low-income areas including major slums will be established by the SWMPC except for the designed 9 zones, since those areas could not be covered by the private sector due to the low-level affordability to pay for collection charges.
- The contractout area will be reduced and transformed into the new zones when those areas are economically affordable to pay for collection charges.
- The SWMPC will act as the agency for supervising the private sector in all zones and the contractout in low-income areas.

(iii) Step-wise Introduction of Franchise System

It is advisable that the franchise system should be introduced through a step-wise and gradual manner to avoid the long-term contract risks. This system has the following features:

- One franchisee for each zone will be selected through the tendering process.
- The formation of consortium of companies will be allowed.
- Each franchisee will be allowed to exclusively collect wastes and charges in one zone.
- The following step-wise enlargement of the franchise zones in 3 phases is proposed. **Figure 4.9.2** illustrates the step-wise introduction of the franchise system (Phase 1).

  Phase 1: Three (3) zones starting from 2016

  Phase 2: Six (6) zones starting from 2021

  Phase 3: Nine (9) zones starting from 2026

- The contract period is 5 years for the awarded franchisees to redeem capital investment on collection vehicles.
- Before stepping into the new system, stakeholder meetings will be held to make the private sector and communities fully understand the new system.

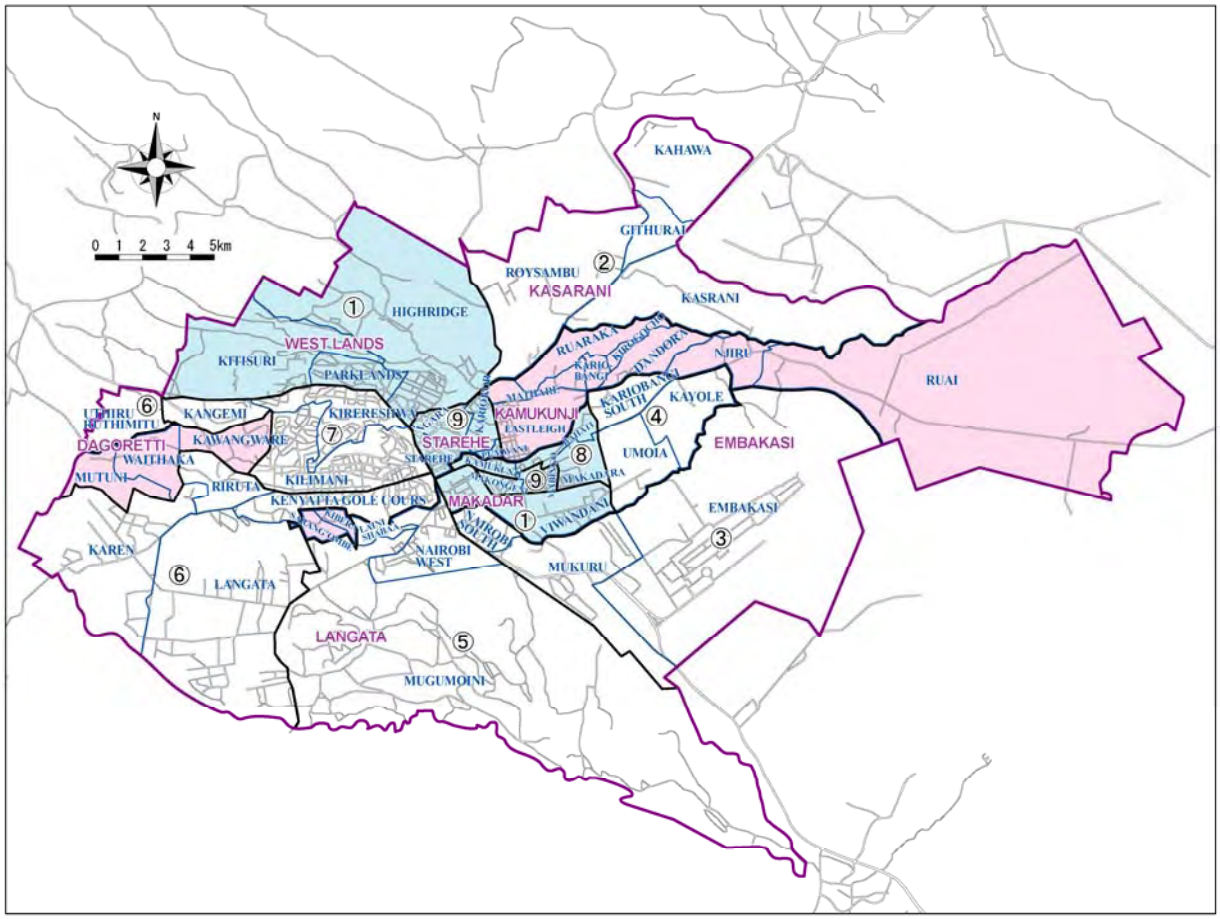


Figure 4.9.2 Step-wise Introduction of Franchise Zone (Phase 1)

Table 4.9.5 shows the overall road map for the l step-wise introduction of the franchise system in accordance with the proposed organisational restructuring plan.

Table 4.9.5 Overall Road Map of Step-wise Introduction of Franchise System

Year	PPP Option	Organisations Responsible for SWM	Zoning System
2010-2011	Improvement of Current Licensing / Contracting Out System	DoE	Current Zoning System
2012-2015	Improvement of Current Licensing / Contracting Out System and Preparation of New 5-Year Zone-based Franchise System	DoE, Setup of Special Account for SWM in CCN	Current Zoning System
2016-2020	New 5-Year Zone-based Franchise System (Phase 1: 3 zones)	SWM Public Corporation separated from CCN	New (1st Phase)
2021-2025	New 5-Year Zone-based Franchise System (Phase 2: 6 zones)	SWM Public Corporation separated from CCN	New (2nd Phase)
2026-2030	New 5-Year Zone-based Franchise System (Phase 3: 9 zones)	SWM Public Corporation separated from CCN	New (3rd Phase)

Source: JICA Survey Team

(iv) Creation of Franchise Fee and SWM Capital Revolving Fund

The SWM Capital Revolving Fund (SWMCRF) will be set up in the SWM Special Account of SWMPC as a sort of trust fund which can be used to provide long-term subsidisation assistance to the cost for replacement and new investment on collection vehicles by the private franchisees. SWMCRF will be separately managed from the general account of SWMPC. Legally, it is a sort of trust fund in which one party donates money to another party which manages the money on behalf of a third party. The beneficiary is allowed to be subsidised to use part of the fund exclusively for a specified purpose agreed beforehand.

The main financial sources of the fund are the franchise fees collected from private franchisees, which is 15 percent of the collected SWM fees. The level of subsidy will be decided separately by the SWMPC.

(b) Establishment of PPP Structure for Sanitary Landfill and Intermediate Treatment Facilities

(i) Concessional Loan for Capital Investment

The major features of a concessional loan option are as follows.

- The cash flow for the repayment will be generated through part of tipping fees as well as franchise fees.
- The concessional loan has normally a long-term grace period as well as a long-term repayment period with low interest rate.
- The Project Management Unit inside the SWMPC should be established for the management of construction with external technical assistance.

(ii) Service Contract for Operation of Sanitary Landfill Site and Intermediate Treatment Facilities

Service contracts include the provision of services for operating a sanitary landfill site or intermediate treatment facilities and the payment of service fees. The responsibility for operating the facilities will be transferred to the private service provider which will receive payment from the SWMPC for operating the facilities. Service contracts leave all responsibilities on investment with the public sector; however, service contracts can be a first step toward a more comprehensive private sector involvement.

(iii) Alternative Option for Capital Investment

If a concessional loan is not available, the DBFO (Design-Build-Finance-Operate) scheme could be the 2nd option. DBFO is the most common mode of the PPP scheme among the BOT and its variations, integrating the functions of Design, Build, Finance and Operate within a single private service provider. The service provider will raise funds from private financial institutions to construct the facilities required for delivering the services to the public sector. The private service providers will then build, maintain and operate the constructed facilities to meet the requirement of the public sector. The private service provides will be paid based on the services delivered in accordance with specified performance standards throughout the entire contract period.

Another possible variation of the DBFO is the DBO model, in which the public sector provides the fund for the design and building of facilities by the private sector, and then continues to entrust to the same private service provider the operation of the facilities with

the payment of a management fee. These models are suitable if there is lack of financial sources.

The following risks should be carefully taken into account when the DBFO option is selected:

- Long-Term Contract: DBFO contracts are usually long-term, depending on the type of facility.
- Formation of special purpose vehicle: In the DBFO scheme, the private service provider is usually a consortium formed by multiple companies.
- Sharing of responsibilities: Responsibilities and risks for activities which can be better controlled and managed by the private partner are transferred to the SPV.
- Performance based payment mechanism: The public sector pays only when services are delivered, depending on whether the services provided meet specified performance standards.

(iv) Creation of SWM Operating Revolving Fund

The SWM Operating Revolving Fund (SWMORF) will be set up to fund the monitoring system as well as the capacity development for the ultimate purpose of improving the enforcement of the solid waste management services. Part of the collected tipping fees will be used for the revolving financial sources of SWMORF, and tipping fees will be applied at the point of entry at the sanitary landfill site. The basic principles of SWMORF are as stated below:

- The tipping fee is based on the amount of wastes to be disposed at the sanitary landfill site, which can be measured on a weight or volume basis. Using a weight-based charge requires a weigh-bridge at the sanitary landfill site.
- In case of funding by the loan option from an international lending institution for the construction of the sanitary landfill site and intermediate treatment facilities, part of the tipping fees will be used for the fund for the repayment of the loan, while the balance will be utilised for the monitoring and capacity development for improving the enforcement of the solid waste management services. The allocation between the repayment of the loan and the improvement of the enforcement of the solid waste management services will depend on the negotiations between the borrower and the SWMPC.

(4) Implementation of Contract Procedures for Franchise Contracts and Service Contracts

The pre-contract requirements for a zone-based franchise contract for a waste collection service as well as a service contract for a sanitary landfill operation are the management of the complicated tendering procedures for the private sector involvement. Especially, it is crucial to secure the following 7-step clear-cut process of preparing for private sector involvement:

Step 1: Preparation for Expression of Interests and Pre-qualification of Bidders

The preparation for the expression of interests as well as the pre-qualification of bidders is the first step of the tendering process. The pre-qualification of bidders will screen out those interested companies which do not satisfy certain criteria, thereby selecting eligible bidders to compete in the full-tendering stage. A pre-procurement briefing is open to any interested private company.

Step 2: Preparation of Tender Documents

Tender documents will be issued to bidders who are interested in providing the required services, and are judged to be competent to provide the solid waste management services. These tender documents are expected to be the model for the contract which would be finally agreed between SWMPC and the awarded bidder. As well as providing the pattern and basis for the contract, tender documents should also provide technical information which bidders will need in preparing their offers, and instructions regarding the preparation and submission of bids and the tendering process.

Before finalising tender documents it is advisable to invite comments on draft tender documents from potential bidders, especially when the authority has little experience in the preparation of the tendering process for the franchise contract as well as the service contract, which is applicable to the case of SWMPC. The experiences of preparing tender documents provide useful training opportunities for the technical, legal and financial staff of SWMPC who will be involved in assessing the bids and working with the private sector.

Step 3: Preparation of the Bid

Bidders are required to provide considerable efforts and expenses in the preparation of bids to offer the technical and financial proposals in accordance with the final tender documents.

Step 4: Clarifications and Feedbacks to Tender Documents

An ad-hoc meeting should be arranged to allow bidders to request the authority to clarify any unclear aspect of the tender documents. The meeting should be held in a transparent way, and clarifications and feedbacks to tender documents should be properly carried out.

Step 5: Bid Bond

The purpose of a bid bond is to encourage all bidders to be serious and ready to commit themselves in providing the required services in the tender documents. All bid bonds should be returned when the contract is signed. If a candidate franchisee or a management service provider does not enter into the contract, the bid bond is forfeit. Apart from the bid bond, at the signing of the contract, the awarded bidder is required to submit a performance bond.

Step 6: Submission of Bids

The preparation of a bid for a complicated contract such as a franchise or a service contract involves a considerable amount of works. Private companies which organise their resources in an effective way are able to produce their technical and financial proposals in time for the announced deadline for submission.

Step 7: Selection of Franchisee and Management Service Provider

The selection of a franchisee or a management service provider is the most critical decision in the entire process, since the cost performance of the awarded private companies will affect the success or failure of the private sector involvement in the long run. While the bidders' proposals can be evaluated only by experts, the process should be monitored by independent officials, so that there is general perception that the decision is purely based on technical and cost evaluations. Evaluation criteria must be prepared and each bid must be assessed in a transparent way.

The tender evaluation committee inside the procurement and contract department of the SWMPC shall evaluate the proposals on the basis of their responsiveness to the terms of reference and the point system specified in the evaluation score card. A proposal shall be rejected at this stage if it does not respond to important aspects of the terms of reference, or if it fails to achieve the minimum technical score indicated in the evaluation score card. Quality and Cost Based Selection (QCBS) method will be employed to select the highest-ranked bidder to negotiate its proposal and the contract on the basis of the technical and financial proposals submitted in accordance with the instructions. The criteria to select a franchisee in each collection zone would be based on the price

factors such as the level of collection charges and franchise fees, and the technical factors such as the number of collection vehicles, frequency of collection services and the collection routes. On the other hand, the criteria to select a service provider for the management of the sanitary landfill site and intermediate treatment facilities would be based on the price factors such as the unit operational cost to dispose the waste per ton and the technical factors such as the quality of equipment and staff.

The level of the tariff for the franchised collection and transport services or the service fee for the service provider for the management of the sanitary landfill site and intermediate treatment facilities will be decided based on the negotiations with reference to the results of the tender in which the bid price is submitted. The SPWMC will finally decide the level of the tariff and the service fee with its own cost calculation of the service delivery in each collection zone and the management of the sanitary landfill and intermediate treatment facilities. In the case of a franchise, the bidders who are competing for a franchise may be asked to compete on the basis of the fee that they will charge for the services, and the bidder who offers a satisfactory service at the lowest user fee is awarded the franchise. Alternatively, the user fee may be set by the SWMPC and the franchise awarded to the bidder that offers the largest franchise fee to the SWMPC. In this case, the SWMPC shall carefully take into account the service charges in other zones than the awarded zones.

4.9.2 Mid-Term Action Plan

(1) Mid-Term Monitoring of Franchised Zone Management

It is critical to monitor the franchised zones in which a monopoly is granted a franchisee to provide collection services and collect fees for the services in a defined area for a specific period. The major concern in the franchise system is that unauthorised private companies might collect wastes from waste generators in exchange for fees, and illegally dump wastes. These activities might deteriorate the sustainability and basis for the franchise system itself by reducing its customers and fees. Therefore, the proper mid-term monitoring of the franchised zones and boundaries is a key to the sustainable operation of the franchise system.

(2) Mid-Term Performance Monitoring of Franchisees and Service Providers

The mid-term monitoring system will significantly contribute to the feedback mechanisms for rectifying poor performance of franchisees and service providers at the timing of the renewal of the first contracts. After the first 5-year contracts with franchisees and service providers, the mid-term performance monitoring by using benchmarks will be carried out.

For example, the benchmarks for the franchisees include:

- Degree of meeting contractual level of quality of services;
- Degree of meeting contractual frequency of services;
- Waste collection rate;
- Charge collection rate;
- Degree of cooperation for 3R activities;
- Contents of financial and activity reports;
- Number of grievances; and
- Degree of meeting other contractual requirements

Effective performance monitoring requires that the SWMPC monitors whether or not the service is actually and properly being delivered by private franchisees or service providers in accordance with the contracted standards. The staff of the monitoring and enforcement department together with the zonal management department of SWMPC should monitor the performance of private franchisees

and service providers on regular and random-spot basis. The performance should be measured and reported reliably and accurately.

4.9.3 Long-Term Action Plan

(1) Auditing of Franchisees, Service Providers and Revolving Funds

The accountability and transparency of the operation of franchisees, service providers and revolving funds is a key to the sustainable private sector involvement for a long period. Therefore, the auditing by the relevant audit authority should be periodically carried out over a long period.

The Specialised Audit Department of Kenya National Audit Office (KENAO) is in charge of the auditing of the organisations in which public financial sources are injected. Since the franchisees, service providers and revolving funds are receiving public financial sources, they should be audited by the Specialised Audit Department of KENAO in terms of fee collections by franchisees, service fee payments for service providers and subsidy utilisation by revolving funds.

(2) Continuous and Long-Term Performance Monitoring of Franchisees and Service Providers, and Enlargement of Franchise Zones

After the second 5-year franchise contract period, the overall private sector involvement system will be comprehensively reviewed to achieve a longer-term sustainability based on the continuous and long-term performance monitoring of franchisees and service providers.

At the same time, in the longer period, there is a possibility that the franchise zones will be enlarged by transferring some CCN/SWMPC contracting-out zones to franchise zones, if the willingness to pay for the charges of the contractout zones increases and become affordable to pay for collection charges.

(3) Long-Term Management of Revolving Funds and Provision of Subsidies

The long-term and continuous management of revolving funds is essential for the sustainable private sector involvement, since one of the revolving funds contribute to the investment of collection vehicles through the provision of subsidies. The continuous management of revolving funds should be carried out in a transparent way. The management tools for the long-term management of funds are:

- Record of payment of franchise fees and auditing;
- Record of receipt of subsidies; and
- Financial and activity reports on franchisees.

(4) Extension of PPP Model to PPPP Model

(a) Concept of PPPP Model

Under a franchise contract between the SWMPC and a private franchisee for the collection and transport services as well as a service contract between the SWMPC and a private service provider for the sanitary landfill management and intermediate treatment facilities, the rights and obligations of both parties can be stipulated clearly in the contract, and if problems arise, they can be resolved within the terms and conditions of the contract. Therefore, the Public-Private Partnership (PPP) can be indicatively defined in the franchise and service contract documents under the selected private sector involvement scheme. Although this sort of a contractual relationship under the private sector involvement is frequently referred to as Public-Private Partnership (PPP), the partnership must involve another important stakeholder,

that is, "People." In other words, the partnership should be extended to three-way **"Public-Private-People Partnership (PPPP)**.

The concept of three-party PPPP is crucial to the success of the private sector involvement. All parties should equally have rights and obligations in accordance with the agreements among them. Such an equal partnership will successfully result in effective and sustainable solid waste management services which will continue for a long period.

The successful implementation of the new Master Plan can be achieved in the framework of a **win-win-win relationship** among these three parties. In this win-win-win framework, the public sector will benefit from the efficient outsourcing and utilisation of the private capital, the private sector will benefit from a reasonable profit, valuable experiences and stable working opportunities, and the people will benefit from sustainable, satisfactory and affordable solid waste management services. This win-win-win relationship can be attained only when these three parties respect the rights and obligations of each party in relation to the sustainable solid waste management.

Figure 4.9.3 is the image of the concept of PPPP.

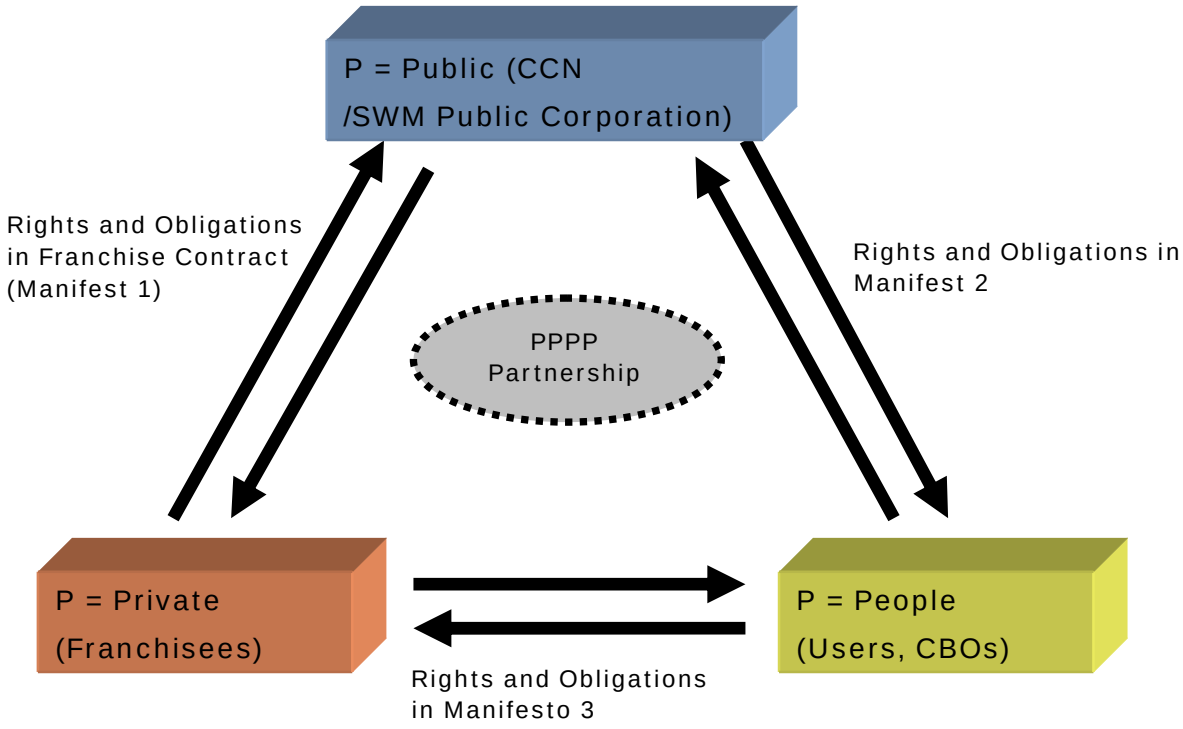


Figure 4.9.3 Image of Concept of PPPP (Public-Private-People Partnership)

(b) Proposed Contents of Manifestos

Clear description of the rights and obligations in the contract document is the first step to establish the long-term and desirable relationship between the public sector and the private sector. In the same manner, in the case of relationship between the public sector and people or the private sector and communities, agreed manifestos should be documented to clarify the obligations of these parties for the long-term partnership. **Table 4.9.6** shows the proposed contents of manifestos.

Table 4.9.6 Proposed Contents of Manifestos

Stakeholders	Obligations	Documents	Updating Timing of Documents
Manfesto 1: Between SWMPC and Private Franchisees/Private Service Providers			
SWMPC	● Strict management of franchise zones ● Monitoring of illegal dumping ● Enforcement of penalties for non-payment of collection fees ● Payment of service fees to service providers	Franchising and Service Contract	In 2016, 2021 and 2026 at the time of contract
Franchisees and Service Providers	● Fulfillment of delivering collection services ● Fulfillment of delivering operation services for management of sanitary landfill site and intermediate treatment facilities ● Cooperation for 3R activities ● Cooperation for monitoring activities	Franchising and Service Contract	In 2016, 2021 and 2026 at the time of contract
Manifesto 2: Between SWMPC and CBOs/Communities			
SWMPC	● Provision of contracting-out collection services in low-income areas ● Provision of assistance in the field of public awareness ● Provision of information on basic knowledge of solid waste management ● Provision of information on the zoning and franchise contract ● Provision of information on financial and activity reports on SWMPC ● Provision of assistance in the field of primary collection practices and technologies	MOU (Minutes of Understanding)	Annual stakeholder meeting from 2016
CBO and Communities	● Commitment to payment of waste collection charges stipulated in the franchise contract in each zone ● Cooperation for primary collection and pilot projects ● Cooperation for 3R and pilot projects ● Cooperation for public awareness and pilot projects	MOU (Minutes of Understanding)	Annual stakeholder meeting from 2016
Manifesto 3: Between Franchisees and CBOs/Communities			
Franchisees	● Delivery of waste collection services ● Provision of information on level and frequency of collection services ● Provision of franchisee's management information ● Provision of information on grievance solution procedures	MOU (Minutes of Understanding)	Annual stakeholder meeting from 2016
CBO and Communities	● Payment of fees to franchisees ● Cooperation for minimisation of wastes at source ● Cooperation for primary collection ● Cooperation for raising public awareness	MOU (Minutes of Understanding)	Annual stakeholder meeting from 2016

Source: JICA Survey Team