

3. REVIEW OF RELEVANT STUDIES

3.1 Review of UNEP Integrated Solid Waste Management Plan (ISWMP)

The report was prepared in February 2010, and its contents are composed of visions and strategy for SWM, the baseline situation on SWM, success factor analysis, gap analysis, proposed plan of actions and specific actions for implementation.

The discussions regarding collection and transportation are summarised as follows:

Target:

- Streamline type of collection vehicles, the collection level shall be increased from current 50 % to 75% by 2013 for all zones
- The increase level of transportation of waste from all zones from 18 % to 50 % to designated waste disposal sites in 2015 by using an appropriate transport system including railway
- Establishment of franchise-based zoning collection system

The Situation before ISWMP:

- The current collection levels are estimated at 50 % at best, which equals to total collection levels of about 1,560 ton/day

Themes for Action:

- Complimentary roles of CBO collectors and private collectors with licensing and regulatory clarity
- Zoning of waste collection
- Development of material recovery and transfer facilities

The report was reviewed as follows:

- The basis of the indicated figures such as collection level is not explained clearly.
- No concrete framework of implementation or implementation plan is indicated.

However, their recommendations as shown below were taken into consideration for the formulation of the master plan in relation to collection and transportation;

- Zoning of waste collection or establishment of franchise based zoning collection system: The collection and transportation plan of this master plan was based on the proposed future franchise zoning system for private collectors
- Utilisation of appropriate transport system including railway: Technical options including railway transport system were studied in this master plan
- Development of material recovery and transfer facilities: The development of a transfer station including a material recovery system was studied

3.2 Review of Old JICA Master Plan

JICA formulated a master plan in 1998 for the old waste management in Nairobi City.

The master plan was prepared in phased implementation of short-, mid- and long-term action plans.

The performance of the action plan regarding collection and transport proposed in the previous master plan and the proposed action plans in the new master plan 2010 is shown in **Table C.3.1** at each implementation phase.

(1) Short-Term Plan (1998 - 2003)

Designing and procurement of collection vehicles:

In the previous master plan, the requirement of collection vehicles mainly composed of the detachable container carrier was proposed to attain the target collection rate of 60% during this period. Therefore, the designing and procurement of collection vehicles and equipment was proposed. However, no collection vehicle was procured during that period. The major reasons are presumed to be the low priority of CCN's budget for the procurement of collection vehicles and the lack of support from foreign donors for the procurement of collection vehicles. In the new master plan of 2010, on the other hand, the procurement of collection vehicles mainly composed of vehicles with detachable container carriers for CCN as in the previous master plan is proposed through a loan application to foreign donors to attain the collection rate of 50% in 2015.

Construction of a new transfer station (1st phase):

The construction of a new transfer station was proposed at the site of Makadara or Kariobangi. However, this project was not realised for almost the same reason as in the procurement of collection vehicles. In the new master plan of 2010, the construction of a new transfer station in the existing Dandora Dumpsite is proposed through a loan application to foreign donors.

The Community Waste Management Project [CWMP(1)]:

The CWMP is a community-based solid waste management project which was planned to be implemented in informal settlements. According to CCN, the Community Development Section (CDS) was created in CCN based on the proposal of the previous master plan to organise the community groups in partnership with NGOs, but no specific action was implemented. In the new master plan of 2010, a pilot project is to be implemented to organise the CBOs and residents in slum areas through the pilot project in a technical cooperation scheme and the creation of PEC (Public Awareness, Environmental Education and Community Participation) Unit in CCN.

(2) Mid-Term Plan (2004-2007)

As in the short-term plan, the procurement of collection vehicles, construction of a new transfer station (2nd phase) and the CWMP (2) were proposed to attain the target collection ratio of 80% in 2004. However, these proposals were not implemented for almost the same reasons as in the short-term plan. In the new master plan of 2010, the procurement of collection vehicles will be done through the secure execution of the budget of CCN or utilisation of the Capital Revolving Fund which is newly proposed in the new master plan to attain the target collection ratio of 65% at 2020. As for the community waste management in informal settlements, the new PEC unit is to continuously implement the community waste management.

(3) Long-Term Plan (2008)

As in the short-term plan, the procurement of collection vehicles, construction of a new transfer station (Final Phase) and the CWMP (3) were proposed. However, these proposals were not implemented for almost the same reasons as the short-term plan. In the new master plan of 2010, the procurement of collection vehicles will be done through the utilisation of the Capital Revolving Fund which is proposed in the new master plan. As for the community waste management in informal settlements, the new PEC Unit is to continuously implement the community waste management.

Table C.3.1 Comparison between Previous Master Plan (JICA-98-MP) and New Master Plan (JICA-2010-MP)

Action Plans in Old Master Plan 1998	Actual Performance of Action Plans in Old Master Plan 1998		Proposed Action Plans in New Master Plan 2010	New Concepts to Remove Constraints in Old Master Plan 1998
	Results (Done: ●, Not done yet: × Partially done: ▲)	Cause or Constraints of "Not done yet" or "Partially done"		
Programme 1: Collection and Transportation Plan				
Short-term Plan (Old Master Plan: 1998 - 2003, New Master Plan: 2011 - 2015)				
Designing and procurement of collection vehicles and other equipment	×	- Low priority of CCN's budget execution on implementation of SWM - No support from foreign donors to implement the project	- Formulation of waste collection implementation plan by CCN - Procurement of collection vehicles for CCN's operation of collection - Application of loan for procurement of collection vehicles for foreign donors	- Secure execution of budget by CCN on implementation of SWM - Application of loan for Procurement of collection vehicles from foreign donors
Construction of a new transfer station (1st Phase)	×	- Low priority of CCN's budget execution on implementation of SWM - No support from foreign donors to implement the project	- Construction of a transfer station at existing Dandora Dumpsite as a priority project - Application of loan for procurement of collection vehicles for foreign donors	- Application of financial support for foreign donors to implement the project
The Community Waste Management Project (CWMP(1))	▲	- The units for implementation of the project was created, but no specific works were done. - Low priority of CCN's implementation of CWMP - Low priority of CCN's budget execution for implementation of SWM	- Implementation of pilot projects for CBOs and residents in low income and slum areas based in a technical cooperation project scheme	- Public education and pilot projects in a technical cooperation project - Establishment of PEC to promote public or environmental education to CBOs and residents (The detailed information is shown in Section F of Supporting Report)
Mid-term Plan: (Old Master Plan: 2004 - 2007, New Master Plan: 2016 - 2020)				
Designing and procurement of collection vehicles and other equipment	×	- Low priority of CCN's budget execution on implementation of SWM - No support from foreign donors to implement the project	- Monitoring of implementation of collection and transportation plan - Procurement of collection vehicles for CCN's operation of collection - Application of loan for procurement of collection vehicles for foreign donors	- Secure execution of budget by CCN for implementation of SWM - Establishment and utilisation of Capital Revolving Fund to procure collection vehicles
Construction of a new transfer station (2nd Phase)	×	- Low priority of CCN's budget execution on implementation of SWM - No support from foreign donors to implement the project	- Construction of a transfer station at existing Dandora Dumpsite as a priority project - Application of loan for procurement of collection vehicles for foreign donors	- Application of financial support for foreign donors

Action Plans in Old Master Plan 1998	Actual Performance of Action Plans in Old Master Plan 1998		Proposed Action Plans in New Master Plan 2010	New Concepts to Remove Constraints in Old Master Plan 1998
	Results (Done: ●, Not done yet: × Partially done: ▲)	Cause or Constraints of "Not done yet" or "Partially done"		
The Community Waste Management Project (CWMP(2))	×	<ul style="list-style-type: none"> - The actual implementation was not realised. - Low priority of CCN's implementation of CWMP - Low priority of CCN's budget execution for implementation of SWM 	<ul style="list-style-type: none"> - Continuous implementation of public / environmental education to the residents in low income or slum areas. - Continuous promotion by PEC to promote CBOs activities in SWM in low income and slum areas 	<ul style="list-style-type: none"> - Public education and pilot projects in a technical cooperation project - Monitoring / Management by PEC to promote public or environmental education to CBOs and residents (The detailed information is shown in Section F of Supporting Report)
Long-term Plan (Old Master Plan: 2008, New Master Plan: 2021 - 2030)				
Designing and procurement of collection vehicles and other equipment	▲	- In 2009, 12 collection vehicles were procured.	<ul style="list-style-type: none"> - Monitoring of implementation of collection and transportation plan by CCN - Procurement of collection vehicles for CCN's operation of collection 	<ul style="list-style-type: none"> - Secure execution of budget by CCN on implementation of SWM - Utilisation of Capital Revolving Fund to procure collection vehicles
Construction of a new transfer station (Final Phase)	×	<ul style="list-style-type: none"> - Low priority of CCN's budget execution on implementation of SWM - No support from foreign donors to implement the project 	- Operation and maintenance of the transfer station in Dandora	- Utilisation of Capital Revolving Fund for the operation and maintenance of the transfer station
The Community Waste Management Project (CWMP(3))	×	<ul style="list-style-type: none"> - The actual implementation was not realised. - Low priority of CCN's implementation of CWMP - Low priority of CCN's budget execution for implementation of SWM 	<ul style="list-style-type: none"> - Continuous implementation of public / environmental education to the residents in low income or slum areas. - Continuous promotion by PEC to promote CBOs activities in SWM in low income and slum areas 	<ul style="list-style-type: none"> - Public education and pilot projects in a technical cooperation project - Monitoring / Management by PEC to promote public or environmental education to CBOs and residents (The detailed information is shown in Section F of Supporting Report)

4. FORMULATION OF THE MASTER PLAN

4.1 Development of Technical Options

(1) Planning Concept

(a) Shift from Division-Based Operation to Proposed Zone-Wide Operation

According to the proposed PPP scheme, the collection operation will shift from the current “division-based operation” to the “zone-wide operation” corresponding to the residents’ income level. The “division-based operation” is currently practiced by private collectors in the smallest administrative units of “division” based on their own “door-to-door” contract with customers, and this could not be controlled by CCN. The “zone-wide operation,” on the other hand, is the collection system being proposed where only one franchisee will operate in a certain Zone in which a unified waste charge is expected to be imposed on the same income level of waste generators.

The collection area in Nairobi City will be divided into 9 franchise zones and another zone such as slum areas where it will be difficult for private collectors to collect waste charges in the proposed PPP scheme. Private collector (franchisee) will collect the residential and commercial wastes in above 9 zones for the future expected increase of income level. CCN and its contractors will concentrate their collection activities on the residential or commercial areas outside above 9 franchise zones, or they will concentrate their operation on the collection of market waste and road sweeping since CCN is still operating in these areas. The inspection or monitoring of private collection activities in above 9 zones will be CCN’s crucial roles in the future SWM system.

Accordingly, the development of collection and transportation plan should be conducted based on the proposed future zone-wide operation system.

(b) Future Development of Transportation Network

(i) Future Transportation Development Plan

The JICA survey team conducted an interview with the Urban Road Authority on March 8, 2010 to obtain clarification on the future road development plans and also the currently on-going projects in Nairobi City. **Table C.4.1** and **Figure C.4.1** show the future road development plan. According to the authority, they are developing their 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 C.4.1** shows that the main bypass roads will be constructed in 2015 and become operational in 2016. For development of the technical options especially for the transportation system, these future road network development plans or their implementation should be fully taken into consideration.

Table C.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
Southern Bypass	New	Preparation of design review and construction	2015	①
Link Road	New	Design is ongoing. Preparation of tender for its construction by using Japanese fund.	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 is on going and preparation for tender.	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

In addition to the roads listed in **Table C.4.1**, the design works are being carried out for the following roads to eliminate their missing links in the city centre of Nairobi city.

- River Road to Ngara Road -M1
- Muratina St(General Waruingi St to Juja Road) -M5
- Likoni Road Extension (Exterprise Road to Mombasa Road)
- Ring road Parklands Extension M15b
- Landhies Road to Quarry Road M16

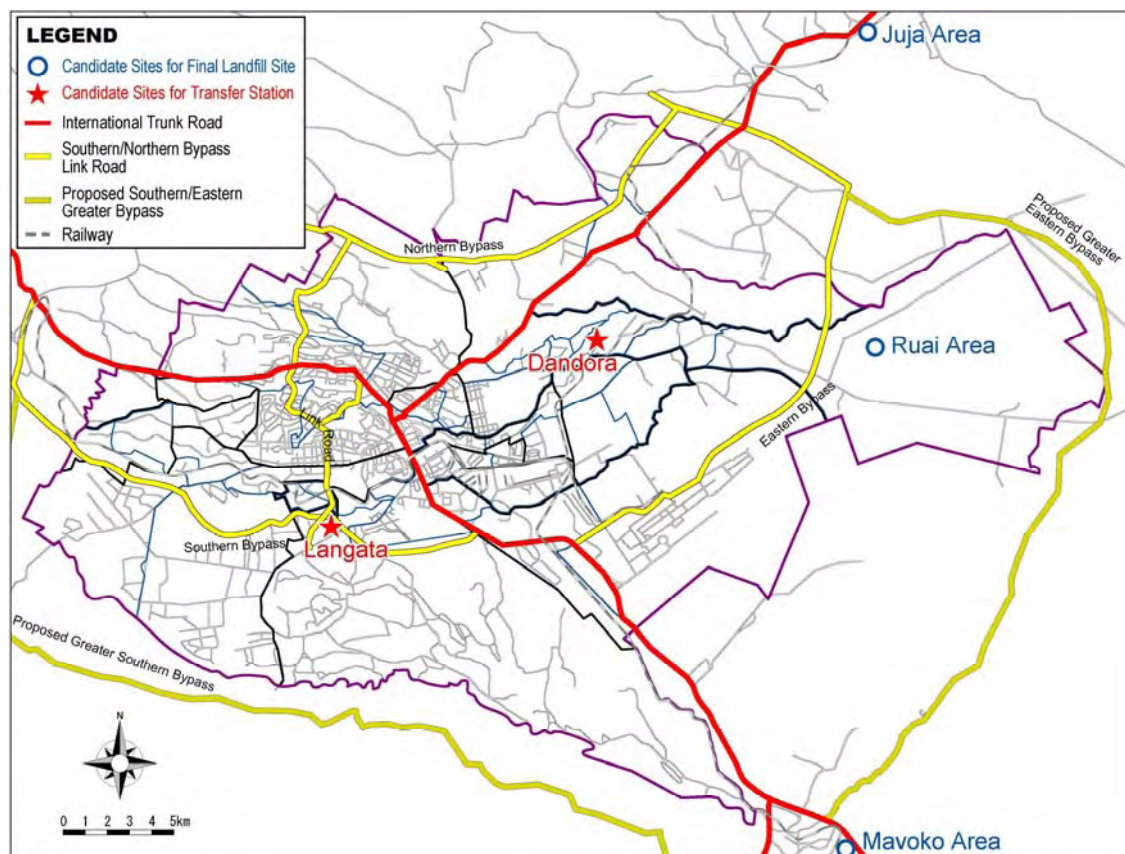


Figure C.4.1 Future Road Network Development Plans

(2) Possible Technical Options

Nairobi City has 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 roles of collectors should be determined by taking this situation. Transportation system, on one hand, should be examined by taking all possible mode of transportation. For example, the transfer transport using road networks or existing railway system will be possible options and they will be worthy of studying if they have advantage to transport the waste in a long distance.

(a) Collection System

(i) Demarcation on Operation of Collection System

In 2016, the collection system will start to shift to zone-wise franchise operation from existing division-wise operation. Based on above change of collection system, the following demarcation of each role/responsibility on collection operation is proposed.

- CCN/SWMPC: Supervision / Inspection of Waste Collection Zone-1 to Zone-9
- CCN/SWMPC and Contractor: Collection of Waste in CCN/SWMPC-Zone, Street Sweeping, Public Parks and Public Market Waste in All Zones
- Private Operator (Franchisee): Collection of all domestic and commercial wastes excluding street sweeping and market waste as an individual franchisee in Zone-1 to Zone-9 (All domestic and commercial wastes discharged from the whole zone excluding street sweeping and market waste)

(ii) Collection Method

Two types of collection method, namely, the station type and the door-to-door type are currently done. CCN operates its collection work through the station method, while private collectors operate by the door-to-door method through contracts with customers who can afford to pay the waste charges. The collection system should be selected by taking the local condition such as type of generation source, land use, residential pattern or current state of operation of waste collectors into consideration to the fullest extent.

Station Type of Collection

This system is suitable for areas such as markets, housing complex (apartments) or slum areas where plenty of wastes are generated and waste generators could not be identified. The container plus detachable container carrier is recommended for this area to raise the collection frequency. Dump truck (or tipper) is to be adopted for the container collection system.

Door-to-Door Type of Collection

This method is already being applied by the private collectors who could easily identify the waste generators for collecting the waste charges. This method can be applied continuously also in the future. In this case, compactor or dump truck (tipper) is recommendable.

The different vehicle types have merits and demerits as shown in **Table C.4.2**. Dump trucks have the merit of lower cost compared to the compactor and the container plus detachable container carrier in spite of the demerit of unsanitary, adverse impact on urban aesthetic environment or heavy burden on loading work. Compactor has the merit of sanitary and demerit of higher cost compared to dump trucks. Container system has the merit of high efficiency of collection and the demerit of regular replacement of containers.

Table C.4.2 Technical Options on Type of Collection Vehicles

Type of Collection Vehicles	Merit	Demerit
Dump Truck	<ul style="list-style-type: none"> Robust Lower cost compared to compactor and detachable container carrier 	<ul style="list-style-type: none"> Unsanitary Adverse impact on aesthetic environment as an urban areas Heavy burden on loading crew
Compactor	<ul style="list-style-type: none"> Sanitary Low impact on loaders work environment 	<ul style="list-style-type: none"> Higher cost compared to dump truck Enough maintenance is required
Container plus Detachable Container Carrier	<ul style="list-style-type: none"> High frequency of collection is expected 	<ul style="list-style-type: none"> Regular replacement of container is necessary

(b) Transportation System

(i) Basic Condition on Alternative Plans of Transportation System

The transport system option is composed of a combination of transfer and transport systems toward the final landfill sites from three collection areas where wastes are generated in Nairobi City, i.e. the west, central and east areas, as shown in **Figure C.4.2**. The target waste collection amounts in these three areas are shown in **Figure C.4.2** based on the collected waste amount in each zone as of the target year 2030, as shown in **Table C.4.3**. For the transport system, the future road network development plan and the utilisation of the existing railway transport system were taken into consideration. With

regard to the final landfill site, the candidate sites including the areas outside the jurisdiction of Nairobi City were considered in addition to the sites inside Nairobi City.

Table C.4.3 Division of Target Collected Waste Amount at Each Area

Area	Covered Zone	Waste Amounts to be collected as of 2030 (t/d)
West	Zone 1 (50%), Zone 5 (100%), Zone 6 (100%), Zone 7 (100%), CCN Zone (Waitihaka, Mutuni, Kawangware, Kibera, Sarangombe)	940
Central	Zone 1 (50%), Zone 2 (50%), Zone 3(50%), Zone 4 (50%), Zone 8 (100%), Zone 9 (100%), CCN Zone (Mathare, Eastleigh, Kariobangi, Korongocho, Ruaraka, Dandora)	1,590
East	Zone 2 (50%), Zone 3 (50%), Zone 4 (50%), CCN Zone (Njiru, Ruai)	340
Total		2,870

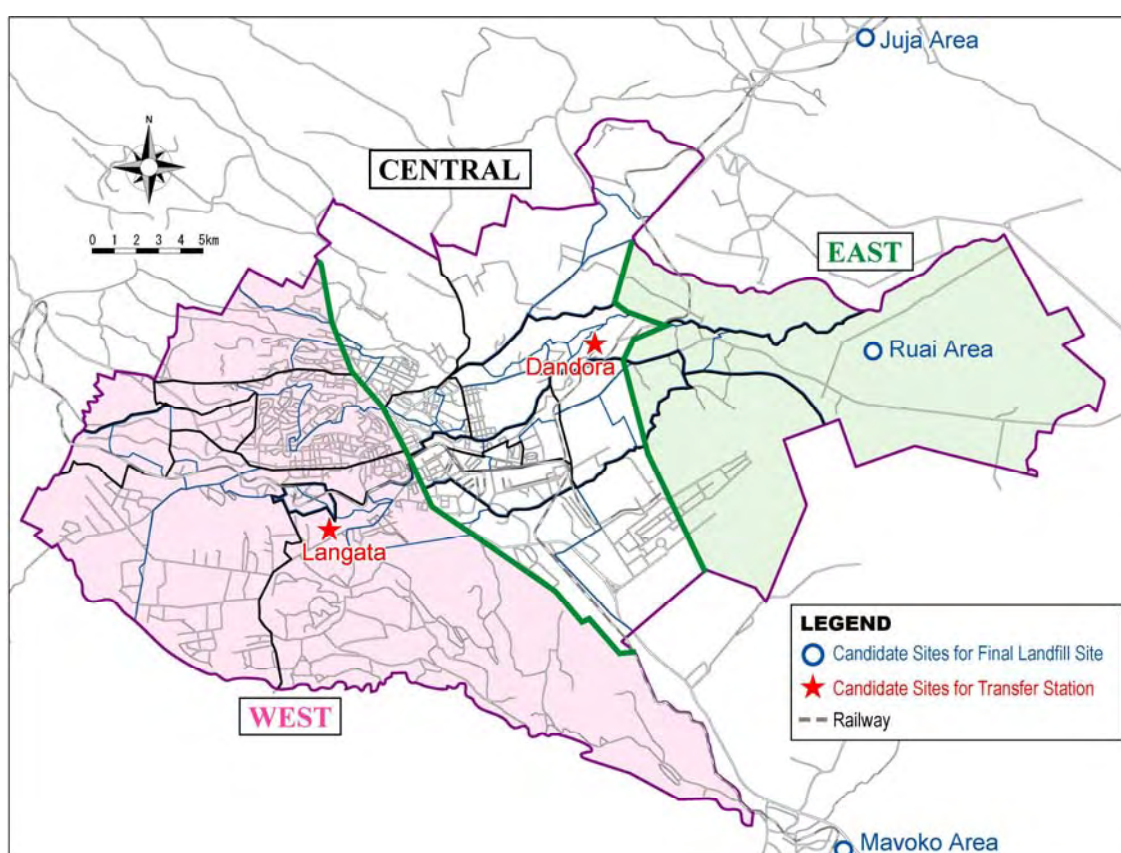


Figure C.4.2 Division of Collected Waste Amount

(ii) Technical Options on Transportation System

There are some options of transporting waste from Nairobi City to the final landfill site: the direct haul or use of a transfer station, and the use of road networks or the existing railway. The transport system could be the combination of a transfer system (including options without transfer system) and the three final landfill sites, namely; the Ruai site (which is located in the east area of Nairobi City, i.e., inside the jurisdiction of Nairobi City); the Mavoko site (which is located south of Nairobi City, i.e., outside of the jurisdiction of Nairobi City); and the Juja site (which is located south of Nairobi City, also outside of the jurisdiction of Nairobi City). Two locations, Langata and Dandora (the

existing open dumping site), are considered as the candidate sites of a transfer station. The candidate site of Kariobangi South for the development of a transfer station and which was identified as a candidate site in the initial stage of the survey was not selected since the existing dwelling houses are close to the site and the future priority of land use are horticulture, storage facilities and matatu terminal.

The existing Kibera Railway Station is considered as a loading facility of waste using the railway transport system, and the existing Mavoko and Juja stations are considered as unloading facilities using the railway transport system. **Table C.4.4** shows the details of each alternative and **Figure C.4.3** shows the location map of each alternative.

All of the alternatives shall include the Ruai site as the final disposal site. Two cases of single or plural (two) system are considered for the transfer system.

In the case of direct haul to the Ruai final landfill site (Case-1), the wastes collected from the west area are transported to the Ruai final landfill site for a distance of 32 km, while in the railway transport (Cases 2, 3, 6 and 7), the wastes collected from the west area are transported to the Juja and Mavoko stations for a distance of 52 and 47 km, respectively.

Table C.4.4 Details of Technical Options of Transport System

Case No.	Collection Area & Transfer System	Final Landfill Site	Details of Technical Options
1	<u>Direct Haul to Ruai</u> (No Transfer System)	Ruai	The generated waste is directly hauled to Ruai final landfill site. Distance: <ul style="list-style-type: none"> West to Ruai: 32 km Central to Ruai: 16 km East to Ruai: 7 km
2	<u>West: Railway Transport to Juja</u> (940 t/d) <u>Central, East: Direct Haul to Ruai</u>	Juja / Ruai	The generated waste in the west area of Nairobi City is transported by railway to Juja. The waste generated in the central and east areas is transported directly to Ruai final landfill site. Distance: <ul style="list-style-type: none"> West to Juja: 52 km Central to Ruai: Same as Case 1 East to Ruai: Same as Case 1
3	<u>West: Railway Transport to Mavoko</u> (940 t/d) <u>Central, East: Direct Haul to Ruai</u>	Mavoko / Ruai	The generated waste in the west area of Nairobi City is transported by railway to Mavoko. The waste generated in the central and east areas is transported directly to Ruai final landfill site. Distance: <ul style="list-style-type: none"> West to Mavoko: 47 km Central to Ruai: Same as Case 1 East to Ruai: Same as Case 1
4	<u>West & Central: Road Transport through Transfer Station at Dandora Dumpsite</u> (2,600 t/d) <u>East: Direct Haul to Ruai</u>	Ruai	The waste in west and central areas is transported to Ruai final dumping site through the transfer station in Dandora Dumpsite. The waste in east area is hauled directly to Ruai final landfill site. Distance: <ul style="list-style-type: none"> West to Dandora: 16 km Central to Dandora: 5km East to Ruai: Same as Case 1
5	<u>West: Road Transport through Transfer Station at Dandora Dumpsite</u> (940 t/d) <u>Central, East: Direct Haul to Ruai</u>	Ruai	The generated waste in the west area of Nairobi City is transported to Ruai through the transfer station in Dandora Dumpsite. The waste generated in the central and east areas is hauled directly to Ruai final landfill site. Distance: <ul style="list-style-type: none"> West to Dandora: Same as Case 4 Central to Dandora: Same as Case 4 East to Ruai: Same as Case 1

Case No.	Collection Area & Transfer System	Final Landfill Site	Details of Technical Options
6	West: <u>Railway Transport to Juja</u> Central: <u>Road Transport through Transfer Station at Dandora to Ruai</u> (1,590 t/d) East: Direct Haul to Ruai	Juja / Ruai	The generated waste in the west area of Nairobi City is transported by railway to Juja. The waste in the central area is transported to Ruai through the transfer station in Dandora Dumpsite. Distance: <ul style="list-style-type: none"> West to Juja: Same as Case 2 Central to Dandora: Same as Case 4 East to Ruai: Same as Case 1
7	West: <u>Railway Transport to Mavoko</u> Central: <u>Road Transport through Transfer Station at Dandora to Ruai</u> (1,590 t/d) East: Direct Haul to Ruai	Mavoko / Ruai	The generated waste in the west area of Nairobi City is transported by railway to Mavoko. The waste in the central area is transported to Ruai through the transfer station in Dandora Dumpsite. Distance: <ul style="list-style-type: none"> West to Mavoko: Same as Case 3 Central to Dandora: Same as Case 4 East to Ruai: Same as Case 1
8	West: <u>Road Transport through Langata Transfer Station (940 t/d)</u> Central, East : <u>Direct Haul to Ruai</u>	Ruai	The generated waste in the west area of Nairobi City is transported to Ruai through the transfer station in Langata site. The waste generated in the central and east areas is hauled directly to Ruai final landfill site. Distance: <ul style="list-style-type: none"> West to Langata: 7 km Central to Ruai: Same as Case 1 East to Ruai: Same as Case 1
9	West: <u>Road Transport through Transfer Station (940 t/d) at Langata to Ruai</u> Central: <u>Road Transport through Transfer Station</u> (1,590 t/d) at Dandora St. to Ruai East: Direct Haul to Ruai	Ruai	The generated waste in the west area of Nairobi City is transported to Ruai through the transfer station in Langata site. The waste generated in the central area is transported to Ruai through the transfer station at Dandora. The waste in the east area is hauled directly to Ruai. Distance: <ul style="list-style-type: none"> West to Langata: Same as Case 8 Central to Dandora: Same as Case 4 East to Ruai: Same as Case 1

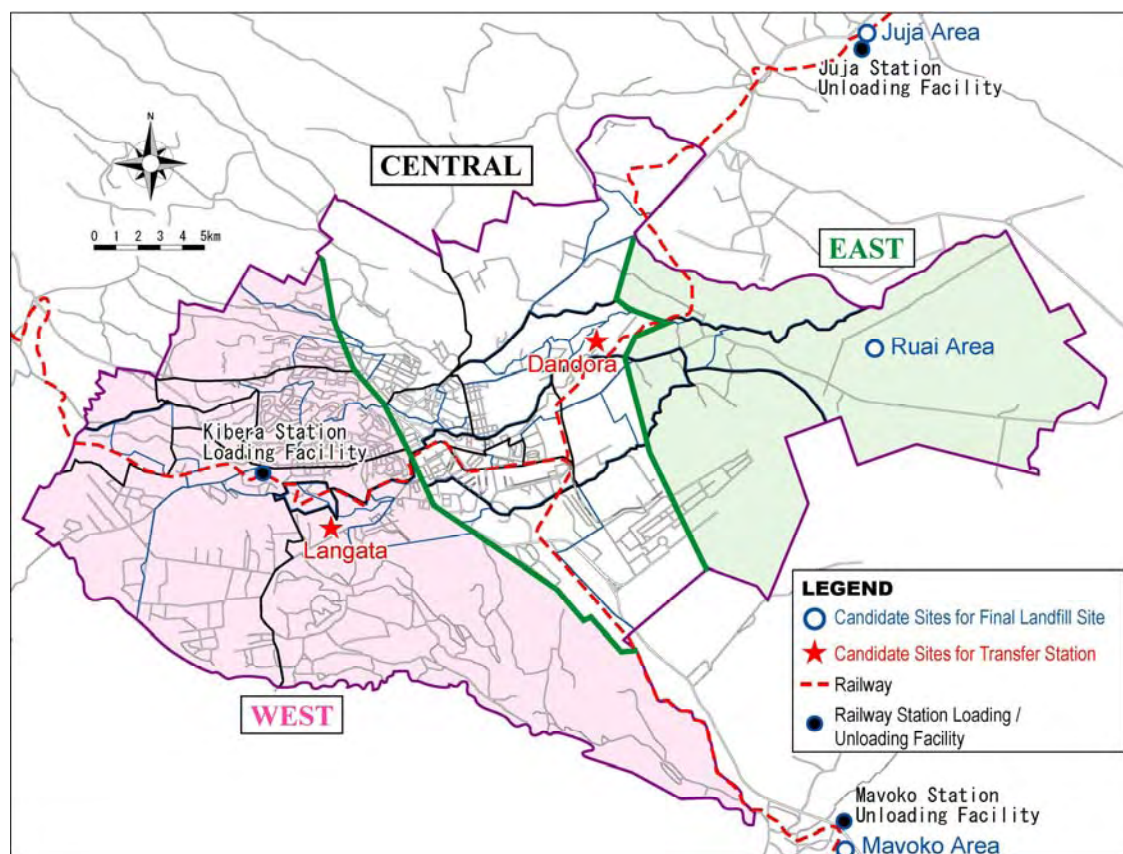


Figure C.4.3 Location Map of Technical Options on Transport System

(3) Selection Procedure

The optimum collection system should be proposed through qualitative evaluation on current operation of each collector, local situation on housing and combining type of collection vehicles and collection frequency.

After the optimum collection system was proposed, the required number of collection vehicles should be estimated from the target collection waste amount. Then, the required number of collection system (vehicles) as of 2030, the final target year, was input into each technical options, and an integrated system of collection and transport was developed in each option.

The technical option were selected based on the principle of cost minimum of capital, operation and maintenance cost since any option has less adverse impact on surrounding environmental and social aspect in 1st screening according to IEE (Initial Environmental Examination) The detailed information is shown in **Section G of the Supporting Report**.

(4) Evaluation of Collection System

(a) Frequency of Collection

Currently, CCN, private collectors and the subcontractors are involved in the collection work. Some private collectors basically operate with daily collection frequency in high income residential areas. However, CCN operates once a week at most. In areas where it is difficult to deploy collection vehicles or where the vehicles could not access the collection points, the collection frequency of once or twice a week is common resulting in piled waste at illegal dumping sites and unsanitary or disfigurement of the urban landscape. Therefore, collection frequency of twice a week is proposed.

(b) Selection of Technical Options on Collection System

As mentioned above, the collection system shown in **Table C.4.5** is proposed as a future collection system. In Zone 1 to 9, private franchisee will take an initiative role in the collection activities of residential and commercial waste with compactor (50%) and dump trucks (50%) basically based on door-to-door collection system excluding the station collection method in housing complex/apartment. CCN and the contractors, on one hand, will operate in CCN /SWMPC zone with the combination of container plus detachable container carrier and dump trucks with the station collection method, and their collection in market wastes and road sweeping with detachable container carrier and dump trucks. In the low income or slum areas in Zone 1 to 9, the CBOs and residents will conduct primary collection with push carts or containers as community-based activities. However, private franchisee will be able to collect the domestic wastes in these areas when future income levels are improved.

Table C.4.5 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 Establishments/ Commercial area	<ul style="list-style-type: none"> 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
	Market + 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
CCN/SWMPC Zone	Slum Area	Primary collection by residents and CBOs	Twice a week	Container + Push cart	Residents, CBOs
		Container collection methods (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: *¹CCN will be transferred to SWM Public Corporation from 2016.

(5) Evaluation of Integrated Collection and Transportation System

(a) Target Collection Ratio and Collection Amount

The collection ratio currently differs in each location in Nairobi City. Therefore, at first, the JICA survey team identified the current collection ratio through interview with CCN and set up the collection ratio for 2015, 2020, 2025 and 2030. The collection ratio at each year was computed through interpolation as a liner line between the target collection ratios of 2010, 2015, 2020, 2025 and 2030 (100% collection rate in 2030 in every location). The total target collection rate in whole Nairobi City was computed through weighing the collection ratio of each location by the ratio of waste amount of each location to total waste amount of Nairobi City. **Figure C.4.4** shows the flow of set-up of the target collection ratio of each location and the total collection ratio of Nairobi City.

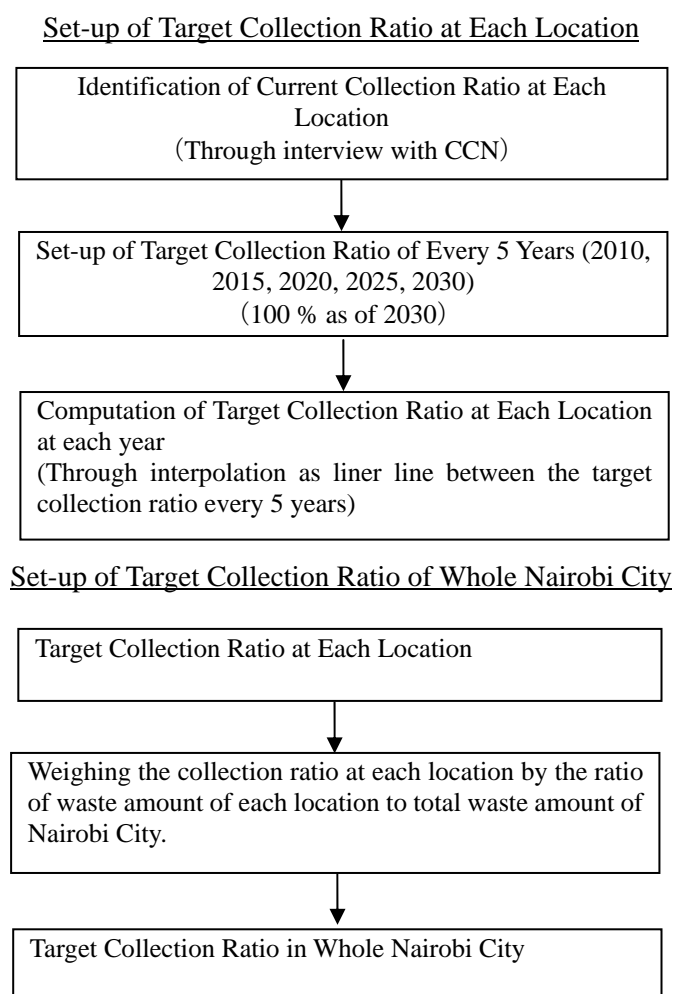


Figure C.4.4 Flow of Set-up of Target Collection Ratio at Location and Whole Nairobi City

Table C.4.6 shows the collection ratios targeted for the whole Nairobi City at each target year based on the approach shown in **Figure C.4.5**. The target collection ratios were obtained by estimating the current collection ratio at each location, by comparing the collection ratio by the waste generation amount at each location to that of the whole Nairobi City, and finally by summing-up the collection ratio at all locations.

Table C.4.6 Target Collection Ratio of Nairobi City at Target Year

Year	2010	2015	2020	2025	2030
Collection Ratio (%)	38.0	48.8	64.6	83.6	100.0

The target collection waste amount at each zone was computed, as shown in **Figure C.4.5**. First, the potential waste collection amount is obtained by deducting the self-disposal amount from the generation amount. Then, the potential waste discharge amount is obtained by adding the market and road sweeping waste to above potential waste collection amount. The target collection amount at each location is computed by multiplying the target collection ratio which is estimated in **Figure C.4.5** and the target collection waste amount at each zone is obtained by summation of those of each location.

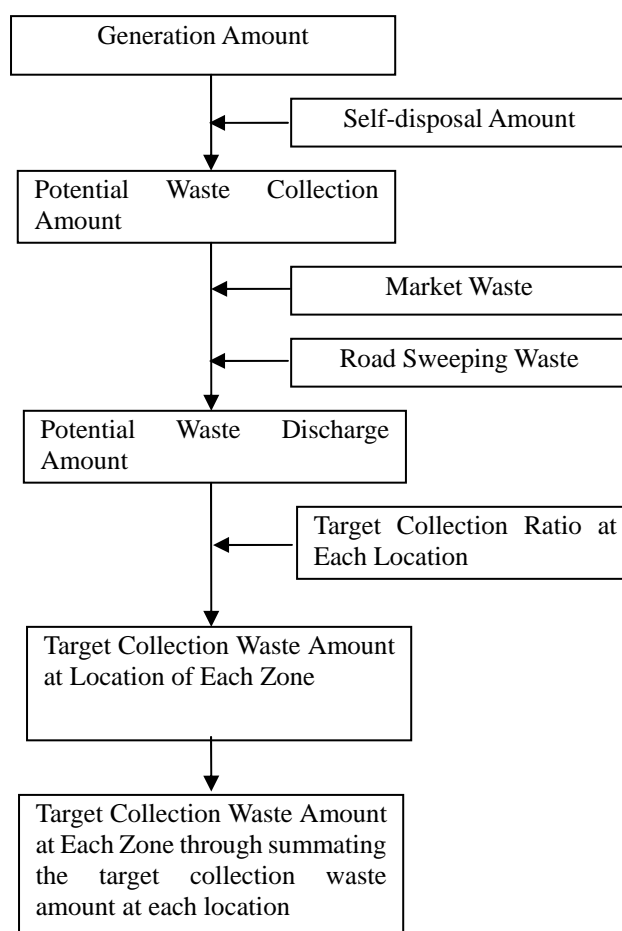


Figure C.4.5 Flow of Estimation of Target Collection Waste Amount

The target collection waste amount at each zone which was estimated based on the flow in **Figure C.4.5** is shown in **Table C.4.7**.

Table C.4.7 Target Collection Waste Amount by Zone

Unit in ton/day

Zone	2010	2015	2020	2025	2030
Zone 1	86	100	131	173	215
Zone 2	38	48	74	114	169
Zone 3	29	47	71	103	155
Zone 4	63	98	151	222	287
Zone 5	34	44	67	106	162
Zone 6	54	72	101	146	188
Zone 7	55	69	91	132	167
Zone 8	58	69	102	145	186
Zone 9	84	109	155	222	289
CCN / SWMPC Zone	134	255	438	714	1,054
Total	634	911	1,381	2,076	2,872

(b) Required Number of Collection Vehicles

(i) Trip Number

The required number of collection vehicles can be obtained through estimating trip number of collection vehicles for 1) the case of direct haul to Ruai final landfill site of all wastes in Nairobi City, 2) the case of development of a transfer station in Langata to accept the wastes generated in wet part of Nairobi City, 3) the case of development of a transfer station in existing Dandora Dumpsite to accept the wastes in the west and central parts. The waste in the east part of the city shall be directly hauled to Ruai final landfill site at any case. **Table C.4.8** shows the summary of trip number of each case. According to the time and motion survey, the average figure of trip number of existing open dump trucks was 1 to 1.5. Therefore, the trip number of compactor and dump truck was estimated as 2 for the case of direct haul to Ruai and as 3 for the case of the development of a transfer station since these vehicles will still require long time of loading. In addition, the trip number was assumed as 1.5 for the case of the direct haulage of the waste in the west part to Ruai. The trip number of detachable container carrier, on one hand, was expected to be shorter compared to compactor and dump trucks because of reduced loading time and obtained in **Table C.4.9** by estimating the distance from collection area to the final landfill site or the transfer station.

Table C.4.8 Trip Number by Type of Collection Vehicle

Transport Pattern	Type of Collection Vehicle		
	Compactor	Dump Truck	Detachable Container Carrier
Direct Haul to Ruai	2	2	(2 to 4) Depends on distance from the collection area to final landfill site as shown in Table 2.3.6.
Transfer Transport	3	3	(3 to 5) Depends on distance from the collection area to transfer station as shown in Table 2.3.6.

Table C.4.9 Trip Number of Detachable Container Carrier by Zone

Zone	Collection Distance (km)	Average Distance from Collection Area to Ruai (km)	Average Velocity of Collection Vehicle (km/hr)	Average Transport Velocity (km/hr)	Average Distance from Collection Area to Langata T/S (km)	Average Distance from Collection Area to Dandora T/S (km)	Required Time per Trip (hr)			Trip Number		
							Case for Direct Haul to Ruai	Case for Langata Transfer Station	Case for Dandora Transfer Station	Case for Direct Haul to Ruai	Case for Langata Transfer Station	Case for Dandora Transfer Station
	x	y	v ₁	v ₂	L ₁	L ₂	$T_1: 5/60 + x/v_1 + 2y/v_2 + 5/60 + 30/60$	$T_2: 5/60 + x/v_1 + 2L_1/v_2 + 5/60 + 30/60$	$T_3: 5/60 + x/v_1 + 2L_2/v_2 + 5/60 + 30/60$	9.5 / T ₁	9.5 / T ₂	9.5 / T ₃
Zone 1	20	21.0	15	30	8	9	3.4	2.5	2.6	2	3	3
Zone 2	20	14.0	15	30	-	5	2.9	-	2.3	3	-	4
Zone 3	25	16.0	15	30	-	8	3.4	-	2.9	2	-	3
Zone 4	20	14.0	15	30	-	4	2.9	-	2.3	3	-	4
Zone 5	15	25.0	15	30	3	17	3.3	1.9	2.8	2	5	3
Zone 6	15	32.0	15	30	5	20	3.8	2.0	3.0	2	4	3
Zone 7	15	30.0	15	30	5	15	3.7	2.0	2.7	2	4	3
Zone 8	15	15.0	15	30	-	3	2.7	-	1.9	3	-	5
Zone 9	15	20.0	15	30	-	10	3.0	-	2.3	3	-	4
CCN Zone											-	
- West	15	32.0	15	30	7	20	3.8	2.1	3.0	2	4	3
- Central	15	15.0	15	30	-	4	2.7	-	1.9	3		4
- East	15	7.0	15	30	-	-	2.1	-	-	4		

Note: 9.5 shows the assumed actual operation hours of landfill and transfer station.

(ii) Required Number of Collection Vehicle

The required number of collection vehicles at each zone can be obtained by dividing the target collection waste amounts from residential areas, establishments, markets and road sweepings at each zone by the capacity of the vehicles (4t), loading ratio (0.8) and trip number as mentioned before.

Table C.4.10 to Table C.4.13 show the required number of collection vehicles at each zone in each case.

Sample Computation

Sample computations of the required number of collection vehicles are shown below for the year 2030 at Zone 1 in the Case of Direct Haul to Ruai Final Landfill Site. The required number for the target year of each zone in the other cases is computed based on the same method as the sample.

The required number of collection vehicles is computed based on the process flow shown below. First, the target collection amount at each target year (2010, 2015, 2020, 2025 and 2030) is set up for each zone. This collection waste amount is divided into three (3) areas, namely; west, central and east, in order to set up the number of trips required to transport the collected wastes from the collection areas to the Ruai final landfill site. Finally, the required number of collection vehicles is computed by dividing the above waste collection amount by the estimated loading ratio, rated load capacity and number of trips.

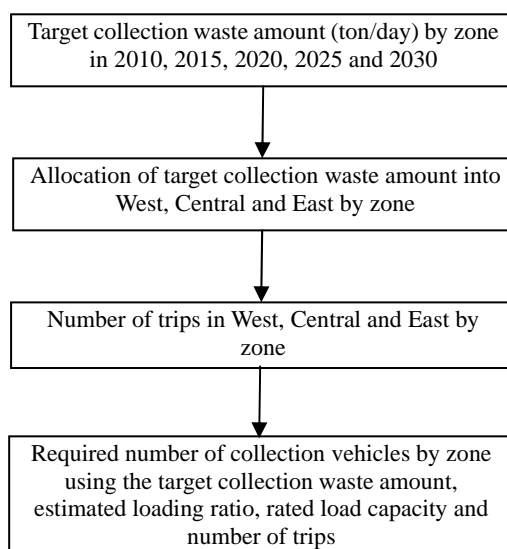


Figure C.4.6 Flow of Computation of Required Number of Collection Vehicles

Collection vehicles for the high and middle income levels shall be composed of compactors (50%) and open dump trucks (50%). Wastes from the low income and slum areas, as well as those from street sweepings, shall be collected using open dump trucks while market wastes shall be collected by the combination of container plus detachable container truck.

The required number of collection vehicles in 2030 in Zone 1 is computed by the type of collection vehicle as below. Zone 1 is located in the west and central areas.

Compactor

A half of the amount of wastes targeted for collection from the west and central areas of the high and middle income areas shall be collected with the use of compactors.

Target Waste in High/Middle Income Areas = 135.0 ton/day

Required Number of Compactors for the West Area

= Target Waste Collection Amount (ton/day) / (Estimated Loading Ratio x Rated Load Capacity x Number of Trips)

= $0.5 \times 0.5 \times 135.0 / (0.8 \times 4.0 \times 1.5)$

= 7 units

Required number of compactor units for the Central Area

= Target Waste Collection Amount (ton/day) / (Estimated Loading Ratio x Rated Load Capacity x Number of Trips)

= $0.5 \times 0.5 \times 135.0 / (0.8 \times 4.0 \times 2)$

= 5 units

Therefore, a total of 12 units of compactors are required.

Dump Truck for High Middle Income Areas

In the same manner as the compactor, a half of the amount of wastes targeted for collection from the west and central areas of the high and middle income areas shall be collected with the use of open dump trucks.

Target Waste in High/Middle Income Areas = 135.0 ton/day

Required Number of Open Dump Trucks for the West Area

= Target Waste Collection Amount (ton/day) / (Estimated Loading Ratio x Rated Load Capacity x Number of Trips)

= $0.5 \times 0.5 \times 135.0 / (0.8 \times 4.0 \times 1.5)$

= 7 units

Required Number of Open Dump Trucks for the Central Area

= Target Collection Waste Amount (ton/day) / (Estimated Loading Ratio x Rated Load Capacity x Number of Trips)

= $0.5 \times 0.5 \times 135.0 / (0.8 \times 4.0 \times 2)$

= 5 units

Therefore, a total of 12 units of open dump trucks are required.

Dump Truck for Low Income/Slum Areas

Wastes from the low income and slum areas shall be collected by open dump trucks. The target waste collection amount in the low income and slum areas is 64.1 ton/day. Half of the targeted waste collection amount shall be collected from the west and central areas.

Required Number of Open Dump Trucks for the West Area:

= Target Collection Waste Amount (ton/day) / (Estimated Loading Ratio x Rated Load Capacity x Number of Trips)

$$= 0.5 \times 64.1 / (0.8 \times 4.0 \times 2)$$

$$= 5 \text{ units}$$

Required Number of Open Dump Trucks for the Central Area:

$$= \text{Target Waste Collection Amount (ton/day)} / (\text{Estimated Loading Ratio} \times \text{Rated Load Capacity} \times \text{Number of Trips})$$

$$= 0.5 \times 64.1 / (0.8 \times 4.0 \times 2)$$

$$= 5 \text{ units}$$

Dump Truck for Street Sweeping

Street sweeping wastes shall be collected by open dump trucks. The targeted waste collection amount of street sweepings is 10.1 ton/day. Half of the targeted waste collection amount shall be collected from the west and central areas.

Required Number of Open Dumps Trucks for the West Area:

$$= \text{Target Waste Collection Amount (ton/day)} / (\text{Estimated Loading Ratio} \times \text{Rated Load Capacity} \times \text{Number of Trips})$$

$$= 0.5 \times 10.1 / (0.8 \times 4.0 \times 2)$$

$$= 0.8$$

$$\doteq 1$$

Required Number of Open Dump Trucks for the Central Area:

$$= \text{Target Waste Collection Amount (ton/day)} / (\text{Estimated Loading Ratio} \times \text{Rated Load Capacity} \times \text{Number of Trips})$$

$$= 0.5 \times 10.1 / (0.8 \times 4.0 \times 2)$$

$$= 0.8$$

$$\doteq 1$$

Container plus Detachable Container Truck

Market wastes shall be collected by the combination of containers plus detachable container trucks. The targeted waste collection amount of market waste is 15.6 ton/day. Half of the targeted waste collection amount shall be collected from the west and central areas.

Required Number for the West Area:

Required Number of Containers:

$$= \text{Target collection waste amount (ton/day)} / (\text{Estimated loading ratio} \times \text{Rated load capacity} \times \text{Trip number})$$

$$= 0.5 \times 15.6 / (0.8 \times 4.0)$$

$$= 2.4$$

$$\doteq 2$$

Required Number of Detachable Container Trucks:

$$\begin{aligned} &= \text{Target Collection Waste Amount (ton/day)} / (\text{Estimated Loading Ratio} \times \text{Rated Load Capacity}) \\ &= 0.5 \times 15.6 / (0.8 \times 4.0 \times 2) \\ &= 1.2 \\ &\doteq 1 \end{aligned}$$

Required Number for the Central Area:

Required Number of Containers:

$$\begin{aligned} &= \text{Target Collection Waste Amount (ton/day)} / (\text{Estimated Loading Ratio} \times \text{Rated Load Capacity} \times \text{Number of Trips}) \\ &= 0.5 \times 15.6 / (0.8 \times 4.0) \\ &= 2.4 \\ &\doteq 2 \end{aligned}$$

Required Number of Detachable Container Trucks:

$$\begin{aligned} &= \text{Target Collection Waste Amount (ton/day)} / (\text{Estimated Loading Ratio} \times \text{Rated Load Capacity}) \\ &= 0.5 \times 15.6 / (0.8 \times 4.0 \times 2) \\ &= 1.2 \\ &\doteq 1 \end{aligned}$$

Summary of Required Number of Collection Vehicles in 2030 in Zone 1 for the Case of Direct Haul to Ruai Final Landfill Site

The required number of collection vehicles is as summarised below.

Compactors: $7 + 5 = 12$

Open dump trucks: $(7 + 5) + (5 + 5) + (1 + 1) = 24$

Containers: $2 + 2 = 4$

Detachable container trucks: $1 + 1 = 2$

The estimation of the required number of collection vehicles in other zones or in other cases was based on the same approach described above.

Table C.4.10 Trip Number of Detachable Container Carrier by Zone**1) Required Number of Collection Vehicles**

Zone	2010				2015				2020				2025				2030			
	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total
1. Zone 1	4	6	2	12	4	10	2	16	7	15	2	24	10	20	2	32	12	24	2	38
2. Zone 2	2	1	2	5	2	3	2	7	6	7	2	15	8	9	2	19	12	13	2	27
3. Zone 3	2	1	0	3	2	3	0	5	6	7	0	13	8	9	0	17	12	13	0	25
4. Zone 4	4	1	2	7	4	5	2	11	10	11	2	23	16	17	2	35	20	21	2	43
5. Zone 5	2	2	0	4	2	4	0	6	4	8	0	12	6	12	0	18	9	17	0	26
6. Zone 6	4	1	1	6	4	5	1	10	10	11	1	22	15	16	1	32	19	20	1	40
7. Zone 7	3	3	1	7	3	6	1	10	6	12	1	19	9	17	1	27	11	21	1	33
8. Zone 8	3	1	1	5	3	4	1	8	6	7	2	15	9	10	3	22	12	13	3	28
9. Zone 9	4	3	2	9	4	7	2	13	6	14	3	23	9	21	4	34	12	28	4	44
10. CCN /SWMPC Zone	0	13	11	24	0	13	9	22	0	35	29	64	0	56	44	100	0	82	64	146
Grand Total	28	32	22	82	28	60	20	108	61	127	42	230	90	187	59	336	119	252	79	450

2) Required number of Containers

Zone	2010	2015	2020	2025	2030
1. Zone 1	2	2	4	4	4
2. Zone 2	2	2	2	4	4
3. Zone 3	0	0	0	0	0
4. Zone 4	4	4	4	6	6
5. Zone 5	0	0	0	0	0
6. Zone 6	1	1	2	2	2
7. Zone 7	1	1	1	1	1
8. Zone 8	5	5	7	9	10
9. Zone 9	6	7	9	11	13
10. CCN /SWMPC Zone	41	44	138	223	331
Grand Total	62	66	167	260	371

Table C.4.11 Required Number of Collection Vehicles (Case: Transport of Waste in West Part to Transfer Station in Langata)

Zone	2010				2015				2020				2025				2030			
	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total
1. Zone 1	4	6	2	12	4	10	2	16	5	13	2	20	7	17	2	26	9	21	2	32
2. Zone 2	2	1	2	5	2	3	2	7	6	7	2	15	8	9	2	19	12	13	2	27
3. Zone 3	2	1	0	3	2	3	0	5	6	7	0	13	8	9	0	17	12	13	0	25
4. Zone 4	4	1	2	7	4	5	2	11	10	11	2	23	16	17	2	35	20	21	2	43
5. Zone 5	2	2	0	4	2	4	0	6	3	7	0	10	4	10	0	14	6	14	0	20
6. Zone 6	4	1	1	6	4	5	1	10	5	6	1	12	7	8	1	16	9	10	1	20
7. Zone 7	3	3	1	7	3	6	1	10	4	10	1	15	4	12	1	17	6	16	1	23
8. Zone 8	3	1	1	5	3	4	1	8	6	7	2	15	9	10	3	22	12	13	3	28
9. Zone 9	4	3	2	9	4	7	2	13	6	14	3	23	9	21	4	34	12	28	4	44
10. CCN/SW MPC Zone	0	13	11	24	0	13	9	22	0	33	26	59	0	53	39	92	0	77	56	133
Grand Total	28	32	22	82	28	60	20	108	51	115	39	205	72	166	54	292	98	226	71	395

2) Required number of Containers

Same as **Table C.4.10**.

Table C.4.12 Required Number of Collection Vehicles (Case: Transport of Waste in West and Central Part to Transfer Station in Dandora)

Zone	2010				2015				2020				2025				2030			
	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total
1. Zone 1	4	6	2	12	4	10	2	16	4	12	2	18	6	16	2	24	8	20	2	30
2. Zone 2	2	1	2	5	2	3	2	7	5	6	2	13	7	8	2	17	10	11	1	22
3. Zone 3	2	1	0	3	2	3	0	5	5	6	0	11	7	8	0	15	10	11	0	21
4. Zone 4	4	1	2	7	4	5	2	11	9	10	2	21	13	14	2	29	17	18	2	37
5. Zone 5	2	2	0	4	2	4	0	6	3	7	0	10	4	10	0	14	6	14	0	20
6. Zone 6	4	1	1	6	4	5	1	10	5	6	1	12	7	8	1	16	9	10	1	20
7. Zone 7	3	3	1	7	3	6	1	10	4	10	1	15	4	12	1	17	6	16	1	23
8. Zone 8	3	1	1	5	3	4	1	8	4	5	1	10	9	7	2	18	8	9	2	19
9. Zone 9	4	3	2	9	4	7	2	13	4	12	2	18	9	18	3	30	8	24	3	35
10. CCN /SWMPC Zone	0	13	8	21	0	13	9	22	0	25	22	47	0	39	33	72	0	56	47	103
Grand Total	28	32	19	79	28	60	20	108	43	99	33	175	66	140	46	252	82	189	59	330

2) Required number of Containers

Same as **Table C.4.10**.

Table C.4.13 Required Number of Collection Vehicles (Case: Transport of Waste in West to Langata Transfer Station and Waste of Central Part to Transfer Station in Dandora)

Zone	2010				2015				2020				2025				2030			
	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total	Compactor	Dump Truck	Detachable Container Truck	Sub Total
1. Zone 1	4	6	2	12	4	10	2	16	4	12	2	18	6	16	2	24	8	20	2	30
2. Zone 2	2	1	2	5	2	3	2	7	5	6	2	13	7	8	2	17	10	11	1	22
3. Zone 3	2	1	0	3	2	3	0	5	5	6	0	11	7	8	0	15	10	11	0	21
4. Zone 4	4	1	2	7	4	5	2	11	9	10	2	21	13	14	2	29	17	18	2	37
5. Zone 5	2	2	0	4	2	4	0	6	3	7	0	10	4	10	0	14	6	14	0	20
6. Zone 6	4	1	1	6	4	5	1	10	5	6	1	12	7	8	1	16	9	10	1	20
7. Zone 7	3	3	1	7	3	6	1	10	4	10	1	15	4	12	1	17	6	16	1	23
8. Zone 8	3	1	1	5	3	4	1	8	4	5	1	10	9	7	2	18	8	9	2	19
9. Zone 9	4	3	2	9	4	7	2	13	4	12	2	18	9	18	3	30	8	24	3	35
10. CCN /SWMPC Zone	0	13	8	21	0	13	9	22	0	25	21	46	0	39	31	70	0	56	44	100
Grand Total	28	32	19	79	28	60	20	108	43	99	32	174	66	140	44	250	82	189	56	327

2) Required number of Containers

Same as **Table C.4.10**.

The required number of collection vehicles for technical options is shown in **Table C.4.14**.

Table C.4.14 Required Number of Collection Vehicles

Case	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

(c) Basic Condition for Selection of Technical Options on Collection and Transport System

The basic condition to be required for studying the technical option is shown as below.

(i) Operation Hour

According to the time and motion survey, it was identified that most of the collection vehicles operated from 6 am to 6 pm; whereas, 12 hours of operation time is identified in overseas countries such as Thailand. Based on this situation, the operation hours are assumed as 12 hours.

(ii) Outline of Facilities

Road Transfer Station

The basic facilities of vehicle transfer station are composed of a weigh bridge, ramp way (slope), parking area, transfer building (hopper, compaction equipment, etc.), wastewater treatment facility, workshop and vehicle washing area. The transferred waste will be transported to the final landfill sites by a trailer vehicle of 10t capacity. The transfer station at Dandora, especially, has a material recycle facility (MRF) which can employ waste pickers (50 workers are assumed for the capacity of 940t/d, 100 workers are assumed for 2,600t/d).

Railway Transport System

There are two types of transport system in case of utilising railway system, one is loading facility and another is an unloading facility. The loading facility is composed almost of the same system as above vehicle transfer system except a fork lift which transfers the loaded container to a railway cargo. The railway company transports the container to the unloading facility. The unloading facility has also a fork lift to transfer the loaded waste to unload to transport vehicles to the final landfill site. The operator of the loading facility shall pay a transport fee of about 15,000 KSh/Wagon per one way to the railway company to transport the transferred waste to the unloading facility.

Operational Staff

The operational staffs of the collection and transport vehicles are assumed to be composed of one driver and three crews.

A transfer station is composed of the following operation staff:

- Facility Manager
- Section Chief

- Administrative Staff
- Wheel Loader Operator
- Operator of Transfer System (hopper, compactor)
- Weigh Bridge Staff for measuring daily waste amount of incoming and outgoing vehicles
- Security Guards
- Electrical and Mechanical Staff

The railway loading facility is almost composed of the same staff as the vehicle transfer station excluding the operator of forklift. The unloading facility is almost the same excluding the operators of wheel loader, hopper and compactor.

(iii) Personnel Cost

The monthly personnel cost was assumed as follows including allowance and over-time pay;

Operation staff of vehicles:

The operation staff of the collection vehicles is composed of a driver, supervisor and two loaders as shown in **Table C.4.15**.

Table C.4.15 Personnel Costs

Collection Vehicles

Position	Personal Cost (KSh/Month)
Driver	27,300
Supervisor	19,500
Loader	17,550

Operational staffs of transfer station, loading / unloading facility:

Position	Personal Cost (KSh/Month)
General Manager	39,000
Section Chief	30,000
General Administration Section	20,000
Wheel Loader	27,300
Hopper / Compactor	19,500
Weigh Bridge	17,550
Security Guard	17,550
Electrical & Machinery Operator	19,500
Fork lift Operator	27,300
Waste Picker	10,000

(iv) Fuel Cost

Assumed as fuel cost for diesel oil was 75 KSh/litre.

Fuel consumption was assumed as follows for vehicles and heavy machines:

- Vehicle: 5 km/litre
- Wheel loader: 18 litre/h
- Fork lift: 15 litre/h

The cost of lubricant was assumed as 25% of the cost of consumed diesel oil.

(v) **Water Cost**

KSh100 was assumed for 1 m³ of water. The container shall be washed regularly. 30 litre of water was assumed to be used for washing per one time and daily water consumption of washing the container was computed by taking the trip number into consideration. A water consumption of operation staff (100 litre/person/day) was also considered in addition to the washing container.

(vi) **Electricity Cost**

Electricity cost was assumed as 14 KSh/Kwh.

The consumed electricity in **Table C.4.16** was assumed for the transfer station and loading facilities.

Table C.4.16 Estimated Consumption of Electricity

Capacity	Consumed Electricity	Kwh/day	Kwh/year
920 t/d	100 kW	1,200	417,600
1280 t/d	125 kW	1,500	522,000
1700 t/d	140 kW	1,680	584,640
2200 t/d	150 kW	1,800	626,400
2600 t/d	160 kW	1,920	668,160

(vii) **Maintenance Cost**

Maintenance cost was assumed as follows for vehicles and facilities:

Vehicle

The maintenance cost was assumed 5% of the price of the vehicle.

Facility

The maintenance cost of civil and building was assumed at 1% of the construction cost.

The maintenance cost of equipment was assumed at 3% of the equipment cost.

- Unit Price and Cost Estimate of Each Component

The details of the unit price of each component and cost estimate are shown in **Volume 4, Data Book, Section C**.

(6) Evaluation of Integrated Collection and Transportation System

The technical options in **Table C.4.4** were evaluated in terms of minimum cost of capital, operation and maintenance for collecting and transporting the waste in the three areas, west, central and east, as shown in **Table C.4.3**. The required number of collection vehicles as shown in **Table C.4.10** to **Table C.4.13** was used for the evaluation. **Table C.4.17** shows the evaluation results of each technical option. The technical option in Case 1 (Direct Haul to Ruai Final Landfill Site) was 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 C.4.17**, depreciation cost was not taken into consideration to figure out the actual cost and compare those of each option based on the same approach in other JICA study cases such as "The Study on Solid Waste Management at Local Cities in the Syrian Arab Republic, January 2002" 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 C.4.17** 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 depreciation cost.)

Table C.4.17 Evaluation of Integrated Collection and Transportation System

Case	Transport System	Final Landfill Site	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	No T/S (<u>Direct Haul</u> to Ruai)	Ruai	2,819	0	2,819	263	395	503.2	898	857	1,120
2	West: <u>Railway Transport</u> to Juja Central, East: <u>Direct Haul</u> to Ruai	Ruai / Juja	2,515	3,717	6,232	604	432	725.9	1,158	1,105	1,709
3	West: <u>Railway Transport</u> to Mavoko Central, East: <u>Direct Haul</u> to Ruai	Ruai / Mavoko	2,515	3,376	5,891	571	432	726.2	1,159	1,105	1,676
4	West, Central: <u>Vehicle Transport</u> through Transfer Station at Dandora Dumpsite (2,600 t/d), East: <u>Direct Haul</u> to Ruai	Ruai	2,162	10,467	12,629	1,242	327	738	1,065	1,016	2,259
5	West: <u>Vehicle Transport</u> through Transfer Station at Dandora Dumpsite (940 t/d), Central, East: <u>Direct Haul</u> to Ruai	Ruai	2,515	3,731	6,246	606	432	480	912	870	1,476
6	West: <u>Railway Transport</u> to Juja Central: <u>Vehicle Transport</u> through Transfer Station at Dandora to Ruai (1,590 t/d) East: <u>Direct Haul</u> to Ruai	Ruai / Juja	2,144	9,055	11,199	1,100	394	866	1,261	1,203	2,303
7	West: <u>Railway Transport</u> to Mavoko Central: <u>Vehicle Transport</u> through Transfer Station at Dandora to Ruai (1,590 t/d) East: <u>Direct Haul</u> to Ruai	Ruai / Mavoko	2,144	8,714	10,858	1,067	394	867	1,261	1,203	2,270
8	West: <u>Vehicle Transport</u> through Langata Transfer Station (940 t/d) Central, East : <u>Direct Haul</u> to Ruai	Ruai	2,515	3,454	5,969	578	432	525	958	913	1,492
9	West: <u>Vehicle Transport</u> through Transfer Station (940 t/d) at Langata to Ruai Central: <u>Vehicle Transport</u> through Transfer Station (1,590 t/d) at Dandora St. to Ruai East: <u>Direct Haul</u> to Ruai	Ruai	2,144	8,792	10,936	1,074	394	661	1,056	1,007	2,081

Sample Computation for Case 1 in Table C.4.17

The cost components in **Table C.4.17** are composed of capital cost and operation and maintenance cost for the target waste collection amount in 2030 in Nairobi City which is divided into three (3) collection areas, namely; the west, central and east areas.

The capital cost is composed of the capital costs for collection (procurement cost of collection vehicles) and transportation (construction cost of transfer station and procurement cost of transport vehicles/equipment), while the operation and maintenance cost is composed of annual personnel cost, fuel cost (diesel and lubricant) and maintenance cost for collection and transportation operations.

The sample computation for Case 1 in **Table C.4.17** is explained as below. The results of other cases were computed based on the same methods as the sample.

Capital Cost

Capital Cost for Collection

The capital cost is the procurement cost of collection vehicles (compactor, open dump truck and detachable container truck), the required number of which were calculated for the target waste collection amounts from the west, central and east areas in 2030.

The above capital cost is calculated by multiplying the unit price of each collection vehicle by the required number of collection vehicles. The calculated capital costs are as shown in **Table C.4.18**.

Table C.4.18 Calculation of Capital Cost

Area		Type of Collection Vehicle / Equipment						Total
		Compac- tor	Open Dump Truck in Residential Areas	Open Dump Truck for Road Cleansing	Container for Market Waste	Container Truck for Market Waste	Container in CCN/ SWMPC Zone	Contain- er Truck in CCN/ SWMPC Zone
Unit Price (KSh)		6,000,000	5,000,000	5,000,000	1,000,000	6,000,000	1,000,000	6,000,000
Number of Vehicles/ Equipment by Area	West	46	82	5	8	4	60	15
	Central	51	134	8	41	14	251	42
	East	22	23	0	6	3	5	1
Procure- ment Cost by Area (Thousand KSh)	West	276,000	410,000	25,000	8,000	24,000	60,000	90,000
	Central	306,000	670,000	40,000	41,000	84,000	251,000	252,000
	East	132,000	115,000	0	6,000	18,000	5,000	6,000
	Total	714,000	1,195,000	65,000	55,000	126,000	316,000	348,000
								2,819,000

Capital Cost for Transportation

There is no procurement of transfer station or transport vehicle in Case 1. Therefore, transportation cost is zero (0).

Total Capital Cost

The total capital cost is calculated as below:

Collection Cost + Transportation Cost = 2,819,000 + 0 = KSh 2,819,000 thousand = KSh 2,819 million.

Capital Cost per Ton

The capital cost per ton is computed by dividing the above total capital cost (KSh 2,819 million) by the accumulated waste collection amount (10,703,625 tons), which is the accumulated collection amount from 2014 to 2030 in case that the procurement of collection vehicles is implemented in 2013, as shown in the table below.

$$\text{Capital Cost per Ton} = 2,819 \times 106 / 10,703,625 = 263 \text{ KSh/ton}$$

Table C.4.19 Target Waste Collection Amount by Zone (2014-2030)

Unit in ton/day

Zone	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Zone 1	97	100	106	112	118	125	131	139	147	155	164	173	181	189	197	206	215
Zone 2	46	48	53	58	63	69	74	82	89	97	105	114	124	135	145	157	169
Zone 3	43	47	52	56	61	66	71	77	83	89	96	103	112	122	133	144	155
Zone 4	91	98	108	118	129	140	151	164	178	192	207	222	234	247	259	273	287
Zone 5	42	44	48	53	57	62	67	74	82	89	98	106	116	127	138	149	162
Zone 6	68	72	77	83	89	95	101	109	118	127	136	146	154	162	170	179	188
Zone 7	66	69	73	77	82	86	91	99	107	115	123	132	139	146	153	160	167
Zone 8	67	69	75	82	88	95	102	110	118	126	135	145	152	160	168	177	186
Zone 9	104	109	118	126	136	145	155	167	180	193	207	222	234	247	260	274	289
CCN / SWMP C Zone	229	255	289	324	360	399	438	488	541	596	654	714	776	842	908	979	1,054
Total	853	911	999	1,089	1,182	1,281	1,381	1,507	1,643	1,779	1,925	2,076	2,222	2,376	2,532	2,697	2,872
Annual Waste Amount	311,307	332,584	364,474	397,465	431,529	467,730	503,910	550,166	599,515	649,473	702,645	757,754	810,882	867,382	924,136	984,380	1,048,292

The accumulated waste collection amount is calculated as $\sum (311,307 + 332,584 + \dots + 984,380 + 1,048,292) = 10,703,625$ ton

Operation and Maintenance Cost

The operation and maintenance cost is composed of personnel cost, fuel cost (diesel and lubricant oil), and maintenance cost of vehicles, equipment and facilities.

Personnel Cost

The personnel cost was set up for the operation of collection vehicles.

The required number of staff, unit price and the final annual personnel cost is calculated as below for the required number of collection vehicle in each area as already explained above.

Table C.4.20 Calculation of Personnel Cost

Area		Type of Collection Vehicle / Equipment					Total
		Compactor	Open Dump Truck in Residential Areas	Open Dump Truck for Road Cleansing	Container Truck for Market Waste	Container Truck in CCN / SWMPC Zone	
Number of Vehicles / Equipment by Area (1)	West	46	82	5	4	15	
	Central	51	134	8	14	42	
	East	22	23	0	3	1	
	Sub Total	119	239	13	21	58	
Number of Operation Staff (2)	Driver	1	1	1	1	1	
	Crew	3	3	3	3	3	
Unit Price of Personal Cost (KSh/Month) (3)	Driver	27,300	27,300	27,300	27,300	27,300	
	Crew	17,550	17,550	17,550	17,550	17,550	
Personal Cost (KSh/Year) ((4) = 365 x (1) x (2) x (3))		114,168,600	229,296,600	12,472,200	20,147,400	55,645,200	431,730,000

The personnel cost for collection and transport operation is set to be the same. Therefore, the personnel cost for collection and transport is obtained as follows:

Personnel cost for collection operation: $431,730,000 / 2 = \text{KSh } 215,865,000$

Personnel cost for transport operation: $431,730,000 / 2 = \text{KSh } 215,865,000$

Fuel Cost

The collection vehicles basically use diesel oil and lubricant oil for their operation.

The unit price of diesel oil is 75 KSh / litre. The fuel consumption rate of collection vehicles was set as 5 km/litre. The consumed fuel oil (diesel oil) was computed by dividing the accumulated operation distance (which was calculated by multiplying the operation distance of collection and transport by the number of trips) by the above fuel consumption rate. The details of the computation of fuel cost are given in the table below for the operation of collection and transport, respectively. In case of transport, the transport distance was made double by taking the round trip distance.

Table C.4.21 Calculation of Fuel Cost for Collection

Area		Type of Collection Vehicle / Equipment					Total
		Compactor	Open Dump Truck in Residential Areas	Open Dump Truck for Road Cleansing	Container Truck for Market Waste	Container Truck in CCN/SWM PC Zone	
Number of Vehicles/ Equipment by Area (1)	West	46	82	5	4	15	
	Central	51	134	8	14	42	
	East	22	23	0	3	1	
	Sub Total	119	239	13	21	58	
Collection Distance (km) (2)	West	20.0	20.0	20.0	20.0	20.0	
	Central	20.0	20.0	20.0	20.0	20.0	
	East	20.0	20.0	20.0	20.0	20.0	
Trip Number (3)	West	1.5	1.5	1.5	2	2	
	Central	2	2	2	3	3	
	East	2	2	2	4	4	
Fuel Consumption (litre/day) (4) = (1) x (2) x (3) / 5.0	West	276.0	492.0	30.0	32.0	120.0	
	Central	408.0	1072.0	64.0	168.0	504.0	
	East	176.0	184.0	0.0	48.0	16.0	
Annual Fuel Consumption (litre/year) (5) = 365 x (4)	West	100,740.0	179,580.0	10,950.0	11,680.0	43,800.0	
	Central	148,920.0	391,280.0	23,360.0	61,320.0	183,960.0	
	East	64,240.0	67,160.0	0.0	17,520.0	5,840.0	
Annual Fuel Cost (6) = 75 x (5)	West	7,555,500	13,468,500	821,250	876,000	3,285,000	26,006,250
	Central	11,169,000	29,346,000	1,752,000	4,599,000	13,797,000	60,663,000
	East	4,818,000	5,037,000	0	1,314,000	438,000	11,607,000
	Sub Total	23,542,500	47,851,500	2,573,250	6,789,000	17,520,000	98,276,250

Table C.4.22 Calculation of Fuel Cost for Transportation

Area		Type of Collection Vehicle / Equipment					Total
		Compactor	Open Dump Truck in Residential Areas	Open Dump Truck for Road Cleansing	Container Truck for Market Waste	Container Truck in CCN/SWM PC Zone	
Number of Vehicles/ Equipment by Area (1)	West	46	82	5	4	15	
	Central	51	134	8	14	42	
	East	22	23	0	3	1	
	Sub Total	119	239	13	21	58	
Collection Distance (km) (2)	West	32.0	32.0	32.0	32.0	32.0	
	Central	16.0	16.0	16.0	16.0	16.0	
	East	7.0	7.0	7.0	7.0	7.0	
Trip Number (3)	West	1.5	1.5	1.5	2	2	
	Central	2	2	2	3	3	
	East	2	2	2	4	4	
Fuel Consumption (litre/day) (4) = 2 x (1) x (2) x (3) / 5.0	West	883.2	1574.4	96.0	102.4	384.0	
	Central	652.8	1715.2	102.4	268.8	806.4	
	East	123.2	128.8	0.0	33.6	11.2	
Annual Fuel Consumption (litre/year) (5) = 365 x (4)	West	322,368.0	574,656.0	35,040.0	37,376.0	140,160.0	
	Central	238,272.0	626,048.0	37,376.0	98,112.0	294,336.0	
	East	44,968.0	47,012.0	0.0	12,264.0	4,088.0	
Annual Fuel Cost (6) = 75 x (5)	West	24,177,600	43,099,200	2,628,000	2,803,200	10,512,000	83,220,000
	Central	17,870,400	46,953,600	2,803,200	7,358,400	22,075,200	97,060,800
	East	3,372,600	3,525,900	0	919,800	306,600	8,124,900
	Sub Total	45,420,600	93,578,700	5,431,200	11,081,400	32,893,800	188,405,700

The cost of lubricant oil is estimated as 20% of that of diesel oil in accordance with the sample of “The Study on Solid Waste Management at Local Cities in the Syrian Arab Republic,” January 2002, JICA.

Therefore, the total fuel cost is obtained as below for collection and transport operations, respectively.

Collection:

$$98,276,250 + 0.2 \times 98,276,250 = \underline{\text{KSh } 117,931,500}$$

Transport:

$$188,405,700 + 0.2 \times 188,405,700 = \underline{\text{KSh } 226,086,840}$$

Maintenance Cost

The maintenance cost was estimated as 5% of the procurement cost of collection vehicles.

Therefore, the following maintenance cost was set as 5% of the capital cost of collection vehicles which was already obtained before.

$$\text{Maintenance cost: } 0.05 \times (714,000 + 1,195,000 + 65,000 + 126,000 + 348,000) \times 10^3 = \underline{\text{KSh } 122,400 \text{ Thousand}}$$

The maintenance cost for collection and transport is assumed as 50% of the total maintenance cost, respectively.

Collection:

$$0.5 \times 122,400,000 = \underline{\text{KSh } 61,200,000}$$

Transport:

$$0.5 \times 122,400,000 = \underline{\text{KSh } 61,200,000}$$

Total of Operation and Maintenance Cost

The total of operation and maintenance cost is obtained as below for the collection and transport operations.

Collection:

$$\text{Personnel cost} + \text{fuel cost} + \text{maintenance cost} = 215,865,000 + 117,931,500 + 61,200,000 = \underline{\text{KSh } 394,996,500}$$

Transport:

$$\text{Personnel cost} + \text{fuel cost} + \text{maintenance cost} = 215,865,000 + 226,086,840 + 61,200,000 = \underline{\text{KSh } 503,151,840}$$

Therefore, the total of operation and maintenance cost is obtained as below.

$$394,996,500 + 503,151,840 = \text{KSh } 898,148,340 = \underline{\text{KSh } 898 \text{ Million}}$$

Operation and Maintenance Cost per Ton

The operation and maintenance cost per ton was computed as below by dividing the total operation and maintenance cost by the annual waste collection amount in 2030 (1,048,292 ton) which was already explained before.

$$\text{KSh } 898,148,340 / 1,048,292 = \underline{857 \text{ KSh/ton}}$$

Therefore, the total cost for capital and operation and maintenance is as shown below.

$$263 + 857 = \underline{1,120 \text{ KSh/ton}}$$

(7) Collection and Transportation in Low Income and Slum Areas

(a) Current Issues Identified

Currently, CBOs conduct collection activity in low income or slum areas. However, the following problems were identified in relation to their activities;

- CBOs cannot collect residential wastes from all households (Low collection ratio from households by CBO's primary collection)
- Extremely low frequency of collection by CCN and the contractors' collection vehicles
- CBO's collection tools are lacking and causes the obstacles to their collection activities
- Collection vehicles cannot access the collection points inside the slum areas because of bad road conditions or steep topography. Accordingly, CBOs are obliged to carry out their collection activity manually
- Very few designated collection points, accordingly, CBOs are obliged to discharge their collected waste to undesignated collection points which causes illegal dumping

(b) Actions to be 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 establish/build relationship of mutual understanding toward the solution of the problems. This will be implemented through pilot projects in the future technical cooperation scheme. The detailed information is shown in **Section F of the Supporting Report**.

(ii) Education to residents toward appropriate discharge of household including source separation

Education to the residents should be carried out toward appropriate discharge of wastes from each household or raise their awareness for sanitation. For the actual action, education materials will be prepared and distributed to the residents. This will be implemented through pilot projects in the future technical cooperation scheme. The detailed information is shown in **Section F of the Supporting Report**.

(iii) Enhancement or expansion of CBOs activity toward the increase of primary collection ratio from residents

The enhancement or expansion of CBOs who are currently main actors in the primary collection in low income and slum areas should be necessary in order to raise the primary collection ratio. A support to the CBOs or creation of new CBOs in the areas where their

collection activities are not carried out will be necessary. This will be implemented through pilot projects in the future technical cooperation scheme. The tools such as hand cart or containers will be provided to the sampled CBOs in the pilot projects. The detailed information is shown in **Section F of the Supporting Report**.

(iv) Formulation and implementation of deployment plan of designated collection points

One of the causes of illegal dumping or piled wastes in low income or slum areas is that CBOs cannot deliver their collected waste to the designated collection points due to their insufficient number. The container collection system is proposed in the target areas and the place of the installation of the containers should be decided in advance when the actual installation is made.

The formulation of deployment plan of designated collection points and its actual implementation is proposed through consultation among CCN, CBOs and residents and their agreement.

(v) Construction or improvement of access roads to the collection points to raise collection frequency

Lack of access to the collection points or the bad condition of existing road is one of the big problems to solve the SWM issues in the target areas. The access to the collection points in slum areas is extremely in bad conditions and causes the bottleneck in which collection vehicles cannot reach these collection points. Construction of new roads or improvement of existing roads will be necessary for removing these bottlenecks. In the master plan, the construction of 100 m roads and returning place (15m x 15m) for the container carriers is proposed for 75 slums for the target short-term and mid-term implementation scheme.

(8) Regular Cleanup Plan

Scattered wastes are currently identified along the road side and causes unsanitary condition and disfigurement of urban environment of Nairobi City. A regular cleanup will be necessary to improve this situation. In the master plan, regular cleanup of the roadsides in 8 divisions excluding CBD area twice a year is proposed. The cleanup will be carried out through a contract-out of these works to subcontractors with 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. These collection vehicles can be deployed at existing division offices. CCN is planning to relocate the existing workshop at Ragos Road to Kaloleni Depot, and this plan will be welcomed for the future increase of vehicle number. The training of technicians is important and the contract-out of maintenance work will be one option to cope future maintenance.

4.2 Technical Evaluation of Alternative Options

4.2.1 Identification of Alternative Plans

From the evaluation of the integrated collection and transportation system, the following options were selected as priority projects. Both Case-A and Case-B target at projects which will be implemented by CCN/SWMPC or contracted to subcontractors. In Case-A, all the collected waste will be transported to the Ruai final landfill site by direct haulage, while in Case-B the waste amount collected from the west

area (940 ton/day at 2030) will be hauled first to the transfer station at Dandora by the collection vehicles of the same west area.

Case A: Direct haul to Ruai final landfill site

Case B: Construction of a transfer station at Dandora Dumpsite

4.2.2 Evaluation of Alternative Plans

(1) Outline of Proposed Projects

Case A: Direct haul to Ruai final landfill site

Case A-1 is the project that transport all waste in Nairobi City to Ruai final landfill site not through transfer stations. The content of the project is the procurement and replacement of collection vehicles to be procured by CCN to attain the target collection ratio at each target year.

Case B: Construction of transfer station at Dandora Dumpsite

A transfer station will be developed at the existing Dandora Dumpsite to transport the waste amount (940 t/d) in west part at the target year of 2030 to Ruai final landfill site through the transfer station. In this case, the waste in central and east part will be directly hauled to Ruai final landfill site. In parallel to the development of the transfer station, collection vehicles will be procured by CCN. The transfer station will install a material recovery facility (MRF) inside the transfer building, which will provide job opportunity for some of the existing waste pickers at Dandora Dumpsite.

(2) Procurement Plan of Collection Vehicles

(a) Procurement Schedule of Collection Vehicles

The procurement of the collection vehicles and container is assumed to be conducted based on the schedule shown in **Table C.4.23**. The collection vehicles will be procured at the years of 2013, 2015, 2020, 2025, while the containers will be procured every 5 years after 2013.

Table C.4.23 Assumed Procurement Schedule of Collection Vehicles and Containers

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1. Procurement																					
- Vehicles				○		○					○					○					
- Container				○		○					○					○					
2. Replacement																					
- Vehicles														—	—	—	—	—	—	—	—
- Container									○		○			○		○			○		○

(b) Method of Estimation of Procurement Number of Collection Vehicles

The method of estimation of procurement number of collection vehicles is as shown in the flowchart in **Figure C.4.7** and its graphical explanation is shown in **Figure C.4.8**. As shown in **Figure C.4.7**, the required number of collection vehicles which is computed from the target waste collection amount from each zone 5 years after the actual procurement should be compared with the existing number of vehicles of private collectors and contractors which are discarded every year with the discarding ratio of 10% every year after 2010 (the collection vehicles of CCN will be discarded by 10 % after 2020 since it procured new vehicles in 2009). When the required number is larger than the number of existing vehicles, new procurement of vehicles will be necessary. However, when the required number is smaller than the vehicle number of existing collection vehicles, new procurement will not be required. The number of existing vehicles of private collectors, contractors and CCN in which discarding is considered

is shown in **Table C.4.24**. The number of collection vehicles which are newly procured are assumed to remain constant for 10 years after the procurement year and discarded at 10% every year after 10 years of procurement. **Figure C.4.9** shows the details of the method in case of procurement in 2013 and 2015. In case of procurement in 2013, the above discarding will start in 2023 and replacement of vehicles will be necessary at the next procurement in 2020 (20% of vehicle number of initial procurement in 2013) and in 2025 (50% of vehicle number of initial procurement in 2013). In the case of procured vehicles in 2015, discarding will start in 2025 and replacement will be necessary in 2025 in such that the replacement number is 50% of the vehicle number of the initial procurement in 2015. The containers, on one hand, are assumed to be replaced every 5 years after the procurement year.

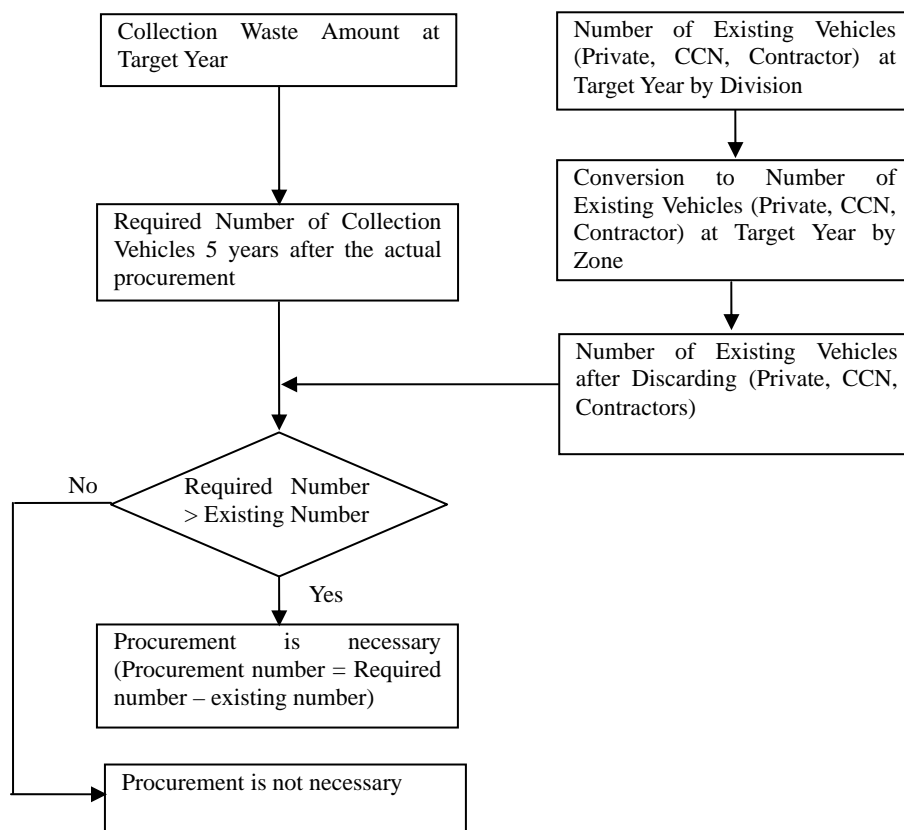


Figure C.4.7 Flow of Estimation of Procurement Number of Collection Vehicles

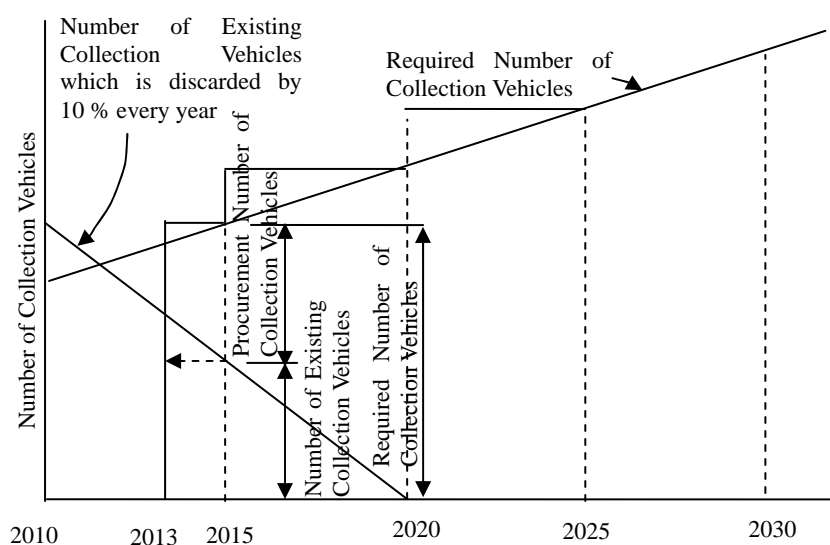


Figure C.4.8 Method of Estimation of Procurement Number

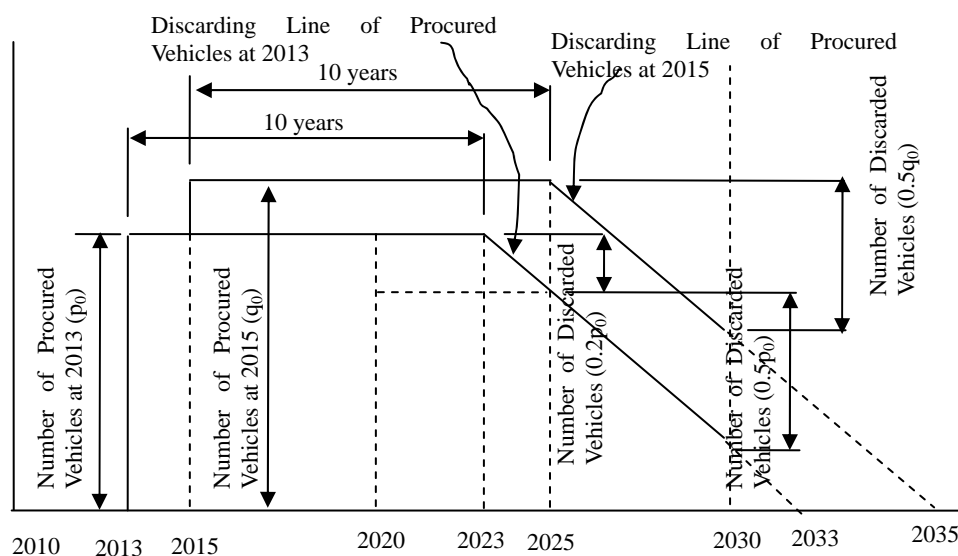


Figure C.4.9 Method of Discarding Procured Vehicles in 2013 and 2015

Table C.4.24 Number of Existing Vehicles

Private Collectors

Zone	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	.....	2030
Zone 1	17	15	14	12	10	9	7	5	3	2	0	.....	0
Zone 2	28	25	22	20	17	14	11	8	6	3	0	.....	0
Zone 3	8	7	6	6	5	4	3	2	2	1	0	.....	0
Zone 4	8	7	6	6	5	4	3	2	2	1	0	.....	0
Zone 5	15	14	12	11	9	8	6	5	3	2	0	.....	0
Zone 6	25	23	20	18	15	13	10	8	5	3	0	.....	0
Zone 7	15	14	12	11	9	8	6	5	3	2	0	.....	0
Zone 8	6	5	5	4	4	3	2	2	1	1	0	.....	0
Zone 9	40	36	32	28	24	20	16	12	8	4	0	.....	0
CCN / SWMPC Zone	0	0	0	0	0	0	0	0	0	0	0	.....	0
Total	162	146	129	116	98	83	64	49	33	19	0	.....	0

Contractor

Zone	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	.....	2030
Zone 1	6	5	5	4	4	3	2	2	1	1	0	.....	0
Zone 2	8	7	6	6	5	4	3	2	2	1	0	.....	0
Zone 3	5	5	4	4	3	3	2	2	1	1	0	.....	0
Zone 4	8	7	6	6	5	4	3	2	2	1	0	.....	0
Zone 5	4	4	3	3	2	2	2	1	1	0	0	.....	0
Zone 6	15	14	12	10	9	8	6	5	3	1	0	.....	0
Zone 7	4	4	3	3	2	2	2	1	1	0	0	.....	0
Zone 8	12	11	10	8	7	6	5	4	2	1	0	.....	0
Zone 9	20	17	16	13	12	9	8	6	3	2	0	.....	0
CCN / SWMPC Zone	0	0	0	0	0	0	0	0	0	0	0	.....	0
Total	82	74	65	57	49	41	33	25	16	8	0	.....	0

CCN

Zone	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	.....	2030
Zone 1	1	1	1	1	1	1	1	1	1	1	0	0	0	.....	0
Zone 2	1	1	1	1	1	1	1	1	1	1	0	0	0	.....	0
Zone 3	1	1	1	1	1	1	1	1	1	1	0	0	0	.....	0
Zone 4	1	1	1	1	1	1	1	1	1	1	0	0	0	.....	0
Zone 5	1	1	1	1	1	1	1	1	1	1	0	0	0	.....	0
Zone 6	1	1	1	1	1	1	1	1	1	1	0	0	0	.....	0
Zone 7	1	1	1	1	1	1	1	1	1	1	0	0	0	.....	0
Zone 8	1	1	1	1	1	1	1	1	1	1	0	0	0	.....	0
Zone 9	1	1	1	1	1	1	1	1	1	1	0	0	0	.....	0
CCN / SWMPC Zone	3	3	3	3	3	3	3	3	3	3	2	1	0	.....	0
Total	12	12	12	12	12	12	12	12	12	12	2	1	0	.....	0

(c) Procurement Number of Collection Vehicles

Based on the methods mentioned before, the number of procured collection vehicles was estimated for the priority projects, namely; 1) Case A: Direct Haul to Ruai Final Landfill Site; and 2) Case B: Development of Transfer Station at Dandora Dumpsite, respectively.

(i) Case A: Direct Haul to Ruai

The summary of procurement number of collection vehicles and containers is shown in **Table C.4.25**. The summary of the procured number for the existing remaining vehicles at each procurement year is shown in **Table C.4.26**. **Table C.4.27** and **C.4.28** shows the procurement number of collection vehicles and containers by zone, respectively.

Table C.4.25 Summary of Procurement Number of Collection Vehicles

Year	Number of Vehicles		
	Private	CCN	Total
2013			
Compactor	11	0	11
Dump Truck	12	1	13
Container Carrier	0	22	22
Container	0	47	47
Pick-up Truck	0	10	10
Total (excl. Container)	23	33	56
2015			
Compactor	50	0	50
Dump Truck	70	42	112
Container Carrier	0	20	20
Container	0	40	40
Pick-up Truck	0	0	0
Total (excl. Container)	120	62	182
2018			
Compactor	0	0	0
Dump Truck	0	0	0
Container Carrier	0	0	0
Container	0	50	50
Pick-up Truck	0	0	0
Total (Container)	0	50	50
2020			
Compactor	31	0	31
Dump Truck	12	1	13
Container Carrier	0	22	22
Container	0	79	79
Pick-up Truck	0	10	10
Total (excl. Container)	43	33	76
2023			
Compactor	0	0	0
Dump Truck	0	0	0
Container Carrier	0	0	0
Container	0	50	50
Pick-up Truck	0	0	0
Total (Container)	0	50	50
2025			
Compactor	66	0	66
Dump Truck	87	55	142
Container Carrier	0	43	43
Container	0	144	144
Pick-up Truck	0	10	10
Total (excl. Container)	153	108	261
2028			
Compactor	0	0	0
Dump Truck	0	0	0
Container Carrier	0	0	0
Container	0	50	50
Pick-up Truck	0	0	0
Total (Container)	0	50	50
2030			
Compactor	0	0	0
Dump Truck	0	0	0
Container Carrier	0	0	0
Container	0	148	148
Pick-up Truck	0	0	0
Total (Container)	0	148	148
Grand Total			
Compactor	158	0	158
Dump Truck	181	99	280
Container Carrier	0	107	107
Container	0	608	608
Pick-up Truck	0	30	30
Total (excl. Container)	339	236	575

**Table C.4.26 Summary of Procurement Number of Collection Vehicles for Existing Vehicles
At 2013**

Items	Zone 1 to Zone 9	CCN + Contractor	Total
Existing No. of Vehicle in 2010	162	94	256
Estimated Existing No. of Vehicle as of 2015	83	53	136
Procurement in 2013			
Procurement in 2015			
Procurement in 2020			
Procurement in 2025			
Discarded Vehicle: Procurement in 2013			
Discarded Vehicle: Procurement in 2015			
Remaining Vehicle as of 2015	83	53	136
Required No. of Vehicle-Compactor	38	0	38
Required No. of Vehicle-Open Dump Truck	51	31	82
Required No. of Vehicle-Container Carrier	0	34	34
Total-Required No. of Vehicle	89	65	154
Procurement-Compactor	11	0	11
Procurement-Open Dump Truck	12	1	13
Procurement -Container Carrier		22	22
Total-Procurement	23	23	46
Balance	17	11	28
Remaining after Procurement 2013	106	76	182
Waste Collection Target for 2015	Zone 1 to Zone 9	CCN + Contractor	Total
Potential Waste Collection Amount (t/d)	1,181	686	1,867
Target Waste Collection Amount (t/d)	656	255	911
Waste Collection Ratio (%)	56%	37%	49%

At 2015

Items	Zone 1 to Zone 9	CCN + Contractor	Total
Existing No. of Vehicle in 2010	162	94	256
Estimated Existing No. of Vehicle as of 2020	0	2	2
Procurement in 2013	23	23	46
Procurement in 2015			
Procurement in 2020			
Procurement in 2025			
Discarded Vehicle: Procurement in 2013			
Discarded Vehicle: Procurement in 2015			
Remaining Vehicle as of 2020	23	25	48
Required No. of Vehicle-Compactor	61	0	61
Required No. of Vehicle-Open Dump Truck	82	45	127
Required No. of Vehicle-Container Carrier	0	42	42
Total-Required No. of Vehicle	143	87	230

Items	Zone 1 to Zone 9	CCN + Contractor	Total
Procurement-Compactor	50	0	50
Procurement-Open Dump Truck	70	42	112
Procurement -Container Carrier		20	20
Total-Procurement	120	62	182
Balance	0	0	0
Remaining after Procurement 2015	143	87	230
Waste Collection Target for 2020			
Potential Waste Collection Amount (t/d)	1,354	784	2,138
Target Waste Collection Amount (t/d)	943	438	1,381
Waste Collection Ratio (%)	70%	56%	65%

At 2020

Items	Zone 1 to Zone 9	CCN + Contractor	Total
Existing No. of Vehicle in 2010	162	94	256
Estimated Existing No. of Vehicle as of 2025	0	2	2
Procurement in 2013	23	23	46
Procurement in 2015	120	62	182
Procurement in 2020			
Procurement in 2025			
Discarded Vehicle: Procurement in 2013	5	5	10
Discarded Vehicle: Procurement in 2015			
Remaining Vehicle as of 2025	138	82	220
Required No. of Vehicle-Compactor	90	0	90
Required No. of Vehicle-Open Dump Truck	119	80	199
Required No. of Vehicle-Container Carrier	0	59	59
Total-Required No. of Vehicle	209	139	348
Procurement-Compactor	31	0	31
Procurement-Open Dump Truck	40	30	70
Procurement -Container Carrier		27	27
Total-Procurement	71	57	128
Balance	0	0	0
Remaining after Procurement 2020	209	139	348
Waste Collection Target for 2025			
Potential Waste Collection Amount (t/d)	1,572	912	2,484
Target Waste Collection Amount (t/d)	1,362	714	2,076
Waste Collection Ratio (%)	87%	78%	84%

At 2025

Items	Zone 1 to Zone 9	CCN + Contractor	Total
Existing No. of Vehicle in 2010	162	94	256
Estimated Existing No. of Vehicle as of 2030	0	0	0
Procurement in 2013	23	23	46
Procurement in 2015	120	62	182
Procurement in 2020	71	57	128
Procurement in 2025			
Discarded Vehicle: Procurement in 2013	16	16	32
Discarded Vehicle: Procurement in 2015	60	31	91
Remaining Vehicle as of 2030	138	95	233
Required No. of Vehicle-Compactor	131	0	131
Required No. of Vehicle-Open Dump Truck	160	92	252
Required No. of Vehicle-Container Carrier	0	100	100
Total-Required No. of Vehicle	291	192	483
Procurement-Compactor	66	0	66
Procurement-Open Dump Truck	87	55	142
Procurement -Container Carrier		43	43
Total-Procurement	153	98	251
Balance	0	0	0
Remaining after Procurement 2025	291	193	484
Waste Collection Target for 2030			
Potential Waste Collection Amount (t/d)	1,818	1,054	2,872
Target Waste Collection Amount (t/d)	1,818	1,054	2,872
Waste Collection Ratio (%)	100%	100%	100%

Table C.4.27 Procurement Number of Collection Vehicles by Zone

	2013							2015						
	Compactor	Dump Truck for Residential Areas	Dump Truck for Street Sweeping	Container Truck for Market Waste	Container Truck for CCN Zone	Pick-up Truck	Sub Total	Compactor	Dump Truck for Residential Areas	Dump Truck for Street Sweeping	Container Truck for Market Waste	Container Truck for CCN Zone	Pick-up Truck	Sub Total
1. Zone 1														
Procurement	1	2	1	2	0	1	7	6	11	1	0	0	0	18
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	2	1	2	0	1	7	6	11	1	0	0	0	18
1. Zone 2														
Procurement	0	0	0	2	0	1	3	6	6	1	0	0	0	13
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	2	0	1	3	6	6	1	0	0	0	13
3. Zone 3														
Procurement	2	2	0	0	0	1	5	4	4	1	0	0	0	9
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2	2	0	0	0	1	5	4	4	1	0	0	0	9
4. Zone 4														
Procurement	4	4	0	2	0	1	11	6	6	1	0	0	0	13
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	4	4	0	2	0	1	11	6	6	1	0	0	0	13
5. Zone 5														
Procurement	0	0	0	0	0	1	1	4	7	1	0	0	0	12
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	1	1	4	7	1	0	0	0	12
6. Zone 6														
Procurement	0	0	0	1	0	1	2	10	10	1	0	0	0	21
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	1	0	1	2	10	10	1	0	0	0	21
7. Zone 7														
Procurement	1	2	0	1	0	1	5	5	9	1	0	0	0	15
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	2	0	1	0	1	5	5	9	1	0	0	0	15
8. Zone 8														
Procurement	3	2	0	2	0	1	8	3	4	1	0	0	0	8
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	3	2	0	2	0	1	8	3	4	1	0	0	0	8
9. Zone 9														
Procurement	0	0	0	2	0	1	3	6	13	1	1	0	0	21
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	2	0	1	3	6	13	1	1	0	0	21
Zone 1-Zone 9 Total														
Procurement	11	12	1	12	0	9	45	50	70	9	1	0	0	130
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	11	12	1	12	0	9	45	50	70	9	1	0	0	130
10. CCN / SWMPC Zone														
Procurement	0	0	0	4	6	1	11	0	32	1	1	18	0	52
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	4	6	1	11	0	32	1	1	18	0	52
Grand Total														
Procurement	11	12	1	16	6	10	56	50	102	10	2	18	0	182
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	11	12	1	16	6	10	56	50	102	10	2	18	0	182

	2020							2025						
	Compactor	Dump Truck for Residential Areas	Dump Truck for Street Sweeping	Container Truck for Market Waste	Container Truck for CCN Zone	Pick-up Truck	Sub Total	Compactor	Dump Truck for Residential Areas	Dump Truck for Street Sweeping	Container Truck for Market Waste	Container Truck for CCN Zone	Pick-up Truck	Sub Total
1. Zone 1														
Procurement	3	5	0	0	0	0	8	2	4	0	0	0	0	7
Replacement	0	0	1	1	0	1	3	4	7	2	1	0	1	15
Total	3	5	1	1	0	1	11	6	11	2	1	0	1	22
1. Zone 2														
Procurement	2	2	0	0	0	0	4	4	4	0	0	0	0	8
Replacement	0	0	0	1	0	1	2	3	3	1	1	0	1	9
Total	2	2	0	1	0	1	6	7	7	1	1	0	1	17
3. Zone 3														
Procurement	2	2	0	0	0	0	4	4	4	0	0	0	0	9
Replacement	0	0	1	0	0	1	2	3	3	1	0	0	1	8
Total	2	2	1	0	0	1	6	7	7	1	0	0	1	17
4. Zone 4														
Procurement	6	6	0	0	0	0	12	4	4	0	0	0	0	8
Replacement	1	1	1	1	0	1	5	5	5	1	1	0	1	13
Total	7	7	1	1	0	1	17	9	9	1	1	0	1	21
5. Zone 5														
Procurement	2	4	0	0	0	0	6	3	5	0	0	0	0	8
Replacement	0	0	1	0	0	1	2	2	4	1	0	0	1	8
Total	2	4	1	0	0	1	8	5	9	1	0	0	1	16
6. Zone 6														
Procurement	5	5	0	0	0	0	10	4	4	0	0	0	0	8
Replacement	0	0	1	1	0	1	3	9	9	1	1	0	1	21
Total	5	5	1	1	0	1	13	13	13	1	1	0	1	29
7. Zone 7														
Procurement	3	5	0	0	0	0	8	2	4	0	0	0	0	7
Replacement	0	0	1	1	0	1	3	4	6	1	1	0	1	13
Total	3	5	1	1	0	1	11	6	10	1	1	0	1	20
8. Zone 8														
Procurement	3	3	0	1	0	0	7	3	3	0	0	0	0	6
Replacement	1	0	1	1	0	1	4	4	3	3	1	0	1	12
Total	4	3	1	2	0	1	11	7	6	3	1	0	1	18
9. Zone 9														
Procurement	3	7	0	1	0	0	11	3	7	0	0	0	0	10
Replacement	0	0	0	1	0	1	2	3	7	1	2	0	1	14
Total	3	7	0	2	0	1	13	6	14	1	2	0	1	24
Zone 1-Zone 9 Total														
Procurement	29	39	0	2	0	0	70	29	40	0	0	0	0	70
Replacement	2	1	7	7	0	9	26	37	47	12	8	0	9	113
Total	31	40	7	9	0	9	96	66	87	12	8	0	9	183
10. CCN / SWMPC Zone														
Procurement	0	21	2	0	15	0	38	0	26	0	1	18	0	45
Replacement	0	0	0	1	2	1	4	0	16	1	3	12	1	33
Total	0	21	2	1	17	1	42	0	42	1	4	30	1	78
Grand Total														
Procurement	29	60	2	2	15	0	108	29	66	0	1	18	0	115
Replacement	2	1	7	8	2	10	30	37	63	13	11	12	10	146
Total	31	61	9	10	17	10	138	66	129	13	12	30	10	261

Table C.4.28 Procurement / Replacement Number of Container by Zone

Zone	2013	2015	2018	2020	2023	2025	2028	2030
Zone 1								
Procurement	4	0	0	0	0	0	0	0
Replacement	0	0	4	0	4	0	4	4
Sub Total	4	0	4	0	4	0	4	4
Zone 2								
Procurement	2	0	0	2	0	0	0	0
Replacement	0	0	2	0	2	2	2	2
Sub Total	2	0	2	2	2	2	2	2
Zone 3								
Procurement	0	0	0	0	0	0	0	0
Replacement	0	0	0	0	0	0	0	0
Sub Total	0	0	0	0	0	0	0	0
Zone 4								
Procurement	4	0	0	2	0	0	0	0
Replacement	0	0	4	0	4	2	4	2
Sub Total	4	0	4	2	4	2	4	2
Zone 5								
Procurement	0	0	0	0	0	0	0	0
Replacement	0	0	0	0	0	0	0	0
Sub Total	0	0	0	0	0	0	0	0
Zone 6								
Procurement	2	0	0	0	0	0	0	0
Replacement	0	0	2	0	2	0	2	0
Sub Total	2	0	2	0	2	0	2	0
Zone 7								
New Procurement	1	0	0	0	0	0	0	0
Replacement	0	0	1	0	1	0	1	0
Sub Total	1	0	1	0	1	0	1	0
Zone 8								
New Procurement	6	1	1	1	0	1	0	0
Replacement	0	0	7	0	8	1	8	2
Sub Total	6	1	8	1	8	2	8	2
Zone 9								
Procurement	8	1	0	1	0	2	0	0
Replacement	0	0	9	1	9	2	9	4
Sub Total	8	1	9	2	9	4	9	4
CCN / SWMPC Zone								
Procurement	20	38	0	30	0	38	0	0
Replacement	0	0	20	42	20	96	20	134
Sub Total	20	38	20	72	20	134	20	134
Grand Total								
Procurement	47	40	1	36	0	41	0	0
Replacement	0	0	49	43	50	103	50	148
Total of Procurement	47	40	50	79	50	144	50	148

(ii) **Case B: Development of Transfer Station at Dandora dumping site**

The summary of procurement number of collection vehicles and containers is shown in **Table C.4.29**. The summary of procured number of remaining vehicles at each procurement year is given in **Table C.4.30**. **Table C.4.31** and **Table C.4.32** shows the procurement number of collection vehicles and containers by zone, respectively.

Table C.4.29 Summary of Procurement Number of Collection Vehicles

Year	Number of Vehicles		
	Private	CCN	Total
2013			
Compactor	11	0	11
Dump Truck	12	1	13
Container Carrier	0	22	22
Container	0	47	47
Pick-up Truck	0	10	10
Total (excl. Container)	23	33	56
2015			
Compactor	40	0	40
Dump Truck	60	40	100
Container Carrier	0	18	18
Container	0	36	36
Pick-up Truck	0	0	0
Total (excl. Container)	100	58	158
2018			
Compactor	0	0	0
Dump Truck	0	0	0
Container Carrier	0	0	0
Container	0	50	50
Pick-up Truck	0	0	0
Total (Container)	0	50	50
2020			
Compactor	23	0	23
Dump Truck	12	1	13
Container Carrier	0	22	22
Container	0	73	73
Pick-up Truck	0	10	10
Total (excl. Container)	35	33	68
2023			
Compactor	0	0	0
Dump Truck	0	0	0
Container Carrier	0	0	0
Container	0	50	50
Pick-up Truck	0	0	0
Total (Container)	0	50	50
2025			
Compactor	59	0	59
Dump Truck	79	54	133
Container Carrier	0	40	40
Container	0	132	132
Pick-up Truck	0	10	10
Total (excl. Container)	138	104	242
2028			
Compactor	0	0	0
Dump Truck	0	0	0
Container Carrier	0	0	0
Container	0	50	50
Pick-up Truck	0	0	0
Total (Container)	0	50	50
2030			
Compactor	0	0	0
Dump Truck	0	0	0
Container Carrier	0	0	0
Container	0	136	136
Pick-up Truck	0	0	0
Total (Container)	0	136	136
Grand Total			
Compactor	133	0	133
Dump Truck	163	96	259
Container Carrier	0	102	102
Container	0	574	574
Pick-up Truck	0	30	30
Total (excl. Container)	296	228	524

**Table C.4.30 Summary of Procurement Number of Collection Vehicles for Existing Vehicles
At 2013**

Items	Zone 1 to Zone 9	CCN + Contractor	Total
Existing No. of Vehicle in 2010	162	94	256
Estimated Existing No. of Vehicle as of 2015	83	53	136
Procurement in 2013			
Procurement in 2015			
Procurement in 2020			
Procurement in 2025			
Discarded Vehicle: Procurement in 2013			
Discarded Vehicle: Procurement in 2015			
Remaining Vehicle as of 2015	83	53	136
Required No. of Vehicle-Compactor	38	0	38
Required No. of Vehicle-Open Dump Truck	51	31	82
Required No. of Vehicle-Container Carrier	0	34	34
Total-Required No. of Vehicle	89	65	154
Procurement-Compactor	11	0	11
Procurement-Open Dump Truck	12	1	13
Procurement -Container Carrier		22	22
Total-Procurement	23	23	46
Balance	17	11	28
Remaining after Procurement 2013	106	76	182
Waste Collection Target for 2015	Zone 1 to Zone 9	CCN + Contractor	Total
Potential Waste Collection Amount (t/d)	1,181	686	1,867
Target Waste Collection Amount (t/d)	656	255	911
Waste Collection Ratio (%)	56%	37%	49%

At 2015

Items	Zone 1 to Zone 9	CCN + Contractor	Total
Existing No. of Vehicle in 2010	162	94	256
Estimated Existing No. of Vehicle as of 2020	0	2	2
Procurement in 2013	23	23	46
Procurement in 2015			
Procurement in 2020			
Procurement in 2025			
Discarded Vehicle: Procurement in 2013			
Discarded Vehicle: Procurement in 2015			
Remaining Vehicle as of 2020	23	25	48
Required No. of Vehicle-Compactor	51	0	51
Required No. of Vehicle-Open Dump Truck	72	43	115
Required No. of Vehicle-Container Carrier	0	40	40
Total-Required No. of Vehicle	123	83	206

Items	Zone 1 to Zone 9	CCN + Contractor	Total
Procurement-Compactor	40	0	40
Procurement-Open Dump Truck	60	40	100
Procurement -Container Carrier		18	18
Total-Procurement	100	58	158
Balance	0	0	0
Remaining after Procurement 2015	123	83	206
Waste Collection Target for 2020			
Potential Waste Collection Amount (t/d)	1,354	784	2,138
Target Waste Collection Amount (t/d)	943	438	1,381
Waste Collection Ratio (%)	70%	56%	65%

At 2020

Items	Zone 1 to Zone 9	CCN + Contractor	Total
Existing No. of Vehicle in 2010	162	94	256
Estimated Existing No. of Vehicle as of 2025	0	2	2
Procurement in 2013	23	23	46
Procurement in 2015	100	58	158
Procurement in 2020			
Procurement in 2025			
Discarded Vehicle: Procurement in 2013	5	5	10
Discarded Vehicle: Procurement in 2015			
Remaining Vehicle as of 2025	118	78	196
Required No. of Vehicle-Compactor	72	0	72
Required No. of Vehicle-Open Dump Truck	101	75	176
Required No. of Vehicle-Container Carrier	0	56	56
Total-Required No. of Vehicle	173	131	304
Procurement-Compactor	23	0	23
Procurement-Open Dump Truck	32	27	59
Procurement -Container Carrier		26	26
Total-Procurement	55	53	108
Balance	0	0	0
Remaining after Procurement 2020	173	131	304
Waste Collection Target for 2025			
Potential Waste Collection Amount (t/d)	1,572	912	2,484
Target Waste Collection Amount (t/d)	1,362	714	2,076
Waste Collection Ratio (%)	87%	78%	84%

At 2025

Items	Zone 1 to Zone 9	CCN + Contractor	Total
Existing No. of Vehicle in 2010	162	94	256
Estimated Existing No. of Vehicle as of 2030	0	0	0
Procurement in 2013	23	23	46
Procurement in 2015	100	58	158
Procurement in 2020	55	53	108
Procurement in 2025			
Discarded Vehicle: Procurement in 2013	16	16	32
Discarded Vehicle: Procurement in 2015	50	29	79
Remaining Vehicle as of 2030	112	89	201
Required No. of Vehicle-Compactor	111	0	111
Required No. of Vehicle-Open Dump Truck	139	87	226
Required No. of Vehicle-Container Carrier	0	95	95
Total-Required No. of Vehicle	250	182	432
Procurement-Compactor	59	0	59
Procurement-Open Dump Truck	79	54	133
Procurement -Container Carrier		40	40
Total-Procurement	138	94	232
Balance	0	0	0
Remaining after Procurement 2025	250	183	433
Waste Collection Target for 2030			
Potential Waste Collection Amount (t/d)	1,818	1,054	2,872
Target Waste Collection Amount (t/d)	1,818	1,054	2,872
Waste Collection Ratio (%)	100%	100%	100%

Table C.4.31 Procurement Number of Collection Vehicles by Zone

	2013							2015						
	Compactor	Dump Truck for Residential Areas	Dump Truck for Street Sweeping	Truck for Container Market Waste	Truck for CCN Zone	Pick-up Truck	Sub Total	Compactor	Dump Truck for Residential Areas	Dump Truck for Street Sweeping	Truck for Container Market Waste	Truck for CCN Zone	Pick-up Truck	Sub Total
1. Zone 1														
Procurement	1	2	1	2	0	1	7	4	9	1	0	0	0	14
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	2	1	2	0	1	7	4	9	1	0	0	0	14
1. Zone 2														
Procurement	0	0	0	2	0	1	3	6	6	1	0	0	0	13
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	2	0	1	3	6	6	1	0	0	0	13
3. Zone 3														
Procurement	2	2	0	0	0	1	5	4	4	1	0	0	0	9
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2	2	0	0	0	1	5	4	4	1	0	0	0	9
4. Zone 4														
Procurement	4	4	0	2	0	1	11	6	6	1	0	0	0	13
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	4	4	0	2	0	1	11	6	6	1	0	0	0	13
5. Zone 5														
Procurement	0	0	0	0	0	1	1	3	6	1	0	0	0	10
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	1	1	3	6	1	0	0	0	10
6. Zone 6														
Procurement	0	0	0	1	0	1	2	5	5	1	0	0	0	11
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	1	0	1	2	5	5	1	0	0	0	11
7. Zone 7														
New Procurement	1	2	0	1	0	1	5	3	7	1	0	0	0	11
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	2	0	1	0	1	5	3	7	1	0	0	0	11
8. Zone 8														
Procurement	3	2	0	2	0	1	8	3	4	1	0	0	0	8
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	3	2	0	2	0	1	8	3	4	1	0	0	0	8
9. Zone 9														
Procurement	0	0	0	2	0	1	3	6	13	1	1	0	0	21
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	2	0	1	3	6	13	1	1	0	0	21
Zone 1-Zone 9 Total														
Procurement	11	12	1	12	0	9	45	40	60	9	1	0	0	110
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	11	12	1	12	0	9	45	40	60	9	1	0	0	110
10. CCN / SWMPC Zone														
Procurement	0	0	0	4	6	1	11	0	30	1	1	16	0	48
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	4	6	1	11	0	30	1	1	16	0	48
Grand Total														
Procurement	11	12	1	16	6	10	56	40	90	10	2	16	0	158
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	11	12	1	16	6	10	56	40	90	10	2	16	0	158

	2020							2025						
	Compactor	Dump Truck for Residential Areas	Dump Truck for Street Sweeping	Container Truck for Market Waste	Container Truck for CCN Zone	Pick-up Truck	Sub Total	Compactor	Dump Truck for Residential Areas	Dump Truck for Street Sweeping	Container Truck for Market Waste	Container Truck for CCN Zone	Pick-up Truck	Sub Total
1. Zone 1														
Procurement	2	4	0	0	0	0	6	2	4	0	0	0	0	7
Replacement	0	0	1	1	0	1	3	3	6	2	1	0	1	13
Total	2	4	1	1	0	1	9	5	10	2	1	0	1	20
1. Zone 2														
Procurement	2	2	0	0	0	0	4	4	4	0	0	0	0	8
Replacement	0	0	0	1	0	1	2	3	3	1	1	0	1	9
Total	2	2	0	1	0	1	6	7	7	1	1	0	1	17
3. Zone 3														
Procurement	2	2	0	0	0	0	4	4	4	0	0	0	0	9
Replacement	0	0	1	0	0	1	2	3	3	1	0	0	1	8
Total	2	2	1	0	0	1	6	7	7	1	0	0	1	17
4. Zone 4														
Procurement	6	6	0	0	0	0	12	4	4	0	0	0	0	8
Replacement	1	1	1	1	0	1	5	5	5	1	1	0	1	13
Total	7	7	1	1	0	1	17	9	9	1	1	0	1	21
5. Zone 5														
Procurement	1	3	0	0	0	0	4	2	4	0	0	0	0	6
Replacement	0	0	1	0	0	1	2	2	3	1	0	0	1	7
Total	1	3	1	0	0	1	6	4	7	1	0	0	1	13
6. Zone 6														
Procurement	2	2	0	0	0	0	4	2	2	0	0	0	0	4
Replacement	0	0	1	1	0	1	3	7	7	1	1	0	1	17
Total	2	2	1	1	0	1	7	9	9	1	1	0	1	21
7. Zone 7														
New Procurement	0	2	0	0	0	0	2	2	4	0	0	0	0	7
Replacement	0	0	1	1	0	1	3	3	5	1	1	0	1	11
Total	0	2	1	1	0	1	5	5	9	1	1	0	1	18
8. Zone 8														
Procurement	3	3	0	1	0	0	7	3	3	0	0	0	0	6
Replacement	1	0	1	1	0	1	4	4	3	3	1	0	1	12
Total	4	3	1	2	0	1	11	7	6	3	1	0	1	18
9. Zone 9														
Procurement	3	7	0	1	0	0	11	3	7	0	0	0	0	10
Replacement	0	0	0	1	0	1	2	3	7	1	2	0	1	14
Total	3	7	0	2	0	1	13	6	14	1	2	0	1	24
Zone 1-Zone 9 Total														
Procurement	21	31	0	2	0	0	54	26	37	0	0	0	0	64
Replacement	2	1	7	7	0	9	26	33	42	12	8	0	9	104
Total	23	32	7	9	0	9	80	59	79	12	8	0	9	168
10. CCN / SWMPC Zone														
Procurement	0	20	0	0	14	0	34	0	24	2	1	16	0	43
Replacement	0	0	0	1	2	1	4	0	15	1	3	11	1	31
Total	0	20	0	1	16	1	38	0	39	3	4	27	1	74
Grand Total														
Procurement	21	51	0	2	14	0	88	26	61	2	1	16	0	107
Replacement	2	1	7	8	2	10	30	33	57	13	11	11	10	135
Total	23	52	7	10	16	10	118	59	118	15	12	27	10	242

Table C.4.32 Procurement / Replacement Number of Container by Zone

	2013	2015	2018	2020	2023	2024	2025	2028	2030
Zone 1									
New Procurement	4	0	0	0	0	0	0	0	0
Replacement	0	0	4	0	4	0	0	4	4
Sub Total	4	0	4	0	4	0	0	4	4
Zone 2									
New Procurement	2	0	0	2	0	0	0	0	0
Replacement	0	0	2	0	2	0	2	2	2
Sub Total	2	0	2	2	2	0	2	2	2
Zone 3									
New Procurement	0	0	0	0	0	0	0	0	0
Replacement	0	0	0	0	0	0	0	0	0
Sub Total	0	0	0	0	0	0	0	0	0
Zone 4									
New Procurement	4	0	0	2	0	0	0	0	0
Replacement	0	0	4	0	4	0	2	4	2
Sub Total	4	0	4	2	4	0	2	4	2
Zone 5									
New Procurement	0	0	0	0	0	0	0	0	0
Replacement	0	0	0	0	0	0	0	0	0
Sub Total	0	0	0	0	0	0	0	0	0
Zone 6									
New Procurement	2	0	0	0	0	0	0	0	0
Replacement	0	0	2	0	2	0	0	2	0
Sub Total	2	0	2	0	2	0	0	2	0
Zone 7									
New Procurement	1	0	0	0	0	0	0	0	0
Replacement	0	0	1	0	1	0	0	1	0
Sub Total	1	0	1	0	1	0	0	1	0
Zone 8									
New Procurement	6	1	1	1	0	0	1	0	0
Replacement	0	0	7	0	8	0	1	8	2
Sub Total	6	1	8	1	8	0	2	8	2
Zone 9									
New Procurement	8	1	0	1	0	0	2	0	0
Replacement	0	0	9	1	9	0	2	9	4
Sub Total	8	1	9	2	9	0	4	9	4
CCN / SWMPC Zone									
New Procurement	20	34	0	28	0	0	34	0	0
Replacement	0	0	20	38	20	0	88	20	122
Sub Total	20	34	20	66	20	0	122	20	122
Grand Total									
New Procurement	47	36	1	34	0	0	37	0	0
Replacement	0	0	49	39	50	0	95	50	136
Total of Procurement	47	36	50	73	50	0	132	50	136

(3) Implementation Schedule

(a) Case A: Direct Haul to Ruai Final Landfill Site

The implementation schedule of the proposed project is shown in **Table C.4.33**. The procurement of collection vehicles will be implemented in 2013, 2015, 2020, and 2025. Containers should be replaced every 5 years. The procurement of collection vehicles will be implemented in 2013, 2015, 2020 and 2025 while the procurement of containers will be made every 2 or 3 years up to 2030. The disbursement of engineering cost will start in 2011 and 2012.

Table C.4.33 Implementation Schedule of Case A: Direct Haul to Ruai Final Landfill Site

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1. Procurement																					
- Vehicles				○		○					○					○					
- Container				○		○					○					○					
2. Replacement																					
- Vehicles															—	—	—	—	—	—	—
- Container									○		○			○		○			○		○
3. Operation & Maintenance					—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

(b) Case B: Construction of Transfer Station at Dandora Dumpsite

The implementation schedule of the proposed project is shown in **Table C.4.34**. The procurement of collection vehicles will be implemented in 2013, 2015, 2020, and 2025, the same as in Case A-1. During 2015 and 2016, a construction work of the transfer station will be carried out. The procurement of transport vehicles should be implemented in 2016.

Table C.4.34 Development of Transfer Station at Dandora Dump Site

	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				○		○					○					○					
- Container				○		○					○					○					
1.2 Replacement																					
- Vehicles															—	—	—	—	—	—	—
- Container									○		○			○		○			○		○
2. Transfer Station																					
2.1 Construction																					
- Design, Tender				—	—	—															
- Construction						—	—	—													
- Procurement of Transport Vehicles							○														
- Replacement of Transport Vehicles																	—	—	—	—	—
- Replacement of Transport Containers												○					○				○
3. Operation & Maintenance					—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

(4) Project Cost

(a) Case A: Direct Haul to Ruai Final Landfill Site

The procurement of collection vehicles is shown in **Table C.4.35**. The detailed information of estimating procurement number is shown in (3) Procurement Number of Collection Vehicles of 3.2 Technical Evaluation of Alternative Options of **Section C of the Supporting Report**. The procurement and project cost with 10% physical contingency for the engineering and procurement cost is shown in **Table C.4.36** and **Table C.4.37**, respectively.

Table C.4.35 Procurement Number of Collection Vehicles (Case A)

	2013	2015	2018	2020	2023	2025	2028	2030	Total
1. Procurement Number									
- 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 of Vehicles	33	62	0	33	0	108	0	0	236
- Container	47	40	50	79	50	144	50	148	608

Table C.4.36 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 C.4.37 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

(b) Case B: Construction of Transfer Station at Dandora Dumpsite

The procurement of collection vehicles is shown in **Table C.4.38**. The procurement and project cost with 10% physical contingency for the engineering and procurement cost is shown in **Table C.4.39** and **Table C.4.40**, respectively. The procurement of collection vehicles will be implemented in 2013, 2015, 2020 and 2025 while construction of the transfer station will be carried out in 2015 and 2016.

Table C.4.38 Procurement Number of Collection Vehicles (Case B)

Unit in Thousand KSh

Type of Vehicles	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 C.4.39 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 C.4.40 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 Contingency*	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.

4.3 Layout of Transfer Station

Figure C.4.10 shows the conceptual image of the proposed transfer station. The proposed transfer station consists of a weigh bridge, ramp, transfer system (MRF is proposed as a waste recovery facility to be segregated manually by the waste pickers), workshop, container yard, waste water treatment facility.

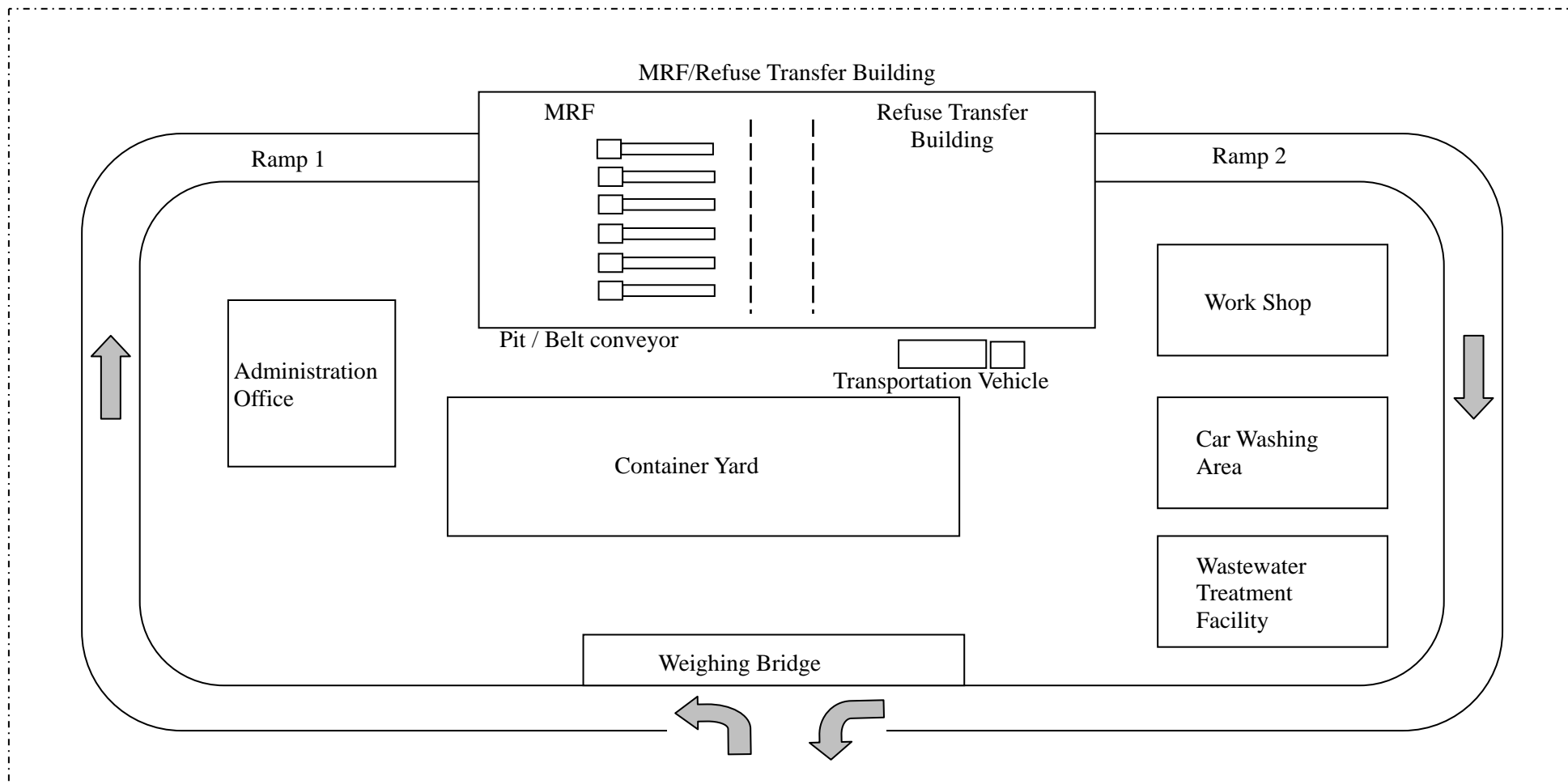


Figure C.4.10 Conceptual Image of Proposed Transfer Station in Dandora

5. ACTION PLAN

5.1 General

The overall goal of the action plan of the proposed master plan on collection and transportation should be the concrete implementation of the optimum technical option which was selected in this survey in order to attain the current extremely low collection ratio mainly through the procurement of collection vehicles and the construction of the transfer station. The SWM in the informal settlements such as low income and slum areas is currently in the worst situation in terms of low collection ratio which has been causing unsanitary situation of Nairobi city compared to other housing areas, should be solved urgently to remove the bottlenecks in the areas at the same time for the actual implementation of the proposal in the master plan. The main actors in such informal sectors will be residents, CBOs and also CCN, the actual implementation should be in collaboration with other sectors such as public education in the survey team.

The Action Plan shows the plan of operation of proposed project components in timeframe of short-, mid and long-term.

5.2 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.

5.3 Planning Policy

The basic policy of the Collection and Transportation Plan is to prioritise an optimum system through taking a timeframe development and proper allotment of collection and transportation system synchronising with other sectors (especially transportation sector) into consideration. For the issue in lower 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.

5.4 Strategy

The following strategies are proposed for the actual implementation of the action plans.

(1) Preparation of waste collection implementation plan at commencement of implementation of action plans:

CCN has to prepare their waste collection plan at the commencement of the implementation of the action plans in collaboration with relevant authorities such as the Ministry of Local Government, treasury or city planning departments of CCN.

(2) Procurement of collection vehicles and construction of a transfer station in early stages of implementation of action plans through the possible application for the financial support from foreign donors or CCN's budget:

The procurement of collection vehicles for CCN should be made in early stage of short-term plan. At the same time, the preparation of construction of a transfer station should be carried out in early stage and its actual construction to mid-term stage. The decision of application of financial support from foreign donors or CCN's budget should be made by the Kenyan Government to implement these projects.

(3) Removal of bottlenecks in informal settlements in early stages to solve the collection and transportation problems through community-based approach:

The community-based pilot projects should be implemented in informal settlements in early stage to raise the current low collection ratio, enhance the residents' awareness toward sanitary environment, raise the residents' cooperation with SWM, enhance or expand CBOs activities. This task should be implemented through the pilot projects in collaboration with the expert of public education.

(4) Raising of sanitary condition of Nairobi City through the implementation of the cleanup of scattered waste along the roadsides in early stage:

The regular cleanup should be implemented for the scattered wastes along roadsides in the early stage to keep Nairobi City clean or sanitary.

(5) Securing accessibility to the collection points in all stages to continue raising the collection ratios:

The access to the collection points should be secured in all stages for collection vehicles to reach the collection points to raise the collection ratio. The construction or improvement of roads will be required to access the collection points.

(6) Implementation of zone-wide PPPP operation in all stages:

The preparation of structuring of the proposed zone-wide PPPP operation system should be done in early stage. This action should be continued to create private franchisee in mid- to long-term.

5.5 Goals of Action Plan

5.5.1 Short-Term Plan

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

5.5.2 Mid-Term Plan

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

5.5.3 Long-Term Plan

- Increase of collection rate up to 100 % in 2030
- Formation of nine (9) franchisees for implementation of PPPP scheme

- Improvement of collection and transport system through procurement of collection vehicles and introduction of container system

5.6 Plan of Operation

The plan of operation consists of 2 cases, namely; 1) Case A: Direct Haul to Ruai and 2) Case B: Construction of a Transfer Station in Dandora.

The Plan of Operation for short-, mid- and long-term for Case A and the cost / responsibilities are shown in **Figure C.5.1, Figure C.5.2 and Figure C.5.3**, respectively.

The Plan of Operation for short-, mid- and long-term for Case B and the cost / responsibilities are shown in **Figure C.5.4, Figure C.5.5 and Figure C.5.36** respectively.

The detailed contents of each plan of operation are shown as below.

5.6.1 Short-Term Action Plan

(1) Formulation of Collection and Transportation Implementation Plan:

CCN will be responsible for the task of preparing the integrated waste collection implementation plan. CCN will have to prepare their draft plan for the approval by relevant authorities. The plan shall include at least overall waste collection plan, approach of monitoring the waste collection ratio, procurement plan of collection vehicles including budgetary arrangement, selection of type and number of collection vehicles, appropriate collection management in informal settlement such as low income and slum areas.

(2) Monitoring of Implementation of Collection and Transportation Plan (Phase I):

CCN has to conduct regular monitoring of the waste collection ratio, actual operation practice of CCN, contractors and private collectors continuously up to 2015.

(3) Implementation of Urgent Waste Collection Plan:

CCN should carry out the cleanup of the scattered wastes along the road sides. The monitoring of the scattered wastes will be also CCN's mandate.

(4) Procurement of Waste Collection Vehicles for the CCN/SWMPC Zone (Phase I):

CCN should prepare the procurement of waste collection vehicles through budgetary arrangement, designing and tender. The application of the loan from foreign donors will be one of options of the financial support for the procurement. After that, CCN should carry out the actual procurement of collection vehicles.

(5) Implementation of Regular Station Collection in the 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 the collection operation in CCN/SWMPC zone. CCN should be responsible for this task.

(6) Construction of Access Road to Slum Areas in the CCN/SWMPC Zone (Phase I):

About 75 slums are estimated for the construction of access roads among all slums (150) in the city. However, the actual slum areas which require the access roads should be selected in advance before the actual construction commences. The stakeholder meetings among residents, CBOs and CCN should be held to select the sites for the access. The utilisation of the financial support from foreign donors will be one of the options to implement of this component successfully.

(7) Implementation of Waste Collection PPPP Scheme (Phase I):

The detailed information is shown in **Section B, Organisational, Institutional and Human Resources Development Study**.

(8) Procurement of Transfer Station in Dandora (940 t/d) (Phase I):

As in the process of procurement of collection vehicles, the budgetary arrangement including application of loan from foreign donors should be made by CCN. All required processes of land acquisition and EIA should be completed before the implementation of this component. The construction work shall commence in 2015 and continue to the mid-term stage.

5.6.2 Mid-Term Action Plan

(1) Monitoring of Implementation of Collection and Transportation Plan (Phase II):

CCN has to continuously conduct regular monitoring of the waste collection ratio, actual operation practice of CCN, contractors and private collectors up to 2020. If the actual collection ratio does not reach the target collection ratio, CCN shall have to take measures to meet the situation.

(2) Procurement of Waste Collection Vehicles for the CCN/SWMPC Zone (Phase II):

CCN should procure waste collection vehicles through budgetary arrangement. The application of loan from foreign donors or the utilisation of SWM Capital Revolving Fund which will be created as a new funding system in the proposed zone-wise operation system will be one of options of the financial support for the procurement.

(3) Implementation of Regular Station Collection in the CCN/SWMPC Zone (Phase II):

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 the collection operation in CCN/SWMPC zone. CCN should be responsible for this task.

(4) Construction of Access Road to Slum Areas in the CCN/SWMPC Zone (Phase II):

This action should be continuously carried out, the same as short-term plan. The target slum areas in which the access roads are required should be selected through stakeholder meetings among residents, CBOs and CCN.

(5) Implementation of Waste Collection PPPP Scheme (Phase II):

The detailed information is shown in **Section B, Organisational, Institutional and Human Resources Development Study**.

(6) Procurement of Transfer Station in Dandora (940 t/d) (Phase II):

The construction work and the procurement of transportation vehicle shall be carried out in 2016. After the construction is completed, the operation and maintenance of the transfer station shall commence.

(7) Operation and Maintenance of Transfer Station in Dandora (940 t/d) (Phase I):

After the construction is completed, the operation and maintenance of the transfer station shall commence.

5.6.3 Long-Term Action Plan

(1) Monitoring of Implementation of Collection and Transportation Plan (Phase III):

CCN has to continuously conduct regular monitoring of the waste collection ratio, actual operation practice of CCN, contractors and private collectors up to 2030. If the actual collection ratio does not reach the target collection ratio, CCN shall have to take a measure to meet the situation.

(2) 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 SWM Capital Revolving Fund which will be created as a new funding system in the proposed zone-wise operation system will be one of options of the financial support for the procurement.

(3) Implementation of Regular Station Collection in the CCN/SWMPC Zone (Phase III):

CCN has to deploy new collection vehicles through analysing local conditions on the collection and transportation. They should also conduct operation and maintenance of CCN's new collection vehicles.

(4) Construction of Access Road to Slum Areas in the CCN/SWMPC Zone (Phase III):

In the same manner, the construction of access roads should be carried out.

(5) Implementation of Waste Collection PPPP Scheme (III):

The detailed information is shown in **Section B, Organisational, Institutional and Human Resources Development Study**.

(6) Procurement of Transfer Station in Dandora (940 t/d) (III):

Replacement of transportation vehicles and containers should be commenced in 2025.

(7) Operation and Maintenance of Transfer Station in Dandora (940 t/d) (II):

The operation and maintenance of the transfer station shall continue as in the Mid-Term Plan.

Time Framework of the Master Plan					Short-Term Plan Period																			
Year					2011				2012				2013				2014				2015			
Quarter					Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WBS for Short-Term Plan																								
S-1-1	Formulation of Collection&Transportation Implementation Plan																							
S-1-1-1	Formulation of Urgent Waste Collection Improvement Plan																							
S-1-1-2	Formulation of Waste Collection Implementation Plan (CCN/SWMPC Zones)																							
S-1-1-3	Formulation of Waste Collection Vehicle Procurement Plan of CCN/SWMPC Zones																							
S-1-2	Monitoring of Implementation of Collection&Transportation Plan (I)																							
S-1-2-1	Monitoring of waste collection amount & waste collection ratio																							
S-1-2-2	Monitoring of O&M of waste collection vehicles of CCN & contractors																							
S-1-2-3	Monitoring of O&M of waste collection vehicles of private collectors																							
S-1-2-4	Comprehensive review of Collection&Transportation Plan																							
S-1-3	Implementation of Urgent Waste Collection Plan																							
S-1-3-1	Regular clean-up of discarded waste along road side																							
S-1-3-2	Regular monitoring/inspection of discarded waste along road side																							
S-1-4	Procurement of Waste Collection Vehicles for CCN/SWMPC Zones (I)																							
S-1-4-1	Preparation for procurement of waste collection vehicles for CCN/SWMPC Zones																							
S-1-4-2	Procurement of waste collection vehicles for CCNSWMPCC Zones																							
S-1-4-3	Procurement/replacement of waste containers for CCN/SWMPC Zones																							
S-1-5	Implementation of Regular Station Collection In CCN/SWMPC Zone (I)																							
S-1-5-1	Preparation for dispatchment/placement of new vehicles/containers																							
S-1-5-2	Operation & maintenance of CCN Waste Collection Vehicles																							
S-1-5-3	Monitoring/inspection of regular station collection																							
S-1-6	Construction of Access Road to Slum Areas In CCN/SWMPC Zone (I)																							
S-1-6-1	Selection of slum areas for construction of access road																							
S-1-6-2	Engineering design and cost estimates for construction of access road																							
S-1-6-3	Tender, award/signing/supervision of construction work																							
S-1-6-4	construction work																							
S-1-6-5	Maintenance work of access road for waste collection																							
S-1-7	Implementation of Waste Collection PPPP Scheme (I)																							
S-1-7-1	Preparation of basic bequrements of waste collection under PPPP scheme																							
PPPP Option					Improvement of Current Contracting Out/Licensing								Improvement of Current Contracting Out/Licensing and Preparation of New Franchising Colntract											
SWM Organisation Type					CCN/DoE, Separate Account								CCN/DoE, Special Account								SWM Public Corporation			
Zoning System					Current Zone																			

**Figure C.5.1 Plan of Operation of Collection and Transportation Plan
(Case A: Direct Haul to Ruai): Short-Term Plan**

Time Framework of the Master Plan						Mid-Term Plan Period					Long-Term Plan Period									
Year						2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WBS for Mid-Term Plan																				
M-1-1	Monitoring of Implementation of Collection&Transportation Plan (II)																			
M-1-1-1	Monitoring of waste collection amount & waste collection ratio																			
M-1-1-2	Monitoring of O&M of waste collection vehicles of CCN & contractors																			
M-1-1-3	Monitoring of O&M of waste collection vehicles of private collectors																			
M-1-1-4	Comprehensive review of Collection&Transportation Plan																			
M-1-2	Procurement of Waste Collection Vehicles for CCN/SWMPC Zone (II)																			
M-1-2-1	Preparation for procurement of waste collection vehicles for CCN/SWMPC Zones																			
M-1-2-2	Procurement of waste collection vehicles for CCN/SWMPC Zones																			
M-1-2-3	Procurement/replacement of waste containers for CCN/SWMPC Zones																			
M-1-3	Implementation of Regular Station Collection In CCN/SWMPC Zone (II)																			
M-1-3-1	Preparation for dispatchment/placement of new vehicles/containers																			
M-1-3-2	Operation & maintenance of CCN waste collection vehicles																			
M-1-3-3	Monitoring/Inspection of regular station collection																			
M-1-4	Construction of Access Road to Slum Areas In CCN/SWMPC Zone (II)																			
M-1-4-1	Selection of slum areas for construction of access road																			
M-1-4-2	Engineering design and cost estimates for construction of access road																			
M-1-4-3	Tender, award/signing/supervision of construction work																			
M-1-4-2	construction work																			
M-1-4-3	Maintenance work of access road for waste collection																			
M-1-5	Implementation of Waste Collection PPPP Scheme (II)																			
M-1-5-1	Preparation of basic bequirements of waste collection under PPPP Scheme																			
M-1-5-2	Implementation of waste collection PPPP scheme In Zone 1, 8 & 9																			
WBA for Long-Term Plan																				
L-1-1	Monitoring of Implementation of Collection&Transportation Plan (III)																			
L-1-1-1	Monitoring of waste collection amount & waste collection ratio																			
L-1-1-2	Monitoring of O&M of waste collection vehicles of CCN & contractors																			
L-1-1-3	Monitoring of O&M of waste collection vehicles of private collectors																			
L-1-1-4	Comprehensive review of Collection&Transportation Plan																			
L-1-2	Procurement of Waste Collection Vehicles for CCN/SWMPC Zone (III)																			
L-1-2-1	Preparation for procurement of waste collection vehicles for CCN/SWMPC Zones																			
L-1-2-2	Procurement of waste collection vehicles for CCN/SWMPC Zones																			
L-1-2-3	Procurement/replacement of waste containers for CCN/SWMPC Zones																			
L-1-3	Implementation of Regular Station Collection In CCN/SWMPC Zone (III)																			
L-1-3-1	Preparation for dispatchment/placement of new vehicles/containers																			
L-1-3-2	Operation & maintenance of CCN waste collection vehicles																			
L-1-3-3	Monitoring/Inspection of regular station collection																			
L-1-4	Construction of Access Road to Slum Areas In CCN/SWMPC Zone (III)																			
L-1-4-1	Maintenance work of access road for waste collection																			
L-1-5	Implementation of Waste Collection PPPP Scheme (III)																			
L-1-5-1	Preparation of basic bequirements of waste collection under PPPP Scheme																			
L-1-5-2	Implementation of waste collection PPPP scheme in Zone 1, 8 & 9																			
L-1-5-3	Implementation of waste collection PPPP scheme in Zone 4, 5 & 7																			
L-1-5-4	Implementation of waste collection PPPP scheme in Zone 2, 3 & 6																			
PPPP Option						Zone-wise Franchising Contract (Phase 1)					Zone-wise Franchising Contract (Phase 2)					Zone-wise Franchising Contract (Phase 3)				
SWM Organisation Type						SWM Public Corporation														
Zoning System						New Zone (3 Zones)					New Zone (6 Zones)					New Zone (9 Zones)				

**Figure C.5.2 Plan of Operation of Collection and Transportation Plan
(Case A: Direct Haul to Ruai): Mid- and Long-Term Plans**

Programme No.	WBS No.	WBS	Legal Action (Required=●)	Name of Act/Regulation/By-law	Budgetary Arrangement (Required=●)	Total Budget (Thousand Ksh)	Responsibility Assignment Matrix: M=Main Responsibility, S=Sub Responsibilities, B=Budgetary Arrangement, L=Legal Action, P=Participation In Discussions																			
							CCN/Dept. of Environment	CCN/Dept. of Treasury	CCN/Dept. of Procurement	CCN/Dept. of Human Resources	SWM Preparatory Committee	SWM Corporation	MoLG	MoNMD	NEMA	Office of Deputy Prime Minister and MoF	KRA	Donor Organisations	Private Contractors	Private Licensed Collectors	Recyclers	CBOs	Waste Pickers	PAPs around Dandora Dumping Site	PAPs around New Dumping Site	Nairobi Citizens
Programme 1: Collection and Transportation Plan (Case A-1: Direct Haul to Ruai)																										
Short-Term Plan																										
	S-1-1	Formulation of Waste Collection Implementation Plan			● CCN		M	B											P	P		P				
	S-1-2	Monitoring of Implementation of Collection&Transportation Plan (I)			● CCN		M	B											P	P						
	S-1-3	Implementation of Urgent Waste Collection Plan			● 7,344		M	B											P			P				
	S-1-4	Procurement of Waste Collection Vehicles for CCN/SWMPC Zones (I)			● 621,049		M	B																		
	S-1-5	Implementation of Regular Station Collection in CCN/SWMPC Zone (I)			● 204,820		M	B																		
	S-1-6	Construction of Access Road to Slum Areas in CCN/SWMPC Zone (I)			● 76,037		M	B														P			P	
	S-1-7	Implementation of Waste Collection PPPP Scheme (I)			● CCN		M				S	S							P	P						
		Sub-Total				909,250																				
Mid-Term Plan																										
	M-1-1	Monitoring of Implementation of Collection&Transportation Plan (II)			● CCN		M	B			S								P	P		P				
	M-1-2	Procurement of Waste Collection Vehicles for CCN/SWMPC Zones (II)			● 310,151		M				S								P							
	M-1-3	Implementation of Regular Station Collection in CCN/SWMPC Zone (II)			● 671,568		M	B			S															
	M-1-4	Construction of Access Road to Slum Areas in CCN/SWMPC Zone (II)			● 268,187		M	B			S								P			P			P	
	M-1-5	Implementation of Waste Collection PPPP Scheme (II)			● CCN		M	B			S	S							P	P						
		Sub-Total				1,249,906																				
Long-Term Plan																										
	L-1-1	Monitoring of Implementation of Collection&Transportation Plan (III)			● CCN		M	B			S								P	P		P				
	L-1-2	Procurement of Waste Collection Vehicles for CCN/SWMPC Zones (III)			● 1,043,383		M				S								P							
	L-1-3	Implementation of Regular Station Collection in CCN/SWMPC Zone (III)			● 2,360,646		M				S															
	L-1-4	Construction of Access Road to Slum Areas in CCN/SWMPC Zone (III)			● 27,450		M				S											P			P	
	L-1-5	Implementation of Waste Collection PPPP Scheme (III)			● CCN		M	B			S	S							P	P						
		Sub-Total				3,431,479																				
		Grand Total				5,590,635																				

Figure C.5.3 Cost and Responsibilities of Collection and Transportation Operation Plan
(Case A: Direct Haul to Ruai)

Time Framework of the Master Plan					Short-Term Plan Period																			
Year					2011				2012				2013				2014				2015			
Quarter					Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WBS for Short-Term Plan																								
S-1-1	Formulation of Collection&Transportation Implementation Plan																							
S-1-1-1	Formulation of Urgent Waste Collection Improvement Plan																							
S-1-1-2	Formulation of Waste Collection Implementation Plan (CCN/SWMPC Zones)																							
S-1-1-3	Formulation of Waste Collection Vehicle Procurement Plan of CCN/SWMPC Zones																							
S-1-2	Monitoring of Implementation of Collection&Transportation Plan (I)																							
S-1-2-1	Monitoring of waste collection amount & waste collection ratio																							
S-1-2-2	Monitoring of O&M of waste collection vehicles of CCN & contractors																							
S-1-2-3	Monitoring of O&M of waste collection vehicles of private collectors																							
S-1-2-4	Comprehensive review of Collection&Transportation Plan																							
S-1-3	Implementation of Urgent Waste Collection Plan																							
S-1-3-1	Regular clean-up of discarded waste along road side																							
S-1-3-2	Regular monitoring/inspection of discarded waste along road side																							
S-1-4	Procurement of Waste Collection Vehicles for CCN/SWMPC Zones (I)																							
S-1-4-1	Preparation for procurement of waste collection vehicles for CCN/SWMPC Zones																							
S-1-4-2	Procurement of waste collection vehicles for CCNSWMPZC Zones																							
S-1-4-3	Procurement/replacement of waste containers for CCN/SWMPC Zones																							
S-1-5	Implementation of Regular Station Collection in CCN/SWMPC Zone (I)																							
S-1-5-1	Preparation for dispatchment/placement of new vehicles/containers																							
S-1-5-2	Operation & maintenance of CCN Waste Collection Vehicles																							
S-1-5-3	Monitoring/inspection of regular station collection																							
S-1-6	Construction of Access Road to Slum Areas In CCN/SWMPC Zone (I)																							
S-1-6-1	Selection of slum areas for construction of access road																							
S-1-6-2	Engineering design and cost estimates for construction of access road																							
S-1-6-3	Tender, award/signing/supervision of construction work																							
S-1-6-4	construction work																							
S-1-6-5	Maintenance work of access road for waste collection																							
S-1-7	Implementation of Waste Collection PPPP Scheme (I)																							
S-1-7-1	Preparation of basic bequirements of waste collection under PPPP scheme																							
S-1-8	Procurement of Transfer Station In Dandora (940 t/d) (I)																							
S-1-8-1	Preparation of procurement of transfer station and transport vehicles																							
S-1-8-2	Construction of transfer station																							
S-1-8-3	Supervision of construction work																							
PPPP Option					Improvement of Current Contracting Out/Licensing								Improvement of Current Contracting Out/Licensing and Preparation of New Franchising Colntract											
SWM Organisation Type					CCN/DoE, Separate Account								CCN/DoE, Special Account								SWM Public Corporation			
Zoning System					Current Zone																			

**Figure C.5.4 Plan of Operation of Collection and Transportation Plan
(Case B: Construction of a Transfer Station): Short-Term Plan**

Time Framework of the Master Plan						Mid-Term Plan Period					Long-Term Plan Period										
Year						2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
WBS for Mid-Term Plan																					
M-1-1	Monitoring of Implementation of Collection&Transportation Plan (II)																				
M-1-1-1	Monitoring of waste collection amount & waste collection ratio																				
M-1-1-2	Monitoring of O&M of waste collection vehicles of CCN & contractors																				
M-1-1-3	Monitoring of O&M of waste collection vehicles of private collectors																				
M-1-1-4	Comprehensive review of Collection&Transportation Plan																				
M-1-2	Procurement of Waste Collection Vehicles for CCN/SWMP Zone (II)																				
M-1-2-1	Preparation for procurement of waste collection vehicles for CCN/SWMP Zones																				
M-1-2-2	Procurement of waste collection vehicles for CCN/SWMP Zones																				
M-1-2-3	Procurement/replacement of waste containers for CCN/SWMP Zones																				
M-1-3	Implementation of Regular Station Collection In CCN/SWMP Zone (II)																				
M-1-3-1	Preparation for dispatchment/placement of new vehicles/containers																				
M-1-3-2	Operation & maintenance of CCN waste collection vehicles																				
M-1-3-3	Monitoring/inspection of regular station collection																				
M-1-4	Construction of Access Road to Slum Areas In CCN/SWMP Zone (II)																				
M-1-4-1	Selection of slum areas for construction of access road																				
M-1-4-2	Engineering design and cost estimates for construction of access road																				
M-1-4-3	Tender, award/signing/supervision of construction work																				
M-1-4-2	construction work																				
M-1-4-3	Maintenance work of access road for waste collection																				
M-1-5	Implementation of Waste Collection PPPP Scheme (II)																				
M-1-5-1	Preparation of basic bequirements of waste collection under PPPP Scheme																				
M-1-5-2	Implementation of waste collection PPPP scheme In Zone 1, 8 & 9																				
WBA for Long-Term Plan																					
L-1-1	Monitoring of Implementation of Collection&Transportation Plan (III)																				
L-1-1-1	Monitoring of waste collection amount & waste collection ratio																				
L-1-1-2	Monitoring of O&M of waste collection vehicles of CCN & contractors																				
L-1-1-3	Monitoring of O&M of waste collection vehicles of private collectors																				
L-1-1-4	Comprehensive review of Collection&Transportation Plan																				
L-1-2	Procurement of Waste Collection Vehicles for CCN/SWMP Zone (III)																				
L-1-2-1	Preparation for procurement of waste collection vehicles for CCN/SWMP Zones																				
L-1-2-2	Procurement of waste collection vehicles for CCN/SWMP Zones																				
L-1-2-3	Procurement/replacement of waste containers for CCN/SWMP Zones																				
L-1-3	Implementation of Regular Station Collection In CCN/SWMP Zone (III)																				
L-1-3-1	Preparation for dispatchment/placement of new vehicles/containers																				
L-1-3-2	Operation & maintenance of CCN waste collection vehicles																				
L-1-3-3	Monitoring/inspection of regular station collection																				
L-1-4	Construction of Access Road to Slum Areas In CCN/SWMP Zone (III)																				
L-1-4-1	Maintenance work of access road for waste collection																				
L-1-5	Implementation of Waste Collection PPPP Scheme (III)																				
L-1-5-1	Preparation of basic bequirements of waste collection under PPPP Scheme																				
L-1-5-2	Implementation of waste collection PPPP scheme In Zone 1, 8 & 9																				
L-1-5-3	Implementation of waste collection PPPP scheme In Zone 4, 5 & 7																				
L-1-5-4	Implementation of waste collection PPPP scheme In Zone 2, 3 & 6																				
PPPP Option						Zone-wise Franchising Contract (Phase 1)					Zone-wise Franchising Contract (Phase 2)					Zone-wise Franchising Contract (Phase 3)					
SWM Organisation Type						SWM Public Corporation															
Zoning System						New Zone (3 Zones)					New Zone (6 Zones)					New Zone (9 Zones)					

**Figure C.5.5 Plan of Operation of Collection and Transportation Plan
(Case B: Construction of a Transfer Station): Mid- and Long-Term Plans**

Programme No.	WBS No.	WBS	Legal Action (Required=●)	Name of Act/Regulation/By-law	Budgetary Arrangement (Required=●)	Total Budget (Thousand Ksh)	Responsibility Assignment Matrix: M=Main Responsibility, S=Sub Responsibilities, B=Budgetary Arrangement, L=Legal Action, P=Participation In Discussions																			
							CCN/Dept. of Environment	CCN/Dept. of Treasury	CCN/Dept. of Procurement	CCN/Dept. of Human Resources	SWM Preparatory Committee	SWM Corporation	MoLG	MoNMD	NEMA	Office of Deputy Prime Minister and MoF	KRA	Donor Organisations	Private Contractors	Private Licensed Collectors	Recyclers	CBOs	Waste Pickers	PAPs around Dandora Dumping Site	PAPs around New Dumping Site	Nairobi Citizens
Programme 1: Collection and Transportation Plan (Case B-1: Construction of a Transfer Station)																										
Short-Term Plan																										
	S-1-1	Formulation of Waste Collection Implementation Plan			● CCN		M	B											P	P		P				
	S-1-2	Monitoring of Implementation of Collection&Transportation Plan (I)			● CCN		M	B											P	P						
	S-1-3	Implementation of Urgent Waste Collection Plan			●	7,344	M	B											P			P				
	S-1-4	Procurement of Waste Collection Vehicles for CCN/SWMPZones (I)			●	592,452	M	B																		
	S-1-5	Implementation of Regular Station Collection in CCN/SWMPZones (I)			●	197,879	M	B																		
	S-1-6	Construction of Access Road to Slum Areas in CCN/SWMPZones (I)			●	76,037	M	B														P			P	
	S-1-7	Implementation of Waste Collection PPPP Scheme (I)			● CCN		M				S		S						P	P						
	S-1-8	Procurement of Transfer Station in Dandora (940 t/d) (I)			●	1,688,818	M						P		P											
		Sub-Total				2,562,530																				
Mid-Term Plan																										
	M-1-1	Monitoring of Implementation of Collection&Transportation Plan (II)			● CCN		M	B				S							P	P		P				
	M-1-2	Procurement of Waste Collection Vehicles for CCN/SWMPZones (II)			●	303,206	M					S							P							
	M-1-3	Implementation of Regular Station Collection in CCN/SWMPZones (II)			●	645,653	M	B				S														
	M-1-4	Construction of Access Road to Slum Areas in CCN/SWMPZones (II)			●	268,187	M	B				S							P			P			P	
	M-1-5	Implementation of Waste Collection PPP Scheme (II)			● CCN		M	B			S		S						P	P						
	M-1-6	Procurement of Transfer Station in Dandora (940 t/d) (II)			●	2,415,039	M						P		P											
	M-1-7	Operation and Maintenance of Transfer Station and Transport Vehicles (I)			●	295,114	M						P		P											
		Sub-Total				3,927,199																				
Long-Term Plan																										
	L-1-1	Monitoring of Implementation of Collection&Transportation Plan (III)			● CCN		M	B				S							P	P		P				
	L-1-2	Procurement of Waste Collection Vehicles for CCN/SWMPZones (III)			●	990,547	M					S							P							
	L-1-3	Implementation of Regular Station Collection in CCN/SWMPZones (III)			●	2,252,504	M					S														
	L-1-4	Construction of Access Road to Slum Areas in CCN/SWMPZones (III)			●	27,450	M					S										P			P	
	L-1-5	Implementation of Waste Collection PPPP Scheme (III)			● CCN		M	B			S		S						P	P						
	L-1-6	Procurement of Transfer Station in Dandora (940 t/d) (III)			●	2,279,560	M						P		P											
	L-1-7	Operation and Maintenance of Transfer Station and Transport Vehicles (II)			●	1,290,898	M				S		P		P						P	P	P		P	
		Sub-Total				6,840,959																				
		Grand Total				13,330,688																				

Figure C.5.6 Cost and Responsibilities of Collection and Transportation Operation Plan
(Case B: Construction of a Transfer Station)

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