

**BASIC DESIGN STUDY REPORT  
ON  
THE SOLID WASTE MANAGEMENT PROJECT  
FOR  
COLOMBO METROPOLITAN AREA  
IN  
THE DEMOCRATIC SOCIALIST REPUBLIC OF  
SRI LANKA**

**FEBRUARY, 1998**

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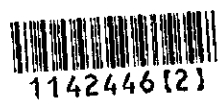




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## PREFACE

In response to a request from the Government of the Democratic Socialist Republic of Sri Lanka, the Government of Japan decided to conduct a basic design study on the Solid Waste Management Project for Colombo Metropolitan Area and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Sri Lanka a study team from September 8 to October 12, 1997.

The team held discussions with the officials concerned of the Government of Sri Lanka, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Sri Lanka in order to discuss a draft basic design, and as this result, the present report was finalized.

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

I wish to express my sincere appreciation to the officials concerned of the Government of the Democratic Socialist Republic of Sri Lanka for their close cooperation extended to the teams.

February, 1998

A handwritten signature in black ink, appearing to read 'Kimio Fujita', with a stylized, flowing script.

Kimio Fujita

President

Japan International Cooperation Agency

## Letter of Transmittal

We are pleased to submit to you the basic design study report on the Solid Waste Management Project for Colombo Metropolitan Area in the Democratic Socialist Republic of Sri Lanka.

This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period from August 25, 1997 to March 11, 1998. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Sri Lanka and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

A handwritten signature in black ink, consisting of three characters: '阿' (Abe), '部' (Hiroshi), and '浩' (Hiroshi).

Hiroshi Abe

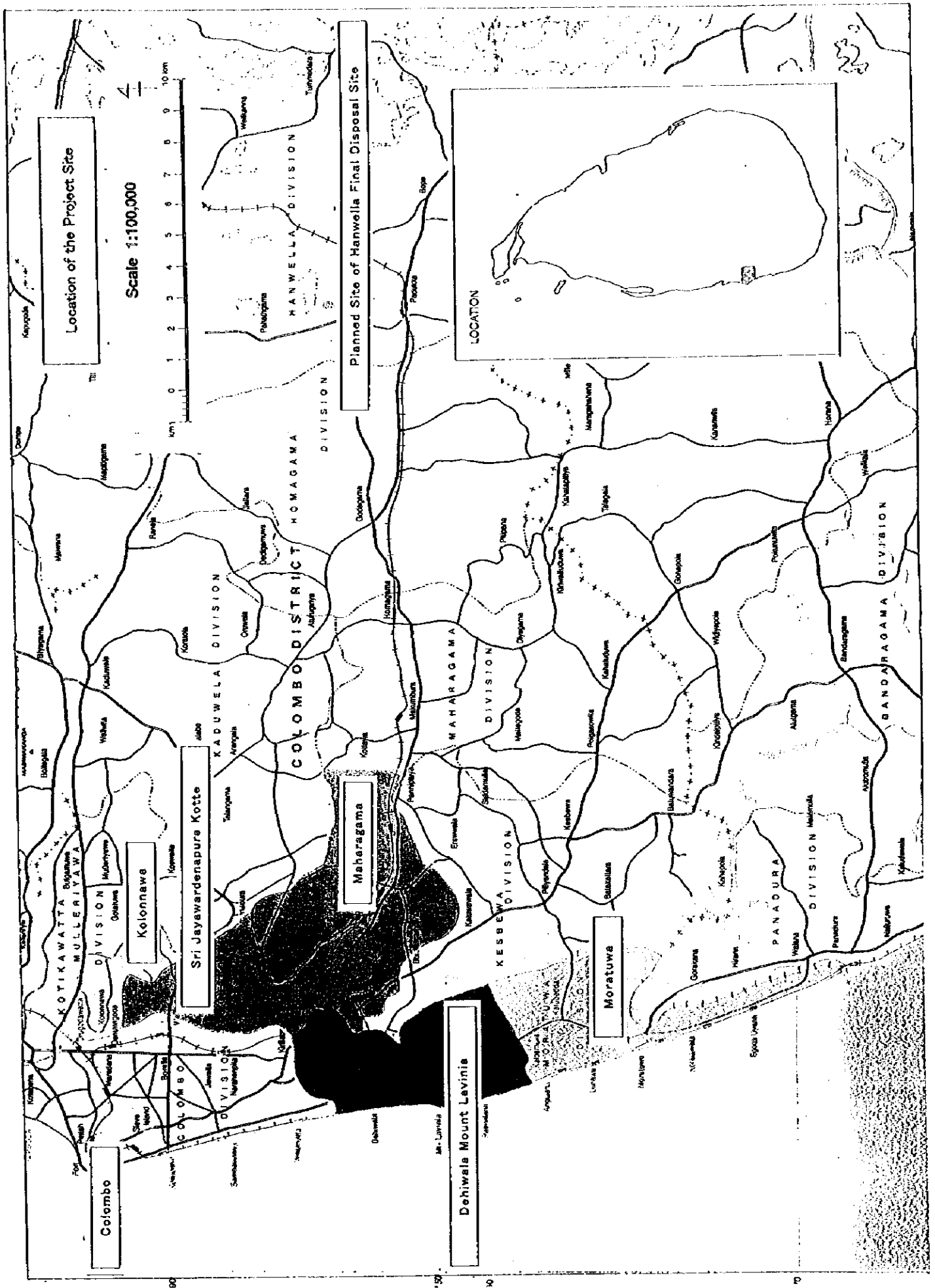
Project Manager,

Basic design study team

on the Solid Waste Management Project  
for Colombo Metropolitan Area

Yachiyo Engineering Co., Ltd.





## **Abbreviations**

<b>Sri Lanka</b>	<b>The Democratic Socialist Republic of Sri Lanka</b>
<b>JICA</b>	<b>Japan International Cooperation Agency</b>
<b>WPC</b>	<b>West Provincial Council</b>
<b>CMA</b>	<b>Colombo Metropolitan Area</b>
<b>CEIP</b>	<b>Colombo Environment Improvement Project</b>
<b>NEAP</b>	<b>National Environmental Action Plan</b>
<b>MEIP</b>	<b>Metropolitan Area Environmental Improvement Plan</b>
<b>The Project</b>	<b>The Solid Waste Management Project of Colombo Metropolitan Area</b>
<b>The Project Area</b>	<b>Dehiwala MC, Moratuwa MC, Kotte MC, Kolonnawa UC and Maharagama PS</b>
<b>The Team</b>	<b>JICA Basic Design Study Team for the Project</b>
<b>The Study</b>	<b>The Basic Design Study of the Project</b>
<b>E/N</b>	<b>Exchange of Notes</b>
<b>GDP</b>	<b>Gross Domestic Product</b>
<b>IBRD</b>	<b>International Bank for Reconstruction and Development</b>
<b>UNDP</b>	<b>United Nations Development Plan</b>
<b>UDA</b>	<b>Urban Development Authority, Ministry of Housing and Urban Development</b>
<b>CEA</b>	<b>Central Environmental Authority</b>
<b>IEE</b>	<b>Initial Environment Examination</b>
<b>EIA</b>	<b>Environment Impact Assessment</b>
<b>PAA</b>	<b>Project Approving Agencies</b>
<b>NEA</b>	<b>National Environmental Act No.47 of 1980</b>
<b>MC</b>	<b>Municipal Council</b>
<b>UC</b>	<b>Urban Council</b>
<b>PS</b>	<b>Pradeshiya Sabha (Suburban Council)</b>
<b>Dehiwala MC</b>	<b>Dehiwala Mount. Lavinia Municipal Council</b>
<b>Kotte MC</b>	<b>Sri Jayawardenapura Kotte Municipal Council</b>
<b>PHI</b>	<b>Public Health Inspector</b>

## **Contents**

Preface	
Letter of Transmittal	
Location Map /Perspective	
Abbreviations	
Chapter 1	Background of the Project
Chapter 2	Contents of the Project
2.1	Objectives of the Project
2.2	Basic Concept of the Project
2.3	Basic Design
2.3-1	Design Concept
2.3-2	Basic Design
Chapter 3	Implementation Plan
3.1	Implementation Plan
3.1-1	Implementation Concept
3.1-2	Implementation Conditions
3.1-3	Scope of Works
3.1-4	Consultant Supervision
3.1-5	Procurement Plan
3.1-6	Implementation Schedule
3.1-7	Obligation of Recipient Country
3.2	Operation and Maintenance Plan
Chapter 4	Project Evaluation and Recommendation
4.1	Project effect
4.2	Recommendation
Appendices	
1.	Member list of the Survey Team
2.	Survey Schedule
3.	List of Party Concerned in the Recipient Country
4.	Minutes of Discussion
5.	Cost estimation Borne by the Recipient Country

## Contents of Tables and Figures

### Chapter 1

### Chapter 2

Table 2.1-1	Required Activity and Input of the Project	4
Table 2.2-1	Problems and Present Situation of Solid Waste Management	5
Table 2.3-1	Project Phases	11
Table 2.3-2	Target Collection Rate	11
Table 2.3-3	Background to Phasing and Relation with the Project	15
Table 2.3-4	Estimated Population of Each Local Authority in 2002	18
Table 2.3-5	Unit Generation Rate and Solid Waste Amount in 2002	18
Table 2.3-6	Quantity of Existing Equipment used in 2002 and its Operation Rate	19
Table 2.3-7	Amount of Solid Waste to be collected in 2002 using Existing Equipment	19
Table 2.3-8	Calculation of Collectable Amount of Solid Waste in 2002	20
Table 2.3-9	Solid Waste Amount to be collected in Phase I	21
Table 2.3-10	Soldi Waste Amount to be collected in Phase II	22
Table 2.3-11	Average Transportation Distance of Collection Vehicles in Phase I	22
Table 2.3-12	Average Transportation Distance of Collection Vehicles in Phase II	22
Table 2.3-13	Daily Collection Capacity of New Equipment	24
Table 2.3-14	Work share of Each Type of Equipment in Phase I	24
Table 2.3-15	Amount to be collected by Each Type of Equipment in Phase I	25
Table 2.3-16	Quantity of Collection Equipment in Phase I	25
Table 2.3-17	Work Share of Each Type of Equipment in Phase II	26
Table 2.3-18	Amount to be collected by Each Type of Equipment in Phase II	26
Table 2.3-19	Quantity of Collection Equipment in Phase II	26
Table 2.3-20	Uncollected Solid Waste in 1997	27
Table 2.3-21	Quantity of Accumulated Waste Collection Equipment	27
Table 2.3-22	Work Load at Existing Final Disposal Site in 2002	29
Table 2.3-23	Capacity of Final Disposal Site Equipment	30
Table 2.3-24	Type and Quantity of New Equipment	31
Table 2.3-25	Transfer Wheel Loaders and Peak Time Work Load	35

Table 2.3-26 Transportation Capacity of a 20 m <sup>3</sup> Container Truck	36
Table 2.3-27 Workshop Equipment for Each Local Authority	37
Table 2.3-28 Equipment to be Purchased by the Project	39
Table 2.3-29 Specification of the Equipment	40-46
Figure 2.3-1 Cleansing Works Flow in Phase I	16
Figure 2.3-2 Cleansing Works Flow in Phase II	17
Figure 2.3-3 Conceptual Layout of Ratmalana Transfer Station	33
Drawing of Main Equipment	48-62
 Chapter 3	
Table 3.1-1 Contents of Consultant Work in the Project	66
Table 3.1-2 Project Implementation Schedule	69
Table 3.2-1 Contents of Vehicle Maintenance Work	72
Table 3.2-2 Useful Lives of Construction Machinery	72
Table 3.2-3 Existing staff of solid waste management	73
Table 3.2-4 Required personnel for Phase I	75
Table 3.2-5 Condition for estimation of required personnel	76
Table 3.2-6 Breakdown of Required Personnel for Final Disposal and etc.	77
Table 3.2-7 Changes in Personnel Expenses in Each city at time of Project Implementation	79
Table 3.2-8 Annual Average Personnel Expenses	79
Table 3.2-9 Running Expenses and Maintenance Expenses of Each Local Authority	80
Table 3.2-10 Running and Maintenance Cost for one unit of Equipment	81
Table 3.2-11 Increase of Cover Soil Cost (1997 price)	83
Table 3.2-12 Transportation Cost and Final Disposal Cost	84
Table 3.2-13 Estimated Cleansing Work Cost	85
Table 3.2-14 Share of Cleansing Works Cost in Overall Expenditure	87
Table 3.2-15 Share of Cleansing Works Cost in Estimated Budget in 2002	87
Table 3.2-16 Unit Cost of Cleansing Work	88
Table 3.2-17 Estimated Increase of Recurrent Grants	89
Table 3.2-18 Phase I, Budget Securing (Considering Recurrent Grant)	90
Table 3.2-19 Phase II, Budget Securing (Considering Recurrent Grant and New Financial Source)	90
Table 3.2-20 Amount to be Collected from Residence: Case A	91

Table 3.2-21 Amount to be Collected form Residence: Case B	92
Figure 3.1-1 Project Implementation Relation Ship Chart	67
Figure 3.2-1 Organization Chart of Ratmalana Transfer Station	78
Chapter 4	
Table 4.1-1 Effect of Project Implementation	95
Table 4.1-2 Main Indicators of the Solid Waste Management Utility in The Target Local Authority	96

## **Chapter 1      Background of the Project**

## Chapter 1 Background of the project

From 1970, environmental problems in the Democratic Socialist Republic of Sri Lanka (hereinafter referred to as Sri Lanka) became an issue to be solved. In 1980, the National Environmental Act (NEA) was enacted and the Central Environmental Authority (CEA) was established. Following that, in 1991, the National Environmental Action Plan (1992-1996, NEAP) was compiled under the cooperation of the World Bank, and in 1994, specific projects were brought together and compiled into the latest National Environmental Action Plan (1995-1998) that is currently being implemented. Within this plan, the urban and industrial pollution has been ranked as one of the most important issues to be tackled. The urban and industrial pollution includes a number of problems, for example, the improper treatment of solid waste, improper land use, air pollution caused by automobiles, and contamination of air, water and soil, etc. arising from industry. To deal with these problems, the Metropolitan Environmental Improvement Project (MEIP) and the Colombo Environmental Improvement Project (CEIP) are being implemented as major ongoing projects.

Under the Colombo Environmental Improvement Project (CEIP), a large-scale sanitary landfill final disposal site at Hanwella, aiming to improve final disposal of solid waste in Colombo Metropolitan Area (CMA) is scheduled to be constructed, and two transfer stations are planned to be constructed to establish efficient transportation system to cope with distant transportation of solid waste. However, CEIP does not include measures to improve solid waste collection in each local authority. As a result, each local authority is obliged to improve solid waste collection by themselves. It is noted that each local authority shall dispose of their solid waste at their final disposal site until Hanwella final disposal site commence the service. Also, in order to deal with the long-distance transportation of solid waste that will be required following the commencement of operations at Hanwella final disposal site, transfer stations shall be constructed for efficient transportation of solid waste.

In spite of the implementation of the aforementioned environmental projects, facilities and equipment for solid waste management, such as collection and haulage vehicles in Colombo Metropolitan Area, local authorities are insufficient to clean up their area due to rapid urbanization, and the solid waste collection rate in each local authority is extremely low. As a result, uncollected solid waste are accumulating in the area. Also, the solid waste that is collected is open dumped in marshy, low-lying areas and contaminating the surrounding environment. For these reasons, the expansion of solid waste collection services and improvement of existing final disposal sites in Colombo Metropolitan Area have become issues that require immediate



countermeasures to improve the public sanitation and urban environment in the area.

The Government of Japan implemented the Solid Waste Management Project for Colombo MC in 1995 under the grant aid scheme in response to the request of the Government of Sri Lanka to provide assistance for the supply of solid waste collection vehicles in Colombo MC. As a result, the collection rate of solid waste, which previously stood at around 66% on average, was improved to almost 100% in Colombo MC and the urban sanitation was greatly improved. However, the solid waste collection rate in neighboring local authorities has remained low and the disparity between Colombo MC and neighboring local authorities has become widened because this project did not include these neighboring local authorities.

Therefore, the 19 local authorities in Colombo Metropolitan Area made a request, via West Provincial Council, to the Government of Japan to provide grant aid for the supply of solid waste collection vehicles and etc., aiming to improve solid waste management in their area. The contents of the request are as follows:

- (1) provision of equipment to improve solid waste collection in the 19 local authority;
- (2) provision of equipment to improve the existing final disposal sites, and equipment to remove accumulated solid waste (some of the 19 local authority);
- (3) provision of equipment for the transfer station to be constructed by West Provincial Council (this is out of the World Bank funding scheme of CEIP)
- (4) supply of maintenance equipment and spare parts for the above-mentioned equipment

Based on this request, the Sri Lanka side and the project formation study team (environmental field) dispatched by the Government of Japan in March 1997 have discussed and agreed to set an order of priority to the 19 cities and narrowed down the project area to the targeted five local authorities including Sri Jayawardenapura Kotte MC. Also, the project formation study team reported the necessity to improve solid waste collection in the five selected local authorities and to procure equipment for one transfer station that is scheduled to be constructed by WPC.

## **Chapter 2    Contents of the Project**

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## **Chapter 2    Contents of the Project**



## **Chapter 2 Contents of the Project**

### **2.1 Objectives of the Project**

- (1) Objectives: To improve the living environment and sanitation in Colombo Metropolitan Area (CMA).

The Project area: Dehiwala MC, Moratuwa MC, Kolonnawa UC, Sri Jayawardenapura Kotte MC and Maharagama PS

#### **(2) Target of the Project**

The Project aims to improve the service of solid waste collection in CMA. The Project include:

- a. Improving the collection service ratio (approximately 39% at present) to 80%. If no countermeasure will be taken, the collection service ratio will fall to around 13% after five years through the deterioration of equipment.
- b. Replacing tractors with proper collection vehicles to improve the efficiency of work and working conditions.
- c. Mitigating the environmental impact on surrounding areas of existing disposal sites by improving existing disposal sites from uncontrolled open dumping to controlled landfill with proper soil covering.
- d. Establishing an efficient transportation system in line with Colombo Environmental Improvement Project (CEIP) which is constructing a large-scale sanitary landfill site at Hanwella to serve the CMA.
- e. Establishing a new financial source for sustainable solid waste management through taking appropriate budgetary measures.
- f. The target year of the Project will be 2002 (after five years from now).

#### **(3) Project Effect**

After successful execution of the Project, the below effects are expected

- a. The solid waste collection and transportation capacity in CMA will be improved.
- b. The environmental impact caused by the existing final disposal sites will be mitigated.

#### **(4) Activity and Input of the Project**

In order to successfully execute the Project, the below activities and inputs are required.

**Table 2.1-1 Required Activity and Input of the Project**

<b>Japan Side</b>	<ul style="list-style-type: none"> <li>a. Supply of solid waste collection and transportation equipment to the five local authorities</li> <li>b. Supply of transfer station equipment</li> </ul>
<b>Sri Lanka Side</b>	<ul style="list-style-type: none"> <li>a. Sustainable operation and maintenance of equipment supplied under the Project.</li> <li>b. Construction of workshop building and garage</li> <li>c. Improvement of existing final disposal sites</li> <li>d. Construction of the Ratmalana transfer station</li> </ul>

## **2.2 Basic Concept of the Project**

### **2.2-1 Current Problems**

The five local authorities in the Project area are major local authorities of CMA. The solid waste management in each of these local authorities is facing the following problems:

- a. Solid waste collection is mainly carried out using tractors at present, but there are only 50 tractors and 2 compactor vehicles in total. Solid waste amount generated in the project area is estimated to be 574 ton/day while only 226 ton/day is collected. As a result, the solid waste collection service ratio in the area is extremely low at around 39%. Uncollected solid waste is accumulated and scattered in uncollected areas, therefore creating an unsanitary situation. As capacity of solid waste collection will fall to 87 ton/day in year 2002 due to deterioration of equipment, procurement of collection equipment is urgently required.
- b. Solid waste collected by the tractors is transported to existing disposal sites and open-dumped on swampy land. Open dumping of solid waste at existing disposal sites pollutes the surrounding environment. Therefore, it is necessary to improve existing disposal sites.
- c. Solid waste is not discharged properly, i.e. discharged without any container or pack. This brings unsanitary conditions in the area, and inefficient and poor working conditions.
- d. As a result of the improvement to solid waste collection in Colombo MC brought by the Solid Waste Management Project in Colombo MC carried out under the grant aid scheme in fiscal year 1995, the disparity between Colombo MC and its five adjoining local authorities has become wide and has generated dissatisfaction of citizens in the Project area..
- e. To improve final disposal in the CMA, CEIP is constructing a large-scale sanitary landfill site in Hanwellla. However, there are several months delay of the schedule at present.

Therefore, each local authorities shall dispose of solid waste at existing disposal site until the start of operation of Hanwella final disposal site. Also they shall carry out proper soil covering to mitigate environmental pollution in order to use existing disposal sites.

- f. Efforts to improve solid waste collection are being made, for example, Moratuwa MC has purchased a compactor and a back hoe loader, and Dehiwala MC has purchased tractors, however, due to budget limitations, the local authorities are unable to procure sufficient number of equipment, particularly, equipment for final disposal sites.
- g. Each local authorities is maintaining their existing equipment at own workshop but they have insufficient tools and their staff have little experience for maintenance of collection vehicles.

**Table 2.2-1 Problems and Present Situation of Solid Waste Management in the Project Area**

	<b>Problems</b>	<b>Present situation</b>
Collection and Transportation	<ul style="list-style-type: none"> <li>. Low collection service ratio resulting from insufficient equipment</li> <li>. Improper discharge of solid waste</li> </ul>	<ul style="list-style-type: none"> <li>a. The current collection rate is 39% and will fall to 13% in 2002 due to equipment deterioration.</li> <li>b. Accumulation of uncollected solid waste</li> <li>c. Not only unsanitary but also inefficient</li> <li>d. Poor working conditions for collection personnel</li> </ul>
Final Disposal	<ul style="list-style-type: none"> <li>. Open dumping</li> <li>. Insufficient equipment</li> <li>. Deficient facilities</li> </ul>	<ul style="list-style-type: none"> <li>a. Environmental pollution of surrounding areas and existence of many illegal dumping sites</li> <li>b. Insufficient soil covering</li> <li>c. No fences and inadequate control of solid waste entry into disposal sites</li> </ul>
Maintenance of Equipment	<ul style="list-style-type: none"> <li>. Insufficient facilities and equipment</li> <li>. Insufficient technology</li> </ul>	<ul style="list-style-type: none"> <li>a. Maintenance of tractors is insufficient.</li> <li>b. There is no experience regarding maintenance of collection vehicles.</li> </ul>

## **2-2-2 Methods and Means to Solve Problems**

The solid waste management in the Project area is carried out by the Health department in each local authority. Although construction of Hanwella final disposal site is being processed in order to introduce sanitary landfill disposal in CMA, each local authority is oblige to improve their collection service urgently. Also, they shall improve existing disposal site because they will use its own disposal site until the start of operation of Hanwella disposal site. Also it is required to establish efficient transportation system in near future to cope with long distant transportation of solid waste to Hanwella disposal site.

Following measures shall be taken urgently to improve solid waste collection and existing disposal sites.

- a. Improvement of the solid waste collection ratio and preparation of collection equipment
- b. Removal of accumulated solid waste



- c. Improvement of existing disposal sites, especially, implementation of earth covering, and preparation of equipment for final disposal
- d. Establishment of workshop for maintenance of collection vehicle.

Also, following measures shall be taken to establish efficient transportation system in line with the construction schedule of Hanwella disposal site.

- a. Construction of Ratmalana transfer station
- b. Preparation of a new budget system to cover transportation and final disposal cost
- c. Further expansion of solid waste collection service in Moratuwa and Maharagama
- d. Rearrangement of used disposal sites such as final covering soil

### **2-2-3 Cooperation Concept**

- a. Solid waste collection services shall be expanded in the five local authorities in order to remove solid waste from urban and residential areas and to improve the living environment and sanitation of the Project area. To expand solid waste collection services, collection vehicles will be introduced to improve the efficiency of services.
- b. At the same time, existing final disposal sites shall be improved to prevent environmental pollution around sites as much as possible. For this purpose, equipment for final disposal will be procured to spread solid waste and to carry out soil covering.
- c. Maintenance equipment shall be procured for each local authority to carry out periodical maintenance and minor repairs of collection vehicles and existing equipment (mainly tractors).
- d. The construction of a large-scale sanitary landfill disposal site (Hanwella final disposal site) to serve CMA is in progress under the Colombo Environmental Improvement Project (CEIP). Also, transfer stations to establish efficient transportation system of solid waste is planned to construct. Therefore, equipment for Ratmalana transfer station (to be constructed by Western Provincial Council) and transportation vehicle will be procured after careful monitoring of progress of construction of Hanwella final disposal site,.
- e. A new financial source for solid waste management shall be established through appropriate budgetary measures, for sustainable operation of solid waste management.

Opening of the Hanwella final disposal site is scheduled for October 1998 under the Colombo Environmental Improvement Project (CEIP), however, there has been several months delay of the schedule at present. And it is thought that another three years will be required to commence operations because the topographical condition of Hanwella site will require time for construction of the access road and landfill facilities.

Under above mentioned conditions, it will be necessary to implement the Project over two phases. In Phase I, the expansion of collection service and improvement of existing disposal site in the five local authorities will be carried out. In Phase II, the Ratmalana transfer station will be constructed and further expansion of collection services in Moratuwa MC and Maharagama PS will be carried out after carefully monitoring and confirmation of progress on construction of Hanwella final disposal site.

## **2.3 Basic Design for Appropriate Project**

### **2.3-1 Design Concept**

#### **(1) Natural Conditions**

The maximum and minimum average temperatures in the Project area are around 30 °C and 25 °C respectively, and the annual rainfall exceeds 2,000 mm. Humidity is around 80% throughout the year. The local climate condition is high temperatures and high humidity. As the Project area is located within approximately 5 km of the coastline, equipment shall be given rust-proof coating.

Ratmalana transfer station is located in Dehiwala and it will have heavy rainfall. Leachate shall be collected and transported to the sewerage treatment plant to be constructed in Ratmalana area using vacuum tank truck to minimize water pollution.

#### **(2) Social Conditions**

The religious composition of the Sri Lanka population breaks down as approximately 69% Buddhists, 15% Hindus (Tamil), 7% Muslims and 9% other religions.

Sunday and also Saturday are holidays for general work of government and municipal offices. However, solid waste collection is carried out every day due to the insufficient amount of equipment and complaints from citizens, etc.

Concerning language, Tamil and Sinhala are the official languages, but English is also widely used in the Project area.

Operation ratio of equipment will be set considering number of holidays and maintenance requirement. In this Project, working days is set 365 days in a year without holidays because collection work is carried out every day at present. But operation ratio of equipment is set to

85% considering 24 days for maintenance (2 days per month) and around 30 days of holiday for each equipment.

With regard to language, English can be used for operation manuals and others because it is widely used in the Project area.

### **(3) Utilization of Local Contractors and Equipment**

The equipment to be procured in the Project consists of collection vehicles and heavy equipment. As these equipment are not manufactured in Sri Lanka, local procurement will not be possible.

Local transportation company can be used for customs clearance work and inland transportation because there are no special conditions for transportation in terms of weight and dimensions of equipment.

Distributors of equipment have own workshop for maintenance and repair service in Sri Lanka. These workshop shall be utilized as much as possible for proper maintenance of collection vehicles and equipment to be procured.

It is recommended to Sri Lanka side to prepare 1 m<sup>3</sup> containers for efficient collection work. The 1 m<sup>3</sup> container can be manufactured in Sri Lanka.

### **(4) Maintenance Capability of the Implementing Agencies**

#### **1) Equipment Maintenance and Repair**

The five local authorities except Maharagama PS have small work shop and carry out maintenance and repair work of tractors at present. But maintenance equipment is insufficient and they have little experience on the maintenance and repair of collection vehicles. But the five local authorities have the basic capacity for carrying out the maintenance and repair of collection vehicles because tractors are currently being repaired. Therefore periodical maintenance and minor repair shall be carried out by each local authority because it is more desirable to maintain collection vehicle by the owner themselves. Also, Ratmalana transfer station will have workshop to maintain transportation vehicles and Western Provincial Council (WPC) will have responsibility for this.

It is necessary to get training of staff required for maintenance in each local authority by the workshop of Colombo MC which is maintaining many collection vehicles and have many staffs at present.

Major repair and overhaul of engine is planned to be contracted out to the distributor's workshop. Therefore, each local authority shall prepare facilities and staffs for periodical maintenance and minor repair as follows.

- a. Sri Lanka Side: Construction of new workshop buildings, preparation of staff and implementation of staff training
- b. Japan Side: Procurement of tools required for periodical maintenance and minor repairs

## 2) Solid Waste Collection and Disposal Work

The current solid waste collection rate in the five target local authorities is extremely low: approximately 57% in Dehiwala MC, 39% in Moratuwa MC, 11% in Kolonnawa UC, 34% in Kotte MC and 19% in Maharagama PS. This is caused by the insufficiency of equipment and personnel, and the low efficiency of collection work. To increase efficiency, large containers (6 m<sup>3</sup>) will be placed in areas which generate large quantity of solid waste, such as markets. Also it is recommended to put small containers (1 m<sup>3</sup>) in areas with wide roads (small containers will be prepared by the Sri Lanka side).

## (5) Type and Specification of Equipment

### 1) Type of Equipment

The Project will supply equipment for collection of solid waste and for removal of accumulated waste in the Project area, and for disposal of solid waste at existing disposal sites in the five local authorities. Appropriate types and quantities of equipment will be procured with consideration of existing collection system, collection service ratio and existing staffs of each local authority.

Equipment for Ratmalana transfer station which will serve to Dehiwala MC and Moratuwa MC and transportation vehicles will also be supplied after careful monitoring of the progress of construction in Hanwella disposal site, being planned under the CEIP. The types and quantities of equipment will be set according to the solid waste amount to be collected in Dehiwala MC and Moratuwa MC.

## **2) Technical Levels and Specification of equipment**

Technical level and specification of the equipment to be procured will be set to meet the technical level in Sri Lanka considering maintenance and repair capability of distributor's workshop in Sri Lanka. Equipment with easy maintenance will be selected in principal. Same type and/or similar specification of equipment owned by Colombo MC will be selected in the Project considering standardization of collection vehicle in CMA since Colombo MC is expected to conduct training of staffs in 5 local authorities for maintenance and repair.

## **(6) Implementation schedule**

It is recommended to implement the Project in two phases. In Phase I, equipment for solid waste collection and final disposal at existing sites will be procured including maintenance equipment and spare parts because of urgency.

It is noted that Phase II can only be implemented after careful evaluation and monitoring on the progress of construction work of the Hanwella final disposal site and on the progress of the environmental impact assessment (EIA) procedure and construction of Ratmalana transfer station. Also, progress of institutional setup for new financial source for solid waste management to cover transportation charge and disposal charge will be evaluated. In Phase II, equipment for Ratmalana transfer station and transportation vehicles, and collection vehicles for further expansion of collection service in Moratuwa MC and Maharagama PS will be procured.

Table 2-3-1 Project Phases

	Phase I	Phase II
Work contents	① Supply of collection equipment to the five local authorities ② Supply of equipment to remove accumulated solid waste to the five local authorities ③ Supply of equipment for existing final disposal sites in the five local authorities ④ Supply of maintenance tools for the above equipment	① Supply of equipment for the transfer station to be constructed in Dehiwala and transportation equipment ② Supply of collection equipment to further expansion of collection capacity in Moratuwa and Maharagama ③ Supply of maintenance tools for the above equipment
Implementation period		
Consultant contract and detailed design	2.5 months	1.5 months
Tender	1 month	1 month
Factory manufacture	6 months	4 months
Transportation and inspection, etc.	2.5 months	2.5 months
Total	12 months	9 months

## (7) Target of Solid Waste Collection Service Ratio

Target of solid waste collection service ratio in year 2002, after five years, is set as shown in Table 2.3-2 considering importance of each local authority, present collection ratio and number of staffs in each local authority. Necessary equipment to achieve this target will be procured in the Project.

Table 2.3-2 Target Collection Rate

Target Local authority	Current Solid Waste Collection Rate	First Stage Target Collection Rate in 2002 (Phase II)	Second Stage Target Collection Rate in 2002 (Phase I)
Dehiwala MC	57%	90%	90%
Moratuwa MC	39%	80%	70%
Kolonnawa UC	25%	80%	80%
Kotte MC	31%	90%	90%
Maharagama PS	21%	60%	50%
Total	39%	81%	77%

#### **(8) Existing Equipment**

The existing equipment owned by five local authorities consists of 50 tractors and two compactors in total. In the long term target, it is planned to replace tractors with collection vehicles. But equipment that can be used until 2002 will be utilized as much as possible in this Project. Existing equipment purchased within the last five years shall be used until 2002. Equipment purchased more than five years ago cannot be used in year 2002 because it will be more than 10 year and operating rate will become too low to maintain adequate collection service.

#### **(9) Equipment Procured in Phase I**

The following equipment will be procured in order to achieve the aforementioned target.

##### **1) Solid waste collection vehicle**

In consideration of vehicle standardization and road conditions in each local authority, the following equipment will be procured:

- a. Standard compactor trucks : for use in ordinary area, partially it is used together with small containers
- b. Small compactor trucks : for use in narrow road districts
- c. Garbage dump trucks : for use in ordinary area, it will be used also for removal of accumulated solid waste
- d. Detachable container trucks :for use in markets and other places discharging large amount of waste

##### **2) Removal of accumulated solid waste**

Accumulated solid waste shall be removed using wheel loaders and dump trucks and/or the above-mentioned garbage dump trucks.

##### **3) Improvement of final disposal site with soil covering**

Bulldozers and/or wheel loaders shall be used to spread solid waste and carry out soil covering. The wheel loaders will also be used for the above-mentioned removal of accumulated solid waste.

##### **4) Maintenance equipment**

Maintenance equipment to conduct periodical maintenance and minor repairs will be procured to maintain collection vehicles. However, major repairs shall be carried out through contract out to distributor's workshop.

### 5) Spare parts

Spare parts required periodically will be distributed to each local authority, while spare parts required in special cases will be stored in the workshop of Western Provincial Council(WPC). It will be supplied to each local authorities according to its necessity under the control of WPC.

### (10) Equipment procured in Phase II

In Phase II, equipment for Ratmalana transfer station and transportation vehicles will be procured together with collection vehicles required for further expansion of the solid waste collection service ratio in Moratuwa MC and Maharagama PS.

#### 1) Transfer station equipment

Ratmalana transfer station is planned to be a flat type transfer station. In order to mitigate the impact on the surrounding environment, the storage of solid waste at the transfer station will be done in containers and leachate will be collected into a pond and carried away by vacuum tank truck to the Ratmalana sewage treatment plant planned to be constructed. A workshop will be constructed in the transfer station to carry out the periodical maintenance and minor repair of transportation vehicles, and necessary equipment for maintenance will be procured.

#### 2) transportation equipment

Large detachable container trucks will be procured for transportation between Ratmalana transfer station and Hanwella disposal site.

#### 3) Collection vehicles

In the same way as in Phase I, standard compactor trucks and garbage dump trucks will be procured to expand collection service in Moratuwa MC and Maharagama PS.



### **2-3-2 Basic Design**

#### **(1) Phasing Plan**

The Project will be implemented over two phases considering progress of the CEIP. The conditions, background of each phase and contents of the Project are indicated in Table 2.3-3. The flows of the solid waste management in Phase I and Phase II are shown in Figure 2.3-1 and Figure 2.3-2 respectively.

As is shown in Table 2.3-3, the solid waste flow in each local authority will have major change in Phase II. The major component of equipment supply in Phase II is the supply of equipment for Ratmalana transfer station and transportation equipment for transportation of solid waste to Hanwella final disposal site. For this reason, the supply of equipment in Phase II of the Project will be implemented to meet the time of completion or near-completion of Hanwella final disposal site, Colombo north transfer station and Colombo south transfer station to be constructed under the CEIP, and Ratmalana transfer station to be constructed by Western Provincial Council (WPC).

Table 2.3-3 Background of Phasing and Relation with the Project

Item		Phase I	Phase II
Back-ground and Conditions	Period and phases	Period until completion of Hanwella final disposal site, Colombo north transfer station and Colombo south transfer station to be constructed under the CEIP, and Ratmalana transfer station to be constructed by Western Provincial Council	After completion of the facilities indicated on the left
	Solid waste collection method	Same as at present, i.e. collection from each household and collection points (containers) by tractor and collection vehicle	Same as on the left
	Haulage destinations of collected solid waste	Existing final disposal sites in each local authority	Solid waste from Dehiwala MC and Moratuwa MC will go to Ratmalana transfer station; that from Kolonnawa UC will go to Colombo north transfer station; and that from Kotte MC and Maharagama PS will go to Colombo south transfer station.
	Operation of transfer stations	None (no need for transfer work)	WPC will operate Ratmalana transfer station. The CEIP will operate Colombo north and Colombo south transfer stations.
	Relay transportation	Same as above	WPC will manage transportation from Ratmalana transfer station; the CEIP will manage transportation from Colombo north and Colombo south transfer stations. All solid waste from these transfer stations will be transported to Hanwella final disposal site.
	Final disposal	Existing disposal sites in each local authority	Hanwella final disposal site
	Existing final disposal sites	Used for final disposal of solid waste.	Final disposal will be stopped and the site will be rearranged.
	Hanwella final disposal site	Under construction	Complete. Start of solid waste final disposal.
Project Contents	Collection equipment	Supply of collection equipment in accordance with the target collection rate in 2002 (Phase I)	Supply of collection equipment in accordance with the target collection rate in 2002 (Phase II)
	Accumulated waste removal & patrol equipment	Supply of equipment to remove accumulated solid waste and for patrol	No additional supply. Continuation work using equipment indicated on the left.
	Transfer station and relay transportation equipment	None	Supply of equipment for Ratmalana transfer station and transportation equipment from Ratmalana transfer station to Hanwella final disposal site.
	Final disposal site equipment	Supply of equipment to carry out spreading of waste and earth covering. Part of the equipment will be used for removal of accumulated solid waste.	The Equipment indicated on the left will be used to rearrange used disposal sites and for removal of accumulated solid waste.

Fig. 2.3-1 Cleansing Works Flow in Phase I

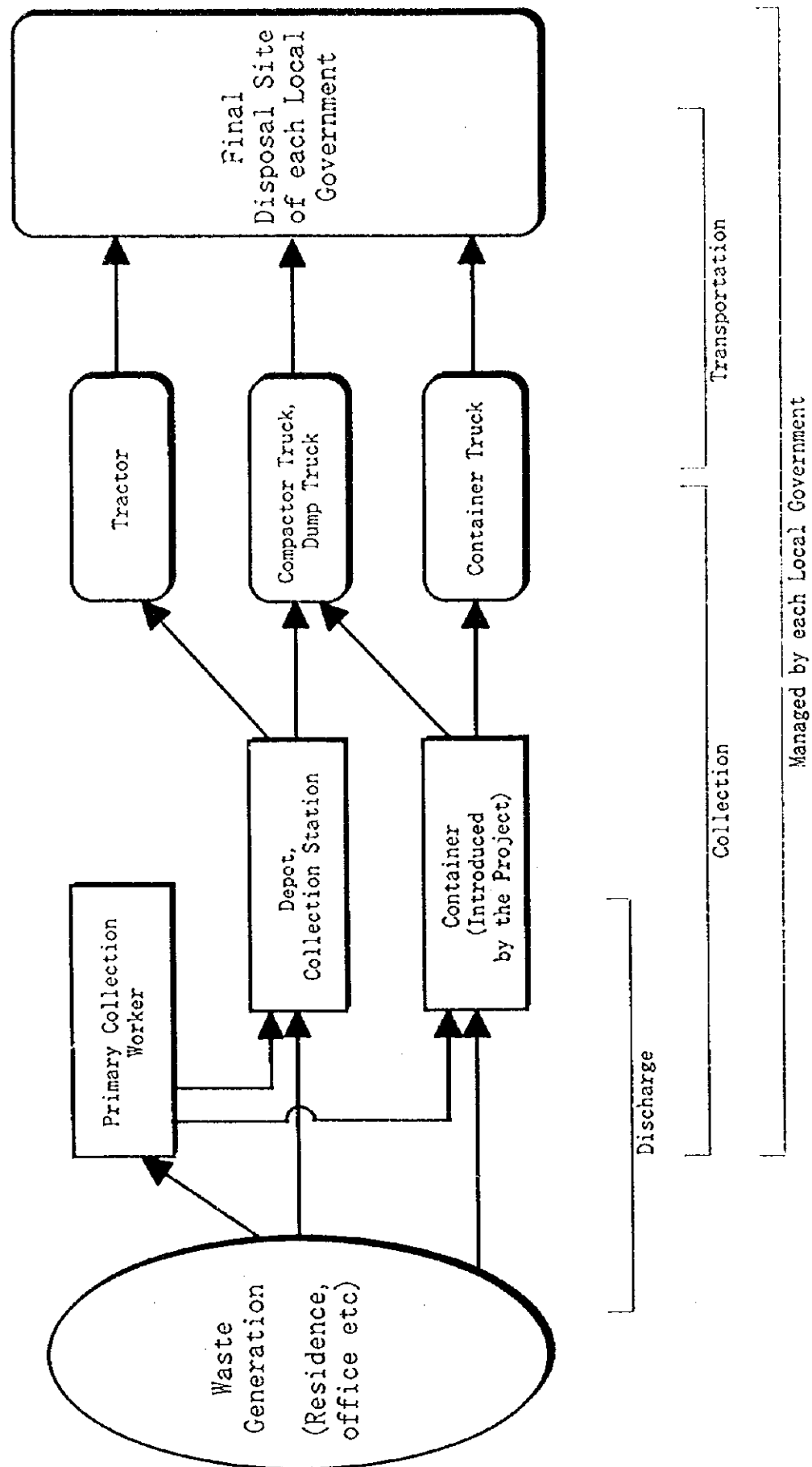
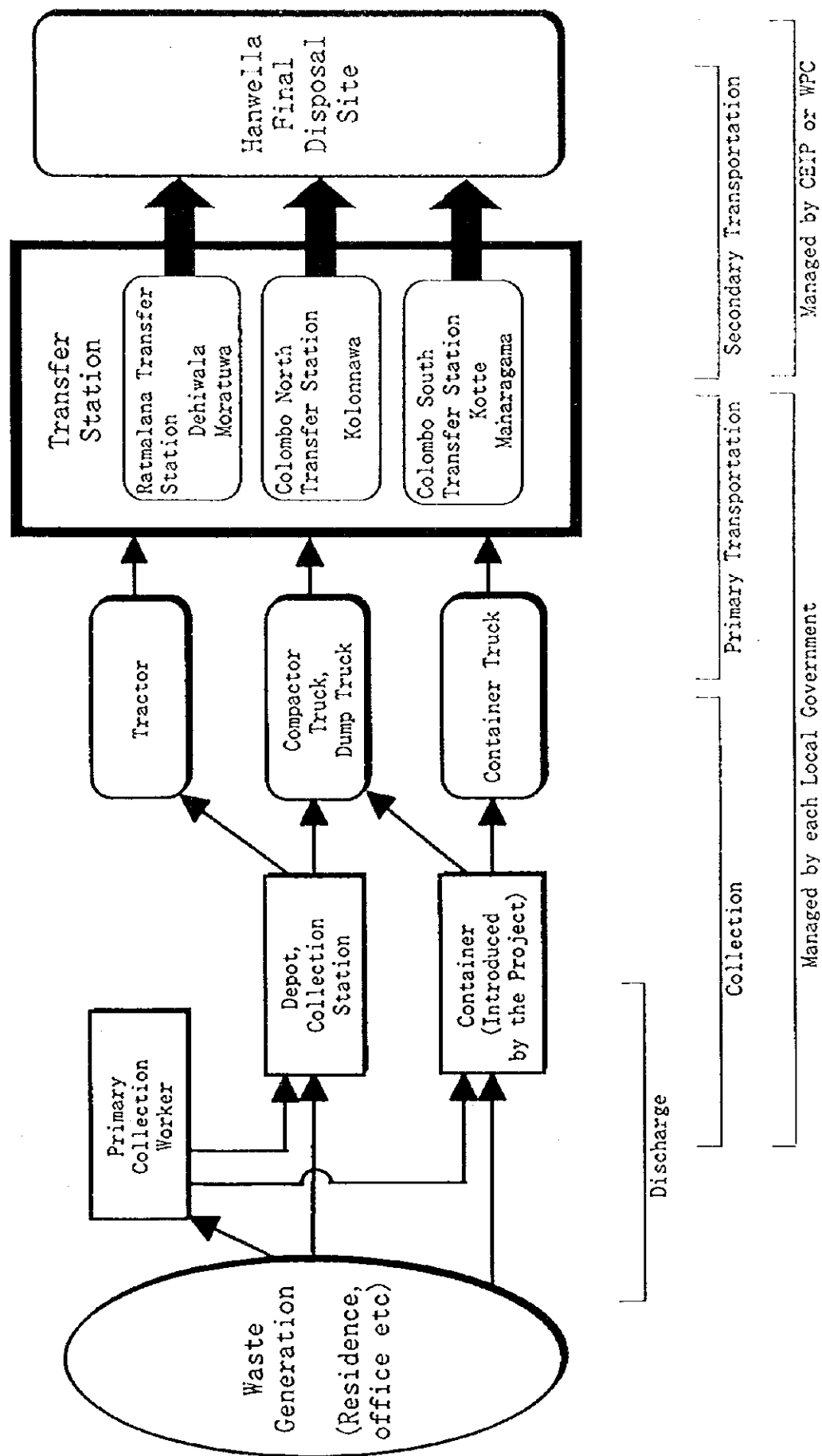


Fig. 2.3-2 Cleansing Works Flow in Phase II



## (2) Design Criteria

### 1) Target Year

The Project target year will be 2002.

### 2) Project Area and Population

The Project area will be all the area of Dehiwala MC, Moratuwa MC, Kolonnawa UC, Kotte MC and Maharagama PS in Colombo Metropolitan Area (CMA). The estimated population of each local authority in 2002 is shown in Table 2.3-4

Table 2.3-4 Estimated Population of Each Local authority in 2002

Local authority	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama PS	Total
Forecast population in 2002	262,349	244,240	74,391	159,618	150,309	890,907

### 3) Unit generation rate of solid waste

The Table 2.3-5 shows the unit generation rate of solid waste in 2002.

Table 2.3-5 Unit Generation Rate and Solid Waste Amount in Each Local Authority

Local authority	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama PS	Total
Generation base unit (kg/person/day)	0.76	0.71	0.69	0.76	0.69	-
Generated amount in 2002 (t/day)	199.4	173.4	51.3	121.3	103.7	649.1

### 4) Capacity of Solid Waste Collection in 2002 Using Existing Equipment

#### (a) Numbers and Operating Rate of Existing Equipment in 2002

Equipment that has been purchased within the past five years (counting from 1997) can be used for solid waste collection work in 2002. Equipment that has been used more than five years at present will not be suitable for sustainable solid waste collection since it will be more than 10 years and too old in 2002 to keep the appropriate collection service. Therefore the equipment that has been used more than five years will not be used in 2002.

The Table 2.3-6 shows the quantity of existing equipment to be used and its operating rate in 2002. The operating rate in 2002 of equipment purchased in the past three years has

been set at 85%, and that of equipment purchased within the past three to five years has been set at 60%. Regarding the 6 m<sup>3</sup> compactor trucks used by Kotte MC, its operating rate in 2002 has been set at 60%.

The daily number of trips made by each type of vehicle has been set as shown in Table 2.3-6. Tractors and the 6 m<sup>3</sup> compactor trucks will make three trips per day and 12 m<sup>3</sup> compactor trucks will make two trips per day.

Table 2.3-6 Quantity of Existing Equipment used in 2002 and its Operating Rate

Equipment	Operating Rate	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama PS
Tractors: 6 years or more since purchase	Do not use	—	8	5	11	1
Tractors: 3-5 years since purchase	60%	—	3	—	1	—
Tractors: 3 years or less since purchase	85%	15	—	—	2	4
6 m <sup>3</sup> compactor trucks	60%	—	—	—	1	—
12 m <sup>3</sup> compactor trucks	85%	—	1	—	—	—

(b) Amount of Solid Waste to be Collected Using Existing Equipment

The amount of solid waste that can be collected in 2002 using the above-mentioned existing equipment is indicated in Table 2.3-7. The calculation is shown in Table 1-3-8.

Table 2.3-7 Amount of Solid Waste to be Collected in 2002 Using Existing Equipment

Local authority	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama PS	Total
Collectable amount (t/day)	45.9	15.7	0	13.1	12.2	86.9

**Table 2.3-8 Calculation of the Collectable Amount of Solid Waste in 2002  
Using Existing Equipment**

	Item	Unit	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama PS	Total
(1)	<b>Tractors purchased within last three years (1994-1997)</b>							
(1)-1	Number of vehicles	(Vehicles)	15	0	0	2	4	
(1)-2	Load capacity	(m <sup>3</sup> /vehicle)	4	-	-	4	4	
(1)-3	Number of trips	(Trips/vehicle/day)	3	-	-	3	3	
(1)-4	Operating rate	(%)	85%	-	-	85%	85%	
(1)-5	Daily collection amount	(m <sup>3</sup> /day)	153.0	0.0	0.0	20.4	40.8	214.2
(1)-6	Daily collection weight (0.3 t/m <sup>3</sup> )	(t/day)	45.9	0.0	0.0	6.1	12.2	64.3
(2)	<b>Tractors purchased in last 3-5 years (1992-1993)</b>							
(2)-1	Number of vehicles	(Vehicles)	0	3	0	1	0	
(2)-2	Load capacity	(m <sup>3</sup> /vehicle)	-	4	-	4	-	
(2)-3	Number of trips	(Trips/vehicle/day)	-	3	-	3	-	
(2)-4	Operating rate	(%)	-	60%	-	60%	-	
(2)-5	Daily collection amount	(m <sup>3</sup> /day)	0.0	21.6	0.0	7.2	0.0	28.8
(2)-6	Daily collection weight (0.3 t/m <sup>3</sup> )	(t/day)	0.0	6.5	0.0	2.2	0.0	8.6
(3)	<b>12 m<sup>3</sup> compactor trucks</b>							
(3)-1	Number of vehicles	(Vehicles)	0	1	0	0	0	
(3)-2	Load capacity	(m <sup>3</sup> /vehicle)	-	12	-	-	-	
(3)-3	Number of trips	(Trips/vehicle/day)	-	2	-	-	-	
(3)-4	Operating rate	(%)	-	85%	-	-	-	
(3)-5	Daily collection amount	(m <sup>3</sup> /day)	0.0	20.4	0.0	0.0	0.0	20.4
(3)-6	Daily collection weight (0.3 t/m <sup>3</sup> )	(t/day)	0.0	9.2	0.0	0.0	0.0	9.2
(4)	<b>6 m<sup>3</sup> compactor trucks</b>							
(4)-1	Number of vehicles	(Vehicles)	0	0	0	1	0	
(4)-2	Load capacity	(m <sup>3</sup> /vehicle)	-	-	-	6	-	
(4)-3	Number of trips	(Trips/vehicle/day)	-	-	-	3	-	
(4)-4	Operating rate	(%)	-	-	-	60%	-	
(4)-5	Daily collection amount	(m <sup>3</sup> /day)	0.0	0.0	0.0	10.8	0.0	10.8
(4)-6	Daily collection weight (0.3 t/m <sup>3</sup> )	(t/day)	0.0	0.0	0.0	4.9	0.0	4.9
(5)	<b>Collectable amount in 2002 using existing equipment</b>	(t/day)	45.9	15.7	0.0	13.1	12.2	86.9

### (3) Equipment to be Procured

#### 1) Solid Waste amount to be collected

The solid waste amount to be collected under Phase I and Phase II of the Project is calculated as shown in Table 2.3-9 and Table 2.3-10 respectively. Purchase plan of new equipment is formulating based on "Target collection amount of Phase I" and "Target collection amount of Phase II".

- a. Target collection ratio of Dehiwala MC and Kotte has been set to 90% considering their population and importance in Sri Lanka.
- b. Target collection ratio of Moratuwa MC and Kolonnawa UC has been set to 80%. However, its of Moratuwa MC for Phase I is set to 70% considering remarkable increase of required personnel.
- c. Target collection ration of Maharagama PS has been set to 50% for Phase I and 60 % for Phase II because present service ratio is only 21% and remarkable increase of required personnel.

Table 2.3-9 Solid Waste Amount to be collected in Phase I

Local authority	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama PS	Total
Amount of solid waste generation in 2002 (t/day)	199.4	173.4	51.3	121.3	103.7	649.1
Target solid waste collection rate (%)	90	70	80	90	50	77
Target solid waste collection amount (t/day)	179.4	121.4	41.1	109.2	51.9	502.9
Collectable amount using existing equipment (t/day)	45.9	15.7	0	13.1	12.2	86.9
Target collection amount of Phase I equipment	133.5	105.7	41.1	96.0	39.6	416.0



**Table 2.3-10 Solid Waste Amount to be collected in Phase II**

Local authority	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama a PS	Total
Amount of solid waste generation in 2002 (t/day)	199.4	173.4	51.3	121.3	103.7	649.1
Target solid waste collection rate (%)	90	80	80	90	60	81
Target solid waste collection amount (t/day)	179.4	138.7	41.1	109.2	62.2	530.6
Collectable amount using existing equipment (t/day)	45.9	15.7	0	13.1	12.2	86.9
Target collection amount using Phase I equipment	133.5	105.7	41.1	96.0	39.6	416.0
Target collection amount of Phase II equipment	0	17.3	0	0	10.4	27.7

## 2) Collection and Transportation Plan

In Phase I, as is indicated in Figure 2.3-1. The collection vehicles will directly transport the solid waste to the existing final disposal sites. The average transportation distance (excluding moving distances in collection work) per trip is shown in Table 2.3-11.

**Table 2.3-11 Average Transportation Distance of Collection Vehicles in Phase I**

Local authority	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama a PS	Remarks
Average transportation distance (km)	4.0	3.0	1.5	4.0	4.0	

In Phase II, as is indicated in Figure 2.3-2, the solid waste will be transported to the final disposal site through the transfer stations. The collection vehicles will transport the solid waste to the transfer stations allocated to each local authority. As is shown in Table 2.3-12, the average transportation distance (excluding moving distances in collection work) per trip will be less than 5.0 km.

**Table 2.3-12 Average Transportation Distance of Collection Vehicles in Phase II**

Local authority	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama a PS	Remarks
Average transportation distance (km)	3.1	4.3	4.3	3.7	4.5	

### 3) Types of New Equipment and Number of Trips

In consideration of equipment standardization and road conditions in each local authority, the collection equipment will consist of 8 m<sup>3</sup> compactor trucks, 4 m<sup>3</sup> compactor trucks, 6 m<sup>3</sup> garbage dump trucks and 6 m<sup>3</sup> detachable container trucks.

The 8 m<sup>3</sup> compactor trucks are capable to load from 1 m<sup>3</sup> container, so it is expected to improve efficiency of loading. Since the resident of the each local authority and primary collection workers can discharge solid waste into the containers, environmental conditions around collection stations will be improved. It is noted that large compactor vehicle will not be suitable without sufficient number of small containers because manual loading will take time then number of trips will decrease. Under the Project, 8 m<sup>3</sup> compactor trucks will be supplied as main collection equipment and its number of trips will be planned as three trips per day.

In the case of 4 m<sup>3</sup> compactor trucks, collection work will be done by manual loading, however, because the vehicles are smaller, they enable work in narrow roads. For this reason, 4 m<sup>3</sup> compactor trucks will be supplied to Dehiwala MC and Kotte MC where there are many narrow roads. Due to the small size of these vehicles, they can make three trips per day even if collection work is carried out manually.

The 6 m<sup>3</sup> garbage dump trucks are also small vehicles which will not only be used on narrow roads but also be effective to collect all kinds of waste including bulky waste. The introduction of garbage dump trucks is necessary in order to collect such special waste, so some garbage dump trucks will be supplied to each local authority. Garbage dump truck will also make three trips per day.

The 6 m<sup>3</sup> container trucks will carry detachable containers (6 m<sup>3</sup>). It is effective to use in markets and other areas where large amounts of solid waste will be generated. These vehicles will be supplied to the relatively large local authorities of Dehiwala MC, Moratuwa MC and Kotte MC. Six containers will be provided for each container truck, and each truck will make six trips per day. For each container truck, three closed type containers, which do not allow odor, and three open type containers will be provided.

The amount of waste planned for each type of vehicle to be collected per day is shown in Table 2.3-13.

Table 2.3-13 Daily Collection Capacity of New Equipment

Equipment Type	① Loading capacity (m <sup>3</sup> /vehicle)	② Number of trips (trips/day/vehicle)	③ Operating rate (%)	④ = ① × ② × ③ Collected amount (m <sup>3</sup> /day)	⑤ Bulk density (ton/m <sup>3</sup> )	⑥ = ④ × ⑤ Collected weight (ton/day)
8 m <sup>3</sup> compactor truck	8.0	3	85	20.4	0.45	9.2
4 m <sup>3</sup> compactor truck	4.0	3	85	10.2	0.45	4.6
6 m <sup>3</sup> garbage dump truck	6.0	3	85	15.3	0.30	4.6
6 m <sup>3</sup> container truck	6.0	6	85	30.6	0.30	9.2

#### 4) Quantity of New Equipment

##### ① Phase I

In Phase I, solid waste amount to be collected by each type of equipment is planned as shown in Table 2.3-14. Compactor trucks will be the main equipment and shall collect 70-80% of all solid waste. Collection of the remaining solid waste will be shared by the 6 m<sup>3</sup> garbage dump trucks and 6 m<sup>3</sup> container trucks.

Compactor trucks will mainly be the efficient 8 m<sup>3</sup> type, however, in the local authorities of Dehiwala MC and Kotte MC, where there are many narrow roads, the 4 m<sup>3</sup> type will be used to collect around 25-30% of the solid waste.

Concerning 6 m<sup>3</sup> garbage dump trucks and 6 m<sup>3</sup> container trucks, in the relatively large local authorities of Dehiwala MC, Moratuwa MC and Kotte MC, each type of vehicle will collect 50% of the remaining solid waste. And in the relatively small local authorities of Kolonnawa UC and Maharagama PS, the garbage dump trucks will collect all the remaining solid waste.

Table 2.3-14 Work Share of Each Type of Equipment in Phase I

Equipment	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama PS
8 m <sup>3</sup> compactor truck	50%	70%	75%	60%	75%
4 m <sup>3</sup> compactor truck	25%			20%	
6 m <sup>3</sup> garbage dump truck	12.5%	15%	25%	10%	25%
6 m <sup>3</sup> container truck	12.5%	15%		10%	
Total	100%	100%	100%	100%	100%

Based on the target collection amounts of Phase I, equipment shown in Table 2.3-9 and the work shares shown in Table 2.3-14, the amount to be collected by each type of equipment is calculated as shown in Table 2.3-15.

Table 2.3-15 Amount to be collected by Each Type of Equipment in Phase I (Unit: t/day)

Equipment	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama PS
8 m <sup>3</sup> compactor truck	66.75	74.00	30.82	57.60	29.70
4 m <sup>3</sup> compactor truck	33.37			19.20	
6 m <sup>3</sup> garbage dump truck	16.69	15.85	10.28	9.60	9.90
6 m <sup>3</sup> container truck	16.69	15.85		9.60	
Total	133.5	105.7	41.1	96.0	39.6

As a result, the number of the equipment shown in Table 2.3-16 will be supplied. Regarding the quantity of 6 m<sup>3</sup> containers, as mentioned earlier, half will be open type containers and remaining will be closed type containers.

Table 2.3-16 Quantity of Collection Equipment in Phase I

Equipment	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama PS
8 m <sup>3</sup> compactor truck	7	8	3	6	27
4 m <sup>3</sup> compactor truck	7	0	0	4	11
6 m <sup>3</sup> garbage dump truck	4	3	2	2	13
6 m <sup>3</sup> container truck	2	2	0	1	5
6 m <sup>3</sup> open type container	6	6	0	3	15
6 m <sup>3</sup> closed type container	6	6	0	3	15
Total (vehicles)	20	13	5	13	56
Total (containers)	12	12	0	6	30

## ② Phase II

In Phase II, solid waste amount to be collected by each type of equipment is planned as shown in Table 2.3-17.

In consideration of equipment standardization, the equipment to be supplied will consist of 8 m<sup>3</sup> compactor trucks and 6 m<sup>3</sup> garbage dump trucks. Regarding the work share of each

type of vehicle, the 8 m<sup>3</sup> compactor trucks will collect approximately 67%, or two-thirds, of the target collection amount, and the garbage dump trucks will collect the remaining 33%.

**Table 2.3-17 Work Share of Each Type of Equipment in Phase II**

Equipment	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama PS
8 m <sup>3</sup> compactor truck	–	67%	–	–	67%
6 m <sup>3</sup> garbage dump truck	–	33%	–	–	33%
Total	–	100%	–	–	100%

Based on the target collection amounts of Phase II equipment shown in Table 2.3-10 and the work shares shown in Table 2.3-17, the amount to be collected by each type of equipment is calculated as shown in Table 2.3-18.

**Table 2.3-18 Amount to be collected by Each Type of Equipment in Phase II**

(Unit: t/day)

Equipment	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama PS
8 m <sup>3</sup> compactor truck	0	11.59	0	0	6.97
6 m <sup>3</sup> garbage dump truck	0	5.71	0	0	3.43
Total	0	17.3	0	0	10.4

As a result, the number of the equipment shown in Table 2.3-19 will be supplied.

**Table 2.3-19 Quantity of Collection Equipment in Phase II**

Equipment	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagama PS	Total
8 m <sup>3</sup> compactor truck	0	1	0	0	1	2
6 m <sup>3</sup> garbage dump truck	0	1	0	0	1	2
Total	0	2	0	0	2	4

#### (4) Equipment for Removal of Accumulated Waste

##### 1) Waste to be collected

Accumulated waste on roads will be removed using wheel loader together with dump truck. The daily amount of solid waste unable to be collected using existing equipment is as shown in Table 2.3-20.

Table 2.3-20 Uncollected Solid Waste in 1997

Item	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagam a PS	Total
Generated solid waste in 1997 (t/day)	180.6	150.3	44.5	108.8	89.9	574.1
Collected solid waste in 1997 (t/day)	103	59	11	34	19	226
Uncollected solid waste (t/day)	77.6	91.3	33.5	74.8	70.9	348.1

## 2) Type and Quantity of Equipment

Since uncollected solid waste is mixed with sand and soil over a period, its removal by manual loading is difficult. For this reason, accumulated waste will be removed by wheel loader together with dump truck.

Dump trucks will be 3.5 ton loading types which can work in narrow roads. Since they will need to carry solid waste mixed with sand and soil, they will be ordinary dump trucks. The wheel loaders will also be small types (1 m<sup>3</sup> class) suitable for working in urban area. Concerning the wheel loaders, it will be also used for final disposal.

Regarding the quantity of dump trucks, since the amount of accumulated waste is too large, the quantity will be set in terms of operation and maintenance capability which is judged from existing personnel and maintenance setups of each local authority. The quantity is shown in Table 2.3-21. Because this equipment is urgently required, it will be supplied under Phase I of the Project.

Table 2.3-21 Quantity of Accumulated Waste Collection Equipment

Equipment	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagam a PS	Total
3.5 t dump truck	2	1	1	1	1	6

## **(5) Patrol Equipment**

In the five local authorities, daily patrol of solid waste management work is necessary to maintain urban area clean. Existing equipment sometimes breaks down on the road. To achieve the target, it is also necessary to prepare patrol vehicle. The patrol equipment will be provided under the Project to Dehiwala MC and Kotte MC where there are many collection supervisors. Patrol vehicles will be four-wheel drive, double cab pickup trucks to check operation of final disposal sites and to carry some staffs and tools. One pickup truck will be supplied to above two local authorities. Since this equipment is urgently required, it will be supplied under Phase I of the Project.

### **1) Target Local authorities for Patrol Equipment Supply**

#### **① Dehiwala MC**

15 existing tractors shall be used after the Project and it is forecasted that many breakdowns will occur on the road in the future. Since the existing solid waste collection rate in Dehiwala is relatively high at 57% and the target collection rate in 2002 is 90%, it is expected that the arrangement of patrol setup will contribute to effective improvement of sanitary environment in the local authority.

#### **② Kotte MC**

Since it is the capital local authority of Sri Lanka, there are many visitors from overseas countries and the awareness regarding sanitation is high and complaints are frequent among citizens, the arrangement of a setup to patrol solid waste collection and sanitary conditions is urgently required.

## **(6) Final Disposal Site Equipment**

### **1) Work Load of Existing Final Disposal Sites**

The work load of existing final disposal sites at the time of Phase I implementation, as calculated from the target amount of solid waste collection in 2002 (Phase I value), is shown in Table 2.3-22. Regarding the covering soil, the thickness shall be 50 cm for each 3 m layer of solid waste (17% of the solid waste amount).

Table 2.3-22 Work Load at Existing Final Disposal Sites in 2002

Item	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagam a PS	Total
① Target solid waste collection amount in 2002 (t/day)	179.4	121.4	41.1	109.2	51.9	502.9
② Quantity of ① in m <sup>3</sup> (bulk density 0.35) (m <sup>3</sup> /day)	512.7	346.8	117.3	311.9	148.2	1,437.0
③ Volume following disposal of ② (compaction rate 50%) (m <sup>3</sup> /day)	256.4	173.4	58.7	156.0	74.1	718.5
④ Earth covering amount (17% of ③) (m <sup>3</sup> /day)	43.6	29.5	10.0	26.5	12.6	122.0

## 2) Types of Final Disposal Site Equipment

In consideration of simple maintenance, equipment of the same specifications shall be provided to each local authority, and the equipment purchase plan shall be formulated with consideration given to the following points:

- ① Since the existing final disposal sites will no longer be used in Phase II, equipment shall be an easily diverted type for alternative use following Phase II.
- ② There are two existing final disposal sites each in Moratuwa and Kotte. Simultaneous operation at two sites shall be considered for those local authorities.
- ③ For Dehiwala, which generates a large amount of solid waste, and Kotte, which is the capital local authority and has a high need for environmental consideration, bulldozers which can carry out sufficient compaction and soil covering shall be introduced.
- ④ Wheel loaders shall also be used for removing accumulated solid waste on roads.

In consideration of the above, final disposal site equipment shall consist of 110 HP swamp-type bulldozers and 1.0 m<sup>3</sup> wheel loaders.



### 3) Capacity of Final Disposal Site Equipment

The respective capacity of 110 HP bulldozers and 1.0 m<sup>3</sup> wheel loaders and the existing 1.0 m<sup>3</sup> back hoe loader owned by Moratuwa are calculated as shown in Table 2.3-23.

Table 2.3-23 Capacity of Final Disposal Site Equipment

Equipment	Work Item	Capacity of Daily Work Load (m <sup>3</sup> /day)
110 HP bulldozer	Solid waste spreading	570
	Soil covering	270
1.0 m <sup>3</sup> wheel loader	Solid waste spreading	190
	Soil covering	190
Existing 1.0 m <sup>3</sup> back hoe loader	Solid waste spreading	190
	Soil covering	190

### 4) Requirement of Final Disposal Site Equipment

From the work loads at the existing final disposal sites and the calculation results of equipment capacity, the required number of equipment for final disposal sites will be arranged as shown below. However, as is described later, the bulldozers will be used to carry out covering soil of used disposal sites in the five local authorities after Phase II implementation. For this reason, the bulldozers shall belong to Western Provincial Council and be used in free of charge to Dehiwala MC and Kotte MC during Phase I and to all five local authorities during Phase II implementation.

### Required number of Equipment of Final Disposal Site

Equipment	Quantity	Target Work	Work Load (m <sup>3</sup> /day) (work time)
Dehiwala MC			
110 HP bulldozer	1	Solid waste spreading Soil covering	380.0 (5.2h) 43.6 (1.3h)
1.0 m <sup>3</sup> wheel loader	1	Solid waste spreading	132.7 (5.6h)
Moratuwa MC			
1.0 m <sup>3</sup> wheel loader	1	For use at Thelawale disposal site Solid waste spreading Soil covering	22.54 (9.5h) 19.2 (0.8h)
Existing 1.0 m <sup>3</sup> back hoe loader	1	For use at Korallawella disposal site Solid waste spreading Soil covering	121.4 (5.1h) 10.3 (0.4h)
Kolonnawa UC			
1.0 m <sup>3</sup> wheel loader	1	Solid waste spreading Soil covering	117.3 (4.9h) 10.0 (0.4h)
Kotte MC			
110 HP bulldozer	1	Mainly for at Moragasmulla site Solid waste spreading Soil covering	218.4 (3.0h) 18.6 (0.5h)
1.0 m <sup>3</sup> wheel loader	1	Mainly for use at Thuduwa disposal site Solid waste spreading Soil covering	93.6 (3.9h) 9.0 (0.3h))
Maharagama PS			
1.0 m <sup>3</sup> wheel loader	1	Solid waste spreading Soil covering	148.2 (6.2h) 12.6 (0.5h)

#### 5) Quantity of Equipment for Existing Final Disposal Sites

As a result of the above, the quantity of new equipment required at the time of Phase I is as shown in Table 2.3-24.

Table 2.3-24 Type and Quantity of New Equipment

Equipment	Dehiwala MC	Moratuwa MC	Kolonnawa UC	Kotte MC	Maharagam a PS	Total
100 HP bulldozer	1	—	—	1	—	2
1.0 m <sup>3</sup> wheel loader	1	1	1	1	1	5

#### 6) Final Disposal Site Equipment after Phase II Implementation

Since the existing final disposal sites will be closed after Phase II implementation, the bulldozers and wheel loaders supplied under Phase I will be diverted for use in the following work.

##### ① Bulldozers

Even if solid waste disposal at the existing final disposal sites will be stopped, it will be necessary to carry out rearrangement of the sites such as final soil covering. Therefore, bulldozers supplied in Phase I will be used to carry out these work. Since only two bulldozers will be supplied in the project, they shall be sent in turns to each of the seven final disposal sites in the five local authorities to carry out these work. Therefore, it will be desirable that Western Provincial Council, which is the supervisory agency over the five local authorities, will manage the bulldozers throughout the Project. In the Phase I, WPC will lent the bulldozers without charge to Dehiwala MC and Kotte MC and they will maintain by themselves. In Phase II, WPC will provide these equipment according to the necessity and request made by each local authority.

##### ② Wheel Loaders

As mentioned earlier, the wheel loaders will be used to remove accumulated solid waste. Therefore, the wheel loaders will be used to remove and collect accumulated waste also after Phase II in each local authority.

#### (7) Equipment of Ratmalana Transfer Station

The plan of Ratmalana transfer station to be constructed by Western Provincial Council is shown in Figure 2.3-3 and outline of the plan and description of main facilities are as follows.

##### 1) Outline of Ratmalana Transfer Station

- ① The Ratmalana transfer station will serve to Dehiwala MC and Moratuwa MC.
- ② Since the solid waste amount collected in Dehiwala MC and Moratuwa MC in 2002 will be 318 tons/day, the design capacity of the station will also be 318 tons/day.
- ③ The transfer station shall be a flat type which wheel loaders load the solid waste onto transfer vehicles .
- ④ The area of the site (already acquired) is 16,000 m<sup>2</sup>.

##### 2) Main Facilities

- ① Weigh bridge
- ② Receiving and loading stage

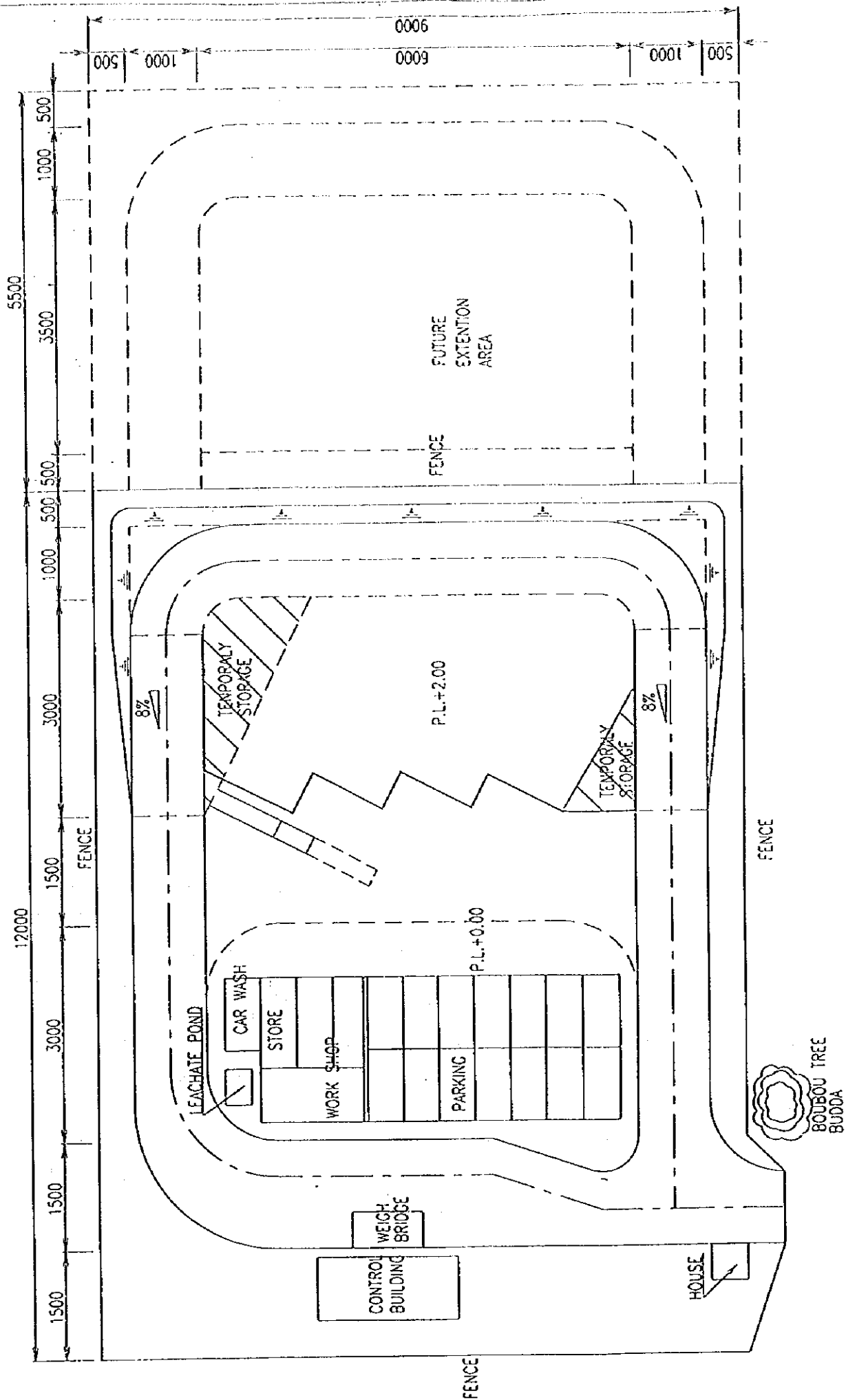


Fig. 2.3-3 CONCEPTUAL LAYOUT OF RATMALANA TRANSFER STATION

- ③ Container berths
- ④ Control building
- ⑤ Guard house
- ⑥ Workshop and garage (parking)
- ⑦ Car Washing bay
- ⑧ Leachate pond
- ⑨ Fence and gate

Of the above, the weigh bridge equipment, workshop equipment, washing equipment, leachate removal equipment and wheel loaders for loading of solid waste will be supplied under Phase II of the Project. Construction work including installation of the above equipment shall be carried out by the Sri Lanka side.

#### 1) Weigh Bridge Equipment

A weigh bridge will be installed to weigh collection vehicles that arrive at the station carrying solid waste to obtain basic data of collection work and data on the solid waste amount. The weigh bridge will be a stationary type with a load capacity of 40 tons that will be possible to measure transfer vehicles.

It is planned that data processing equipment will be limited to simple one, indicator, a monitor and a printer to fulfil the basic requirement of solid waste management in the Project.

#### 2) Workshop Equipment

It is necessary to prepare a workshop in order to carry out periodical maintenance and minor repair, because the Ratmalana transfer station will be newly built. Under the Project, a minimum set of tools necessary for carrying out periodical maintenance and minor repair for transferring vehicles and transfer station equipment will be supplied, while the Sri Lanka side shall be responsible for construction of the workshop building. Details regarding the workshop equipment including the washing equipment are given later.

#### 3) Washing Equipment

It is desirable to install washing equipment to make clean transfer vehicles and to reduce environmental impact along the transportation route. One high-pressure car washer with a tank capacity of 18 liters shall be supplied.

#### 4) Leachate Removal Equipment

Since rainfall in the Project area exceeds 2,000 mm per year, leachate will be generated in the transfer station, and the leachate will be a major negative impact for the surrounding environment. Since it is difficult to install and maintain leachate treatment plan in the transfer station, a leachate pond and a vacuum tank truck will be prepared to remove the leachate from the site. The removed leachate will be transported to Hanwella final disposal site or Ratmalana sewage treatment plant to be constructed by CEIP.

It is estimated that the amount of generated leachate will be around 2% of the solid waste amount, so its amount will be roughly 6 tons (6,000 liters) per day. Under the Project, one vacuum tank truck of 3,000 liter capacity will be supplied and this will make two trips per day.

#### 5) Wheel Loaders

Wheel loaders shall be procured to carry out the transferring work of solid waste in Ratmalana Transfer Station. The work load of the transfer station will be the solid waste amount to be collected in Dehiwala MC and Moratuwa MC in 2002, i.e. 1,060.6 m<sup>3</sup> per day (318 tons/day), and the peak load of the transfer station will be approximately 20% of daily waste amount. Therefore, wheel loaders required for loading of 20% of daily waste amount will be prepared. According to the calculation result, two wheel loaders of 3 m<sup>3</sup> will be required because of loading capacity of each wheel loader will be 125 m<sup>3</sup>/hour. This will enable to load solid waste to transfer vehicle at peak time as indicated in the following table.

Table 2-3-25 Transfer Wheel Loaders and Peak Time Work Load

Equipment	Quantity	Target Work	Required Work Time
3 m <sup>3</sup> wheel loader ①	1	Solid waste reloading work 115 m <sup>3</sup>	0.92 h
3 m <sup>3</sup> wheel loader ②	1	Solid waste reloading work 115 m <sup>3</sup>	0.92 h

#### (8) Transferring Vehicles

In Phase II of the Project, it is necessary to transport solid waste from Ratmalana transfer station to Hanwella final disposal site. Transfer station shall be managed by Western Provincial Council. Transfer Vehicles to be supplied in Phase II is planned as following consideration.

### 1) Design Criteria

The amount of solid waste to be transported will be collected waste amount in Dehiwala MC and Moratuwa MC in 2002, i.e. 318 tons per day. Since access roads to the transfer station is not so wide, it is not suitable to use large tractor trailer system

### 2) Types of Transferring Vehicles

Detachable containers system, which can store solid waste in containers, will be used. In order to raise the efficiency of transferring work, 20 m<sup>3</sup> containers and container trucks will be introduced. The container lift system of container trucks will be the arm type which is suited to large containers.

Hanwella final disposal site is located approximately 40 km away from Ratmalana transfer station, and it is estimated that approximately 2.5 hours will be required to make one trip (trip 2 hours + loading/unloading 0.5 hours). Therefore, it is estimated that the large container trucks can make between three and four trips per day. For this reason, the quantity of equipment to be supplied has been calculated by an average number of trips of 3.5 per day.

### 3) Quantity of Transferring Equipment

#### a) Container Trucks

The transportation capacity of a 20 m<sup>3</sup> container truck is 17.85 tons per day as shown below. Therefore, in order to transport 318 tons of solid waste per day, 18 such trucks will be required.

Table 2-3-26 Transportation Capacity of a 20 m<sup>3</sup> Container Truck

Equipment	① Loading capacity (m <sup>3</sup> )	② Trips (trips/day)	③ Operating rate (%)	④ = ① × ② × ③ Transportation capacity (m <sup>3</sup> /day)	⑤ = ④ × 0.3 Transportation capacity (t/day)
20 m <sup>3</sup> container truck	20	3.5	85	59.5	17.85

#### b) Containers

The required number of containers is the sum of the above number of container trucks plus the number required for temporally storage. The necessary amount for storage is dependent on the receiving conditions of solid waste. At Ratmalana transfer station, the difference between the peak time receiving waste amount (230 m<sup>3</sup>/hour) and the average transportation capacity (120 m<sup>3</sup>/hour) is 110 m<sup>3</sup>. Therefore six containers shall be prepared

to handle this amount. Consequently, the total number of containers to be supplied is as follows:

18 containers for container trucks + 6 containers for temporally storage = 24 containers.

#### (9) Workshop Equipment

In accordance with the planned quantity of equipment to be supplied to each local authority and Ratmalana transfer station, tools necessary for periodical maintenance and minor repair shall be supplied as shown in Table 2.3-27. Tools for the five local authorities of Dehiwala MC, Moratuwa MC, Kolonnawa UC, Kotte MC and Maharagama PS will be supplied in Phase I, and tools for Ratmalana transfer station will be supplied in Phase II.

Table 2.3-27 Workshop Equipment for Each Local authority

		Dehiwala	Moratuwa	Kolonnawa	Kotte	Maharagama	Ratmalana transfer station	Total
1	Hydraulic garage jack	2	1	1	1	1	2	8
2	Rigid Rack	1	1	1	1	1	1	6
3	Electric bench grinder	1	1	1	1	1	1	6
4	Screw Plate Set	1	1	1	1	1	1	6
5	Torque wrench (1/2")	1	1	1	1	1	1	6
6	Torque wrench (3/4")	1	1	1	1	1	1	6
7	Gear oil lubrication	2	1	1	1	1	2	8
8	Grease gun	2	1	1	1	1	2	8
9	Drill bit	1	1	1	1	1	1	6
10	Mechanic Tool set	2	1	1	1	1	2	8
11	Chain block	1	1	1	1	1	1	6
12	Bench Drilling machine	1	1	1	1	1	1	6
13	Electric Drill	1	1	1	1	1	1	6
14	Air impact wrench (3/4")	1	1	1	1	1	1	6
15	Air impact wrench (1")	1	1	1	1	1	1	6
16	Brake pipe repair tools	1	1	1	1	1	1	6
17	Nozzle tester	1	1	1	1	1	1	6
18	Gas welding Cutting tool set	1	1	1	1	1	1	6
19	High power wrench	1	1	1	1	1	1	6
20	Brake bleeder wrench set	1	1	1	1	1	1	6
21	Battery quick charger	1	1	1	1	1	1	6
22	Air compressor 5.5 kw	1					1	2
23	Air compressor 2.2 kw		1	1	1	1		4
24	AC arc welder set	1	1	1	1	1	1	6
25	High pressure car washer	1	1	1	1	1	1	6
26	Tire Remover	1	1	1	1	1	1	6
27	Oil filter wrench	1	1	1	1	1	1	6
28	Measuring instrument	1					1	2



## **(10) Spare Parts Supply and Management Plan**

### **1) Spare Parts Supply**

Throughout Phase I and Phase II, spare parts will be supplied based on the following criteria in accordance with the specifications and quantity of supplied equipment.

- ① Vehicle: Spare parts required for approximately 75,000 km traveling distance
- ② Construction machinery: Spare parts required for approximately 7,500 working hours

### **2) Spare Parts Management**

Spare parts management shall be divided between Western Provincial Council and the five local authorities in the manner indicated below.

- ① Since the equipment supplied to each local authority will be limited, supplying spare parts which will be necessary for low frequency breakdown will be uneconomic to provide each local authority. Therefore, these spare parts will be supplied to Western Provincial Council (WPC) and spare parts store will be constructed by WPC.
- ② Concerning spare parts that are regularly required for each type of equipment, it will be provided to each local authority and shall be managed by each local authority.
- ③ Concerning spare parts required for Ratmalana transfer station and the transfer vehicles will be stored at Ratmalana transfer station under the management of Western Provincial Council.

## **(11) Total Required Quantity of Equipment**

The quantities of equipment to be supplied in Phase I and Phase II are compiled in Table 2.3-28. The outline specifications of main equipment are shown in Table 2.3-29.

**Table 2.3-28 Equipment to be Purchased by the Project**

[illegible]

Table 2.3-29 Specifications of the Equipment

(1/7)

Item	Specifications	Note
1. Collection Equipment		
1. 8m <sup>3</sup> Compactor Truck		
(1) Main Specifications		
-- Type of vehicle	8m <sup>3</sup> Compactor Truck	
-- Steering wheel	Right-hand, forward control	
-- Traction	4×2 rear traction	
-- Max. payload	3,500kg	
-- Gross vehicle weight	Approx. 9,000kg	
(2) Dimensions		
-- Overall length	Approx. 6,700mm	
-- Overall width	Approx. 2,200mm	
-- Overall height	Approx. 2,900mm	
-- Wheel base	Approx. 3,400mm	
-- Min. turning radius	Approx. 5,700mm	
-- Tire	Approx. 8.25-16-14PR	
(3) Engine		
-- Type	Water-cooled, 4-cycle, diesel engine	
-- Max. output	160PS	
(4) Attachments		
-- Body volume	Not less than 8m <sup>3</sup>	
-- Hopper volume	Not less than 1m <sup>3</sup>	
-- Container lift	Lifting capacity : 700kg	
2. 4m <sup>3</sup> Compactor Truck		
(1) Main Specifications		
-- Type of vehicle	4m <sup>3</sup> Compactor Truck	
-- Steering wheel	Right-hand, forward control	
-- Traction	4×2 rear traction	
-- Max. payload	1,800kg	
-- Gross vehicle weight	Approx. 6,000kg	
(2) Dimensions		
-- Overall length	Approx. 5,500mm	
-- Overall width	Approx. 2,000mm	
-- Overall height	Approx. 2,300mm	
-- Wheel base	Approx. 2,500mm	
-- Min. turning radius	Approx. 5,000mm	
-- Tire	Approx. 7.00-16-10PR	
(3) Engine		
-- Type	Water-cooled, 4-cycle, diesel engine	
-- Max. output	Approx. 100PS	
(4) Attachments		
-- Body volume	Approx. 4m <sup>3</sup>	
-- Hopper volume	Approx. 0.6m <sup>3</sup>	

Table 2.3-29 Specifications of the Equipment

(2/7)

Item	Specifications	Note
<b>3. 6m<sup>3</sup> Garbage Dump Truck</b>		
(1) Main Specifications		
— Type of vehicle	6m <sup>3</sup> Garbage Dump Truck	
— Steering wheel	Right-hand, forward control	
— Traction	4×2 rear traction	
— Max. payload	3,500kg	
— Gross vehicle weight	Approx. 8,500kg	
(2) Dimensions		
— Overall length	Approx. 5,800mm	
— Overall width	Approx. 2,200mm	
— Overall height	Approx. 2,400mm	
— Wheel base	Approx. 3,300mm	
— Min. turning radius	Approx. 5,000mm	
— Tire	Approx. 8.25-16-14PR	
(3) Engine		
— Type	Water-cooled, 4-cycle, diesel engine	
— Max. output	120PS	
(4) Attachments		
— Body volume	6m <sup>3</sup> with Top Cover	
<b>4. 6m<sup>3</sup> Detachable Container Truck</b>		
(1) Main Specifications		
— Type of vehicle	6m <sup>3</sup> Detachable Container Truck	
— Steering wheel	Right-hand, forward control	
— Traction	4×2 rear traction	
— Max. payload	3,500kg	
— Gross vehicle weight	Approx. 9,000kg	
(2) Dimensions		
— Overall length	Approx. 6,500mm	
— Overall width	Approx. 2,300mm	
— Overall height	Approx. 3,200mm	
— Wheel base	Approx. 3,600mm	
— Min. turning radius	Approx. 6,000mm	
— Tire	Approx. 8.25-16-14PR	
(3) Engine		
— Type	Water-cooled, 4-cycle, diesel engine	
— Max. output	160PS	
(4) Attachments		
— Container lift	Lifting capacity : 5,500kg	

Table 2.3-29 Specifications of the Equipment

(3/7)

Item	Specifications	Note
<p>5. Container(open type)for Detachable Container Truck</p> <p>(1) Dimensions</p> <ul style="list-style-type: none"> <li>-- Overall length</li> <li>-- Overall width</li> <li>-- Overall height</li> </ul> <p>(2) Body volume</p> <p>(3) Weight</p>	<p>All-steel welded construction open-top type</p> <p>Approx. 3,880mm</p> <p>Approx. 1,930mm</p> <p>Approx. 1,350mm</p> <p>6m<sup>3</sup></p> <p>Approx. 850kg</p>	
<p>6. Container(closed type)for Detachable Container Truck</p> <p>(1) Dimensions</p> <ul style="list-style-type: none"> <li>-- Overall length</li> <li>-- Overall width</li> <li>-- Overall height</li> </ul> <p>(2) Body volume</p> <p>(3) Weight</p>	<p>All-steel welded construction closed type</p> <p>Approx. 3,270mm</p> <p>Approx. 1,930mm</p> <p>Approx. 1,700mm</p> <p>6m<sup>3</sup></p> <p>Approx. 1,000kg</p>	
II. Accumulated Garbage Collection Equipment		
<p>1. 3.5ton Dump Truck</p> <p>(1) Main Specifications</p> <ul style="list-style-type: none"> <li>-- Type of vehicle</li> <li>-- Steering wheel</li> <li>-- Traction</li> <li>-- Max. payload</li> <li>-- Gross vehicle weight</li> </ul> <p>(2) Dimensions</p> <ul style="list-style-type: none"> <li>-- Overall length</li> <li>-- Overall width</li> <li>-- Overall height</li> <li>-- Wheel base</li> <li>-- Min. turning radius</li> <li>-- Tire</li> </ul> <p>(3) Engine</p> <ul style="list-style-type: none"> <li>-- Type</li> <li>-- Max. output</li> </ul> <p>(4) Attachments</p> <ul style="list-style-type: none"> <li>-- Body volume</li> </ul>	<p>3.5ton Dump Truck</p> <p>Right-hand, forward control</p> <p>4×2 rear traction</p> <p>3,500kg</p> <p>Approx. 8,500kg</p> <p>Approx. 5,300mm</p> <p>Approx. 2,200mm</p> <p>Approx. 2,400mm</p> <p>Approx. 3,000mm</p> <p>Approx. 5,000mm</p> <p>Approx. 8.25-16-14PR</p> <p>Water-cooled, 4-cycle, diesel engine</p> <p>120PS</p> <p>2.2m<sup>3</sup></p>	

Table 2.3-29 Specifications of the Equipment

(4/7)

Item	Specifications	Note
<b>III. Patrol Equipment</b>		
<b>1. 4WD Double Cab Pick Up</b>		
(1) Main Specifications		
— Type of vehicle	4WD Double Cab Pick Up truck	
— Steering wheel	Right-hand, forward control	
— Traction	4×4 rear traction	
— Gross vehicle weight	Approx. 2,500kg	
(2) Dimensions		
— Overall length	Approx. 5,000mm	
— Overall width	Approx. 1,700mm	
— Overall height	Approx. 1,800mm	
— Wheel base	Approx. 2,800mm	
(3) Engine		
— Type	Water-cooled, 4-cycle, diesel engine	
— Max. output	75PS	
(4) Other		
— Seating capacity	5 seats	
— Doors	4 doors	
(5) Attachments	Air conditioner	
<b>IV. Disposal Equipment</b>		
<b>1. Bulldozer</b>		
	110HP Bulldozer (swamp type)	
(1) Dimensions		
— Overall length	Approx. 5,150mm	
— Overall width	Approx. 2,800mm	
— Overall height	Approx. 3,000mm	
— Ground clearance	Approx. 430mm	
(2) Blade	Straight tilt type	
— Width	Approx. 3,400mm	
— Height	Approx. 950mm	
(3) Operation weight	Approx. 13,000kg	
(4) Engine		
— Type	Direct injection, 4-stroke-	
— Max. output	cycle, water cooled, turbo charged	
— Max. forward speed	110HP	
	Approx. 9km/h	
(5) Track		
— Type	Sealed and lubricated tracks	
— Width	Approx. 800mm	
— Ground pressure	0.35kg/m <sup>2</sup>	

Table 2.3-29 Specifications of the Equipment

(5/7)

Item	Specifications	Note
(6) Attachments <ul style="list-style-type: none"> <li>-- Cab</li> <li>-- Air conditioner</li> <li>-- Engine hood with side covers</li> <li>-- Radiator guard</li> <li>-- Trash rack</li> </ul>	ROPS canopy steel cab  Height : Approx. 500mm	
2. Wheel Loader <ul style="list-style-type: none"> <li>(1) Dimensions               <ul style="list-style-type: none"> <li>-- Overall length</li> <li>-- Overall width(w/o bucket)</li> <li>-- Overall height(ROPS cab)</li> <li>-- Ground clearance</li> <li>-- Min. turning radius</li> </ul> </li> <li>(2) Bucket</li> <li>(3) Operations weight</li> <li>(3) Engine               <ul style="list-style-type: none"> <li>-- Type</li> <li>-- Max. output</li> <li>-- Max. travel speed</li> </ul> </li> <li>(5) Tire</li> <li>(6) Attachments               <ul style="list-style-type: none"> <li>-- Cab</li> <li>-- Air conditioner</li> </ul> </li> </ul>	1m <sup>3</sup> Bucket Type  Approx. 5,950mm Approx. 2,200mm Approx. 3,000mm Approx. 350mm Approx. 4,500mm  1.0m <sup>3</sup>  Approx. 7,000kg  Direct injection, 4-cycle, water cooled, turbo charged diesel engine 80HP Approx. 30km/h  Approx. 15.5-25-8PR  ROPS cab	
V. Transfer Station Equipment <ul style="list-style-type: none"> <li>1. Wheel Loader               <ul style="list-style-type: none"> <li>(1) Dimensions                   <ul style="list-style-type: none"> <li>-- Overall length</li> <li>-- Overall width(w/o bucket)</li> <li>-- Overall height(ROPS cab)</li> <li>-- Ground clearance</li> <li>-- Min. turning radius</li> </ul> </li> <li>(2) Bucket</li> <li>(3) Operations weight</li> <li>(4) Engine                   <ul style="list-style-type: none"> <li>-- Type</li> <li>-- Max. output</li> <li>-- Max. travel speed</li> </ul> </li> <li>(5) Tire</li> </ul> </li> </ul>	3m <sup>3</sup> Bucket Type  Approx. 7,800mm Approx. 2,800mm Approx. 3,400mm Approx. 500mm Approx. 6,500mm  3.0m <sup>3</sup>  Approx. 17,000kg  Direct injection, 4-cycle, water cooled, turbo charged diesel engine 180HP Approx. 35km/h  Approx. 23.5-25-12PR	

Table 2.3-29 Specifications of the Equipment

(6/7)

Item	Specifications	Note
(6) Attachments -- Cab -- Air conditioner	ROPS cab	
2. Vacuum Tank Truck ( 3,000 lit. )		
(1) Main Specifications -- Type of vehicle -- Steering wheel -- Traction -- Max. payload -- Gross vehicle weight	Vacuum Tank Truck ( 3,000 lit. ) Right-hand, forward control 4×2 rear traction 3,000kg Approx. 8,000kg	
(2) Dimensions -- Overall length -- Overall width -- Overall height -- Wheel base -- Min. turning radius -- Tire	Approx. 5,500mm Approx. 2,300mm Approx. 2,500mm Approx. 3,000mm Approx. 6,000mm Approx. 7.50~8.25-16-4PR	
(3) Engine -- Type -- Max. output	Water-cooled, 4-cycle, diesel engine 120PS	
(4) Attachments -- Body volume	3,000 lit.	
3. Weigh Bridge ( 40ton )		
(1) Type	Load cell	
(2) Capacity -- Load capacity -- Min. Graduation	40ton 10kg	
(3) Dimensions -- Overall length -- Overall width	Approx. 8,000mm Approx. 3,000mm	
(4) Monitor -- Digital display -- printer		
4. Washing Equipment		
(1) Type	High pressure Car Washer	
(2) Discharge volume	1,500 lit./m	
(3) Detergent tank capacity	Approx. 18 lit.	
(4) Weight	Approx. 150kg	



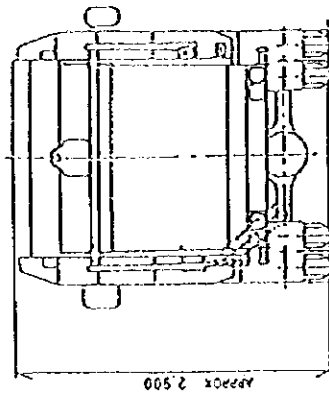
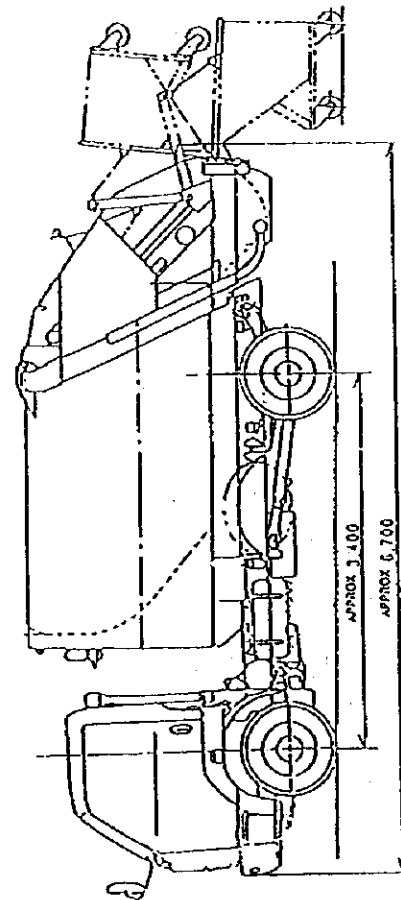
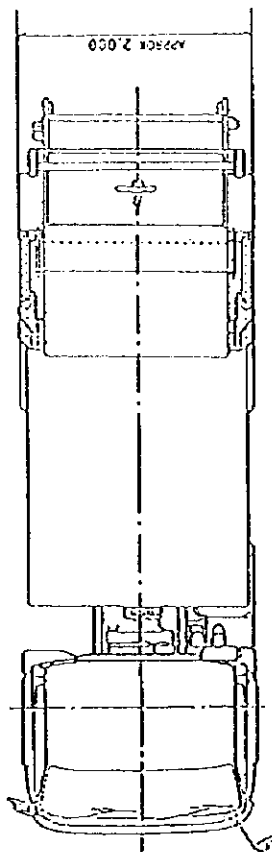
Table 2.3-29 Specifications of the Equipment

Item	Specifications	Note
<b>VI. Transportation Equipment</b> <b>1. 20m<sup>3</sup> Arm-Type Detachable Container Truck</b> (1) Main Specifications - Type of vehicle - Steering wheel - Traction - Max. payload - Gross vehicle weight (2) Dimensions - Overall length - Overall width - Overall height - Wheel base - Min. turning radius - Tire (3) Engine - Type - Max. output (4) Attachments - Container lift	20m <sup>3</sup> Arm-Type Detachable Container Truck Right-hand, forward control 6×4 rear traction Approx. 14,000kg Approx. 24,500kg Approx. 9,300mm Approx. 2,500mm Approx. 3,300mm Approx. 5,700mm Approx. 8,000mm Approx. 10.0~11.0-20-14PR Water-cooled, 4-cycle, diesel engine 300PS Lifting capacity : 15,000kg (Arm-type)	
<b>2. Container</b> (1) Dimensions - Overall length - Overall width - Overall height (2) Body volume	20m <sup>3</sup> open-type (Arm-type) Approx. 5,900mm Approx. 2,500mm Approx. 1,900mm 20m <sup>3</sup>	

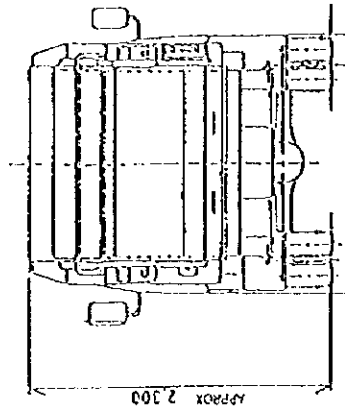
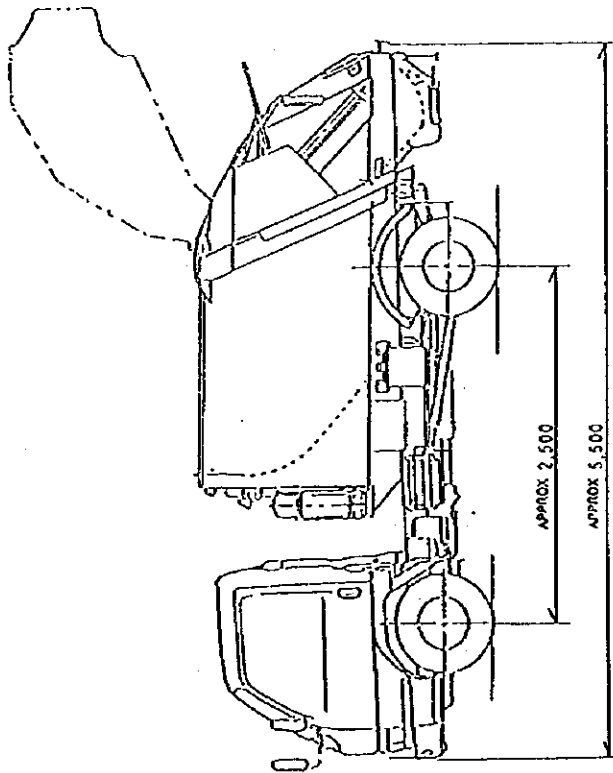
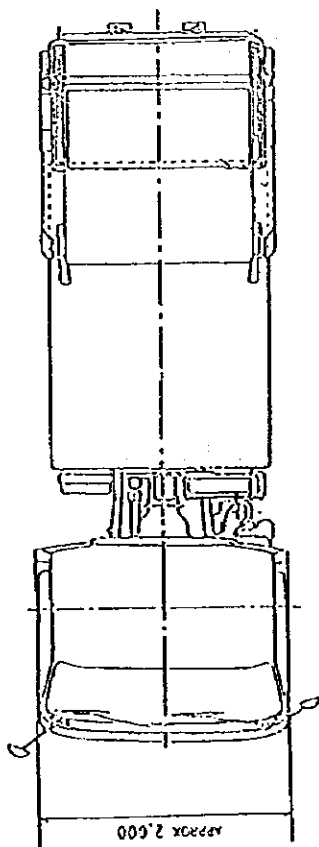
(12) Equipment Standard Drawings

The drawings of main equipment are indicated in below drawings.

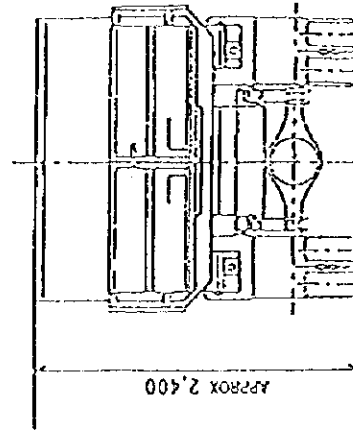
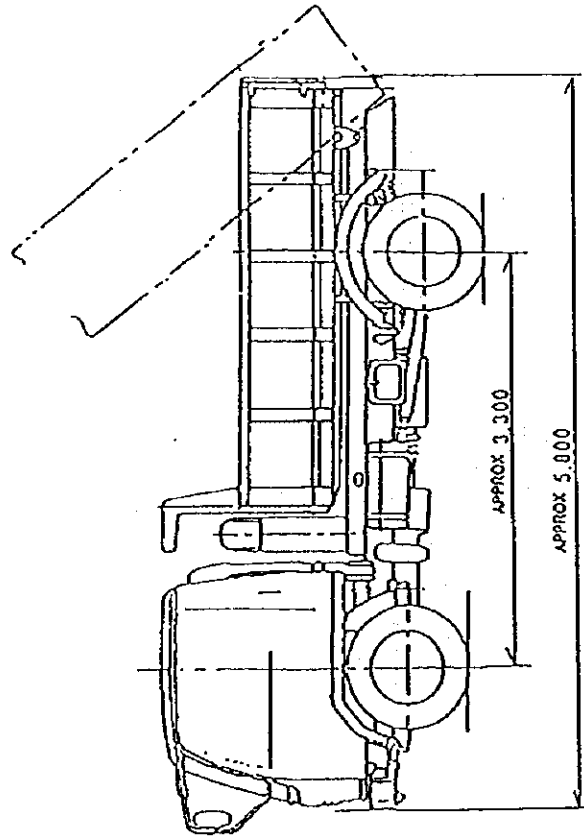
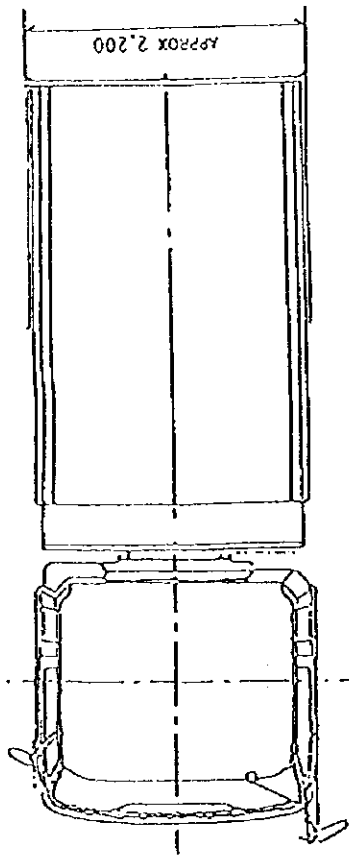
Equipment	Drawing Number
8 m <sup>3</sup> compactor truck	CSW-01
4 m <sup>3</sup> compactor truck	CSW-02
6 m <sup>3</sup> garbage dump truck	CSW-03
6 m <sup>3</sup> container truck	CSW-04
Open type 6 m <sup>3</sup> container	CSW-05
Closed type 6 m <sup>3</sup> container	CSW-06
3.5 ton dump truck	CSW-07
Double cabin pickup truck	CSW-08
Bulldozer	CSW-09
Wheel loader (1 m <sup>3</sup> )	CSW-10
Wheel loader (3 m <sup>3</sup> )	CSW-11
Vacuum tank truck	CSW-12
Weigh bridge	CSW-13
20 m <sup>3</sup> container truck	CSW-14
20 m <sup>3</sup> container	CSW-15



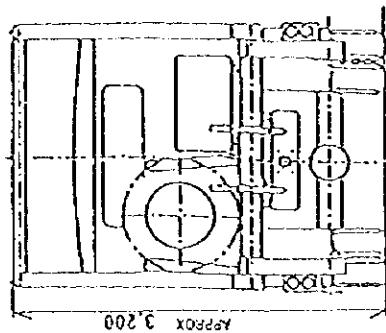
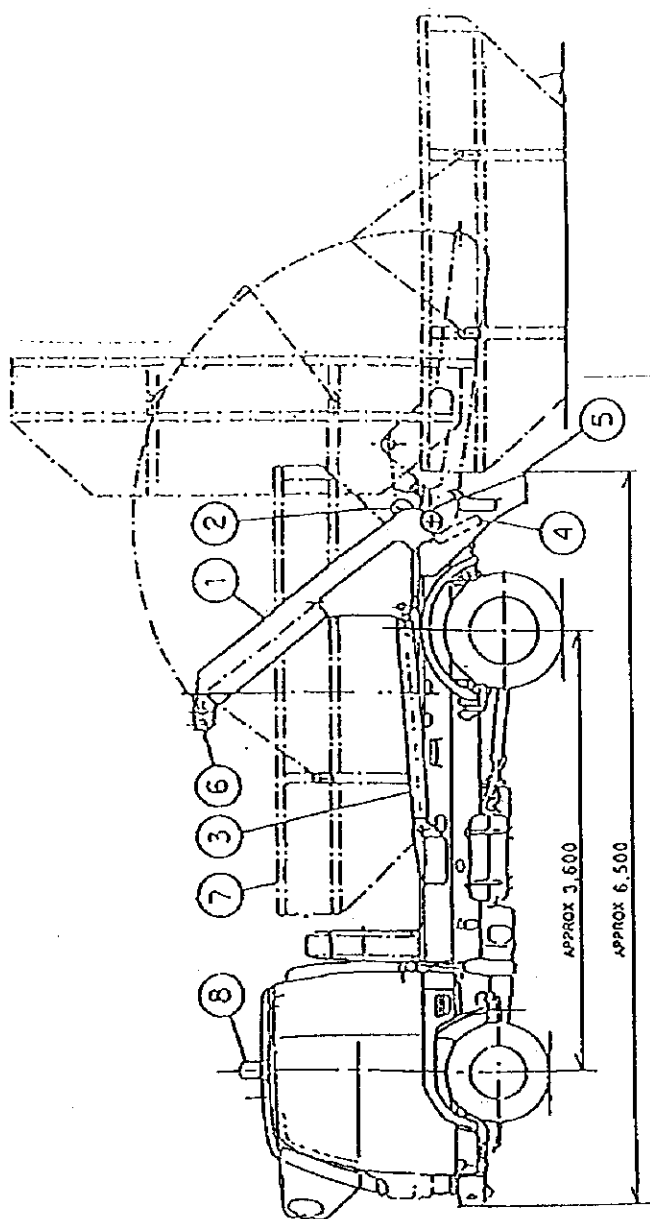
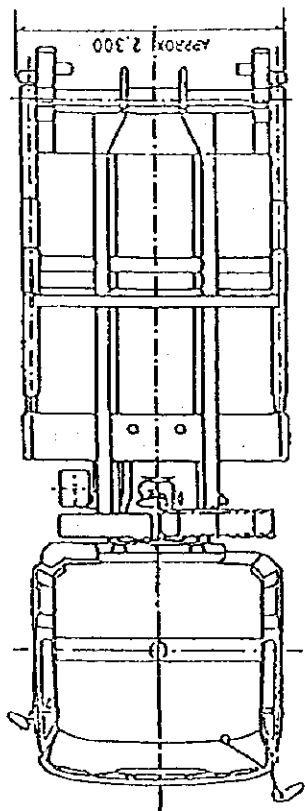
Drawings No.	Title
CSW-01	8m <sup>3</sup> Compactor Truck



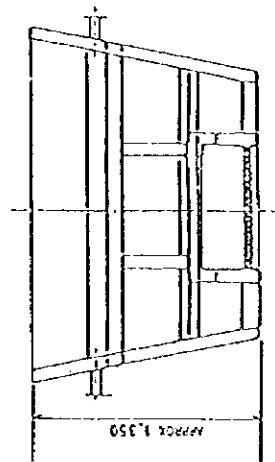
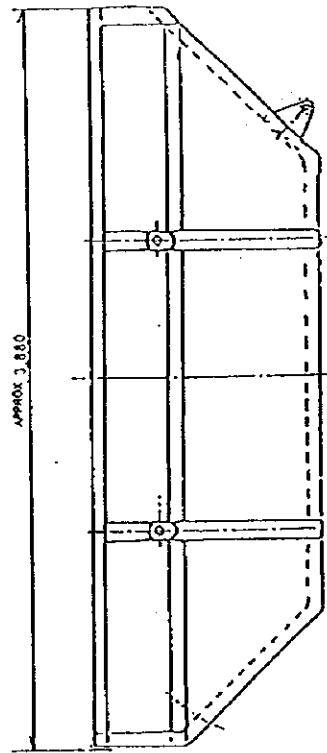
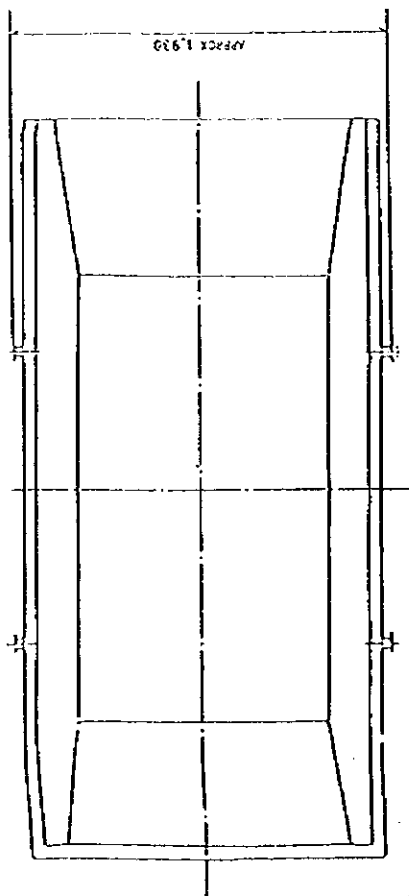
Drawings No.	Title
CSW-02	4m <sup>3</sup> Compactor Truck



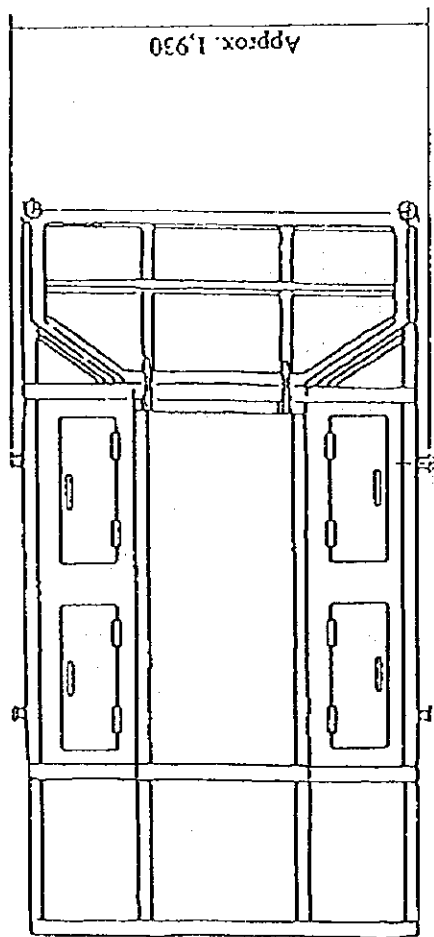
Drawings No.	Title
CSW—03	6m <sup>3</sup> Garbage Dump Truck



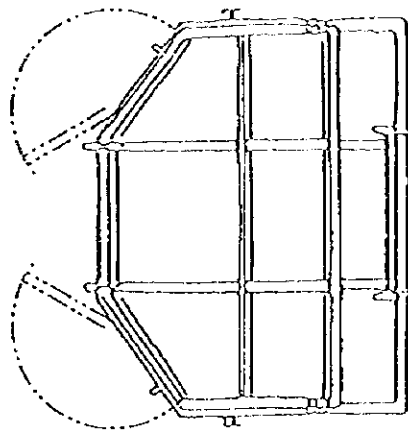
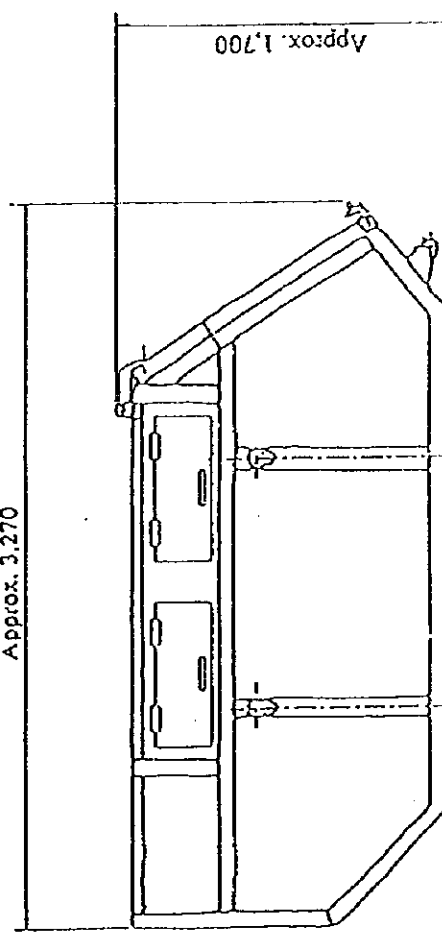
Drawings No.	Title
CSW-04	6m <sup>3</sup> Detachable Container Truck



Drawings No.	Title
CSW—05	Container (open type) for Detachable Container Truck

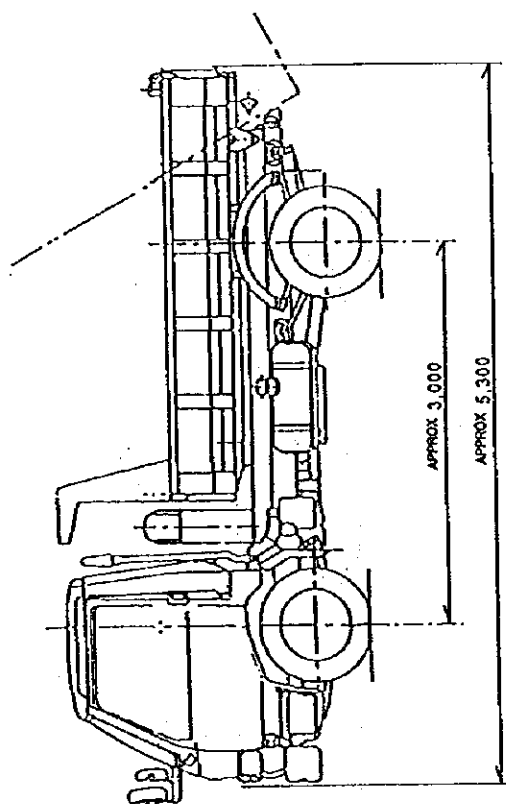
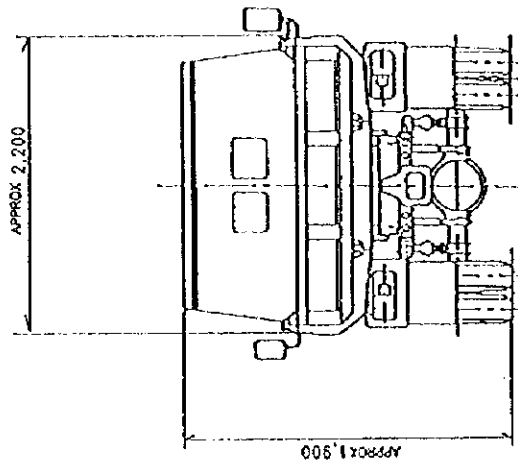


Approx. 3,270

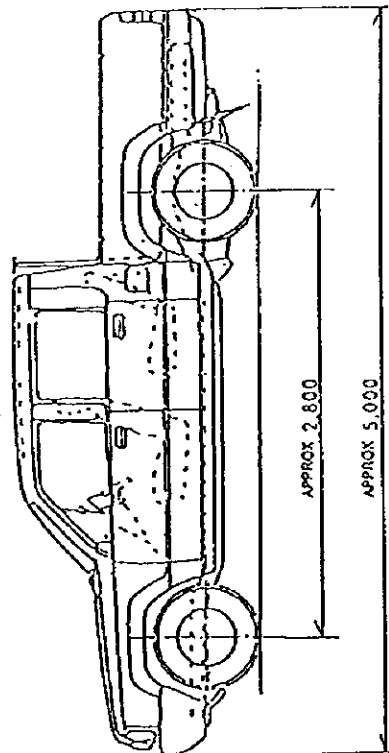
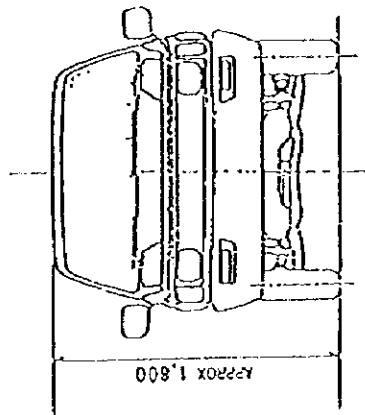
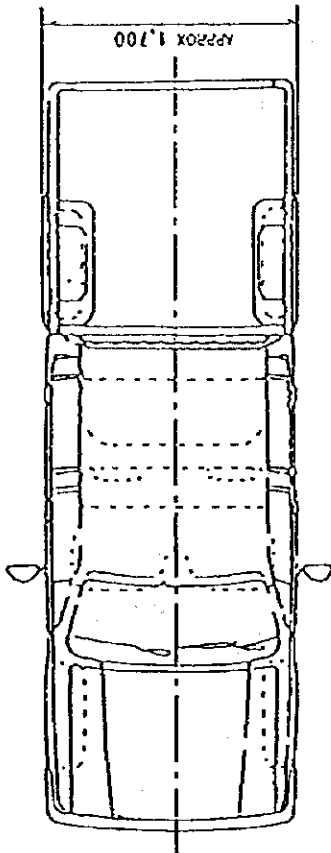


Drawings No.	Title
CSW--06	Container(closed type) for Detachable Container Truck

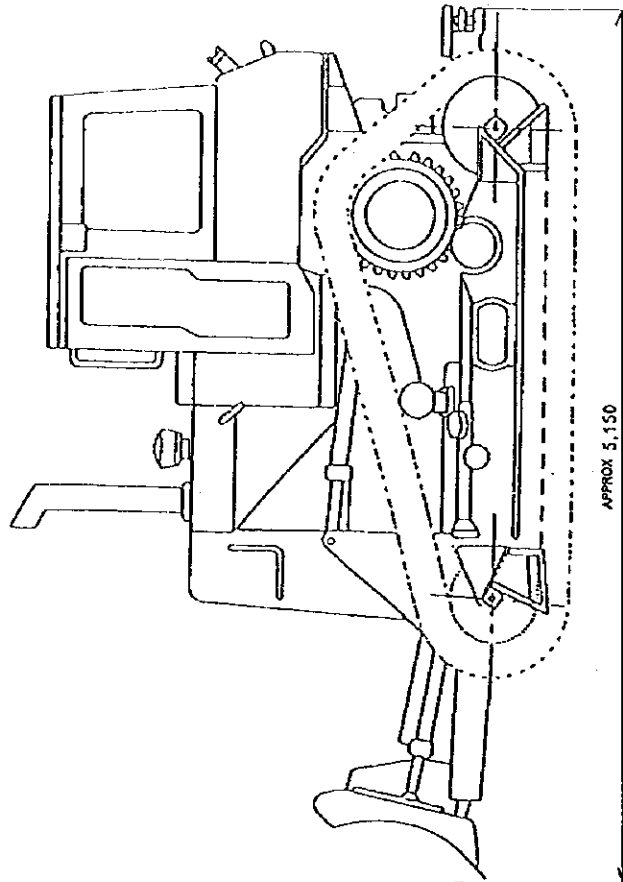




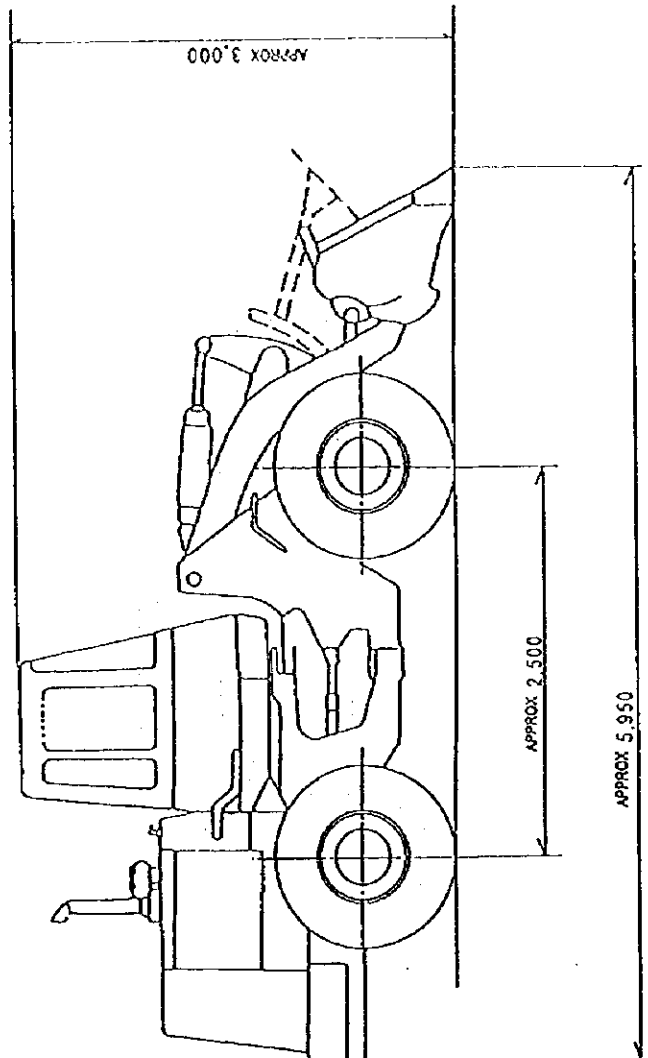
Drawings No.	Title
CSW-07	3.5ton Dump Truck



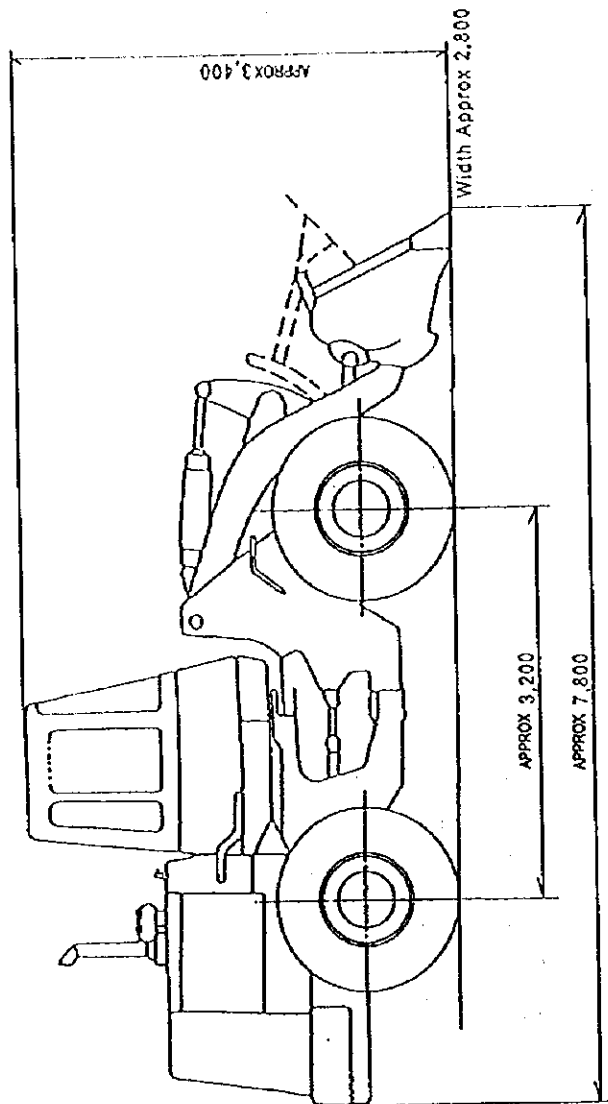
Drawings No.	Title
CSW-08	4WD Double Cab Pick Up



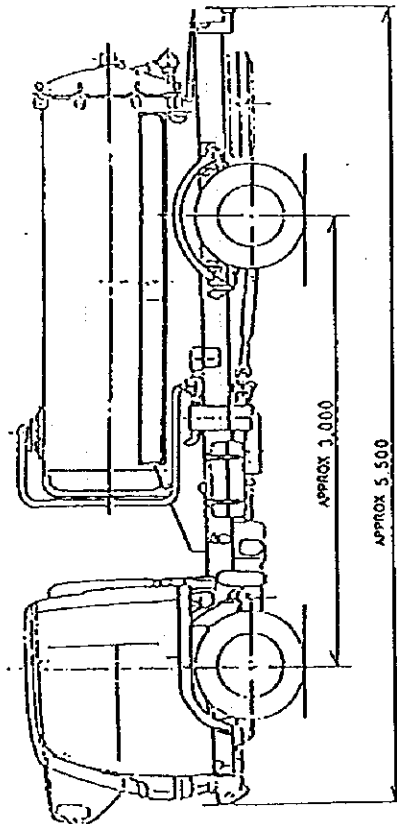
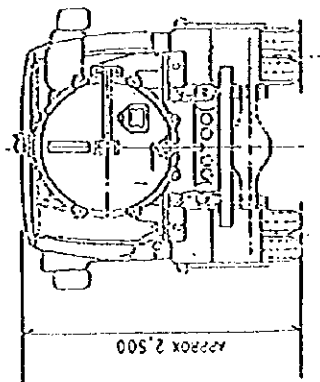
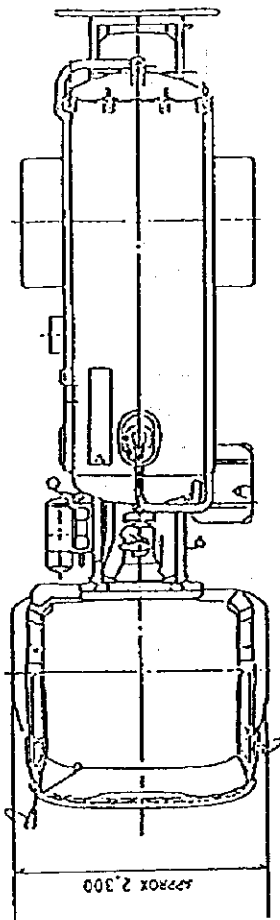
Drawings No.	Title
CSW—09	Bulldozer



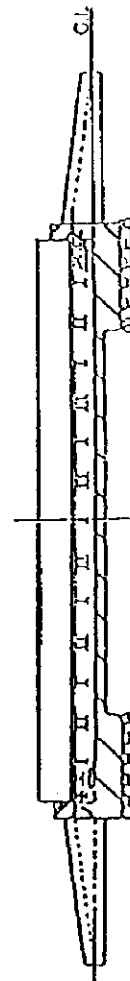
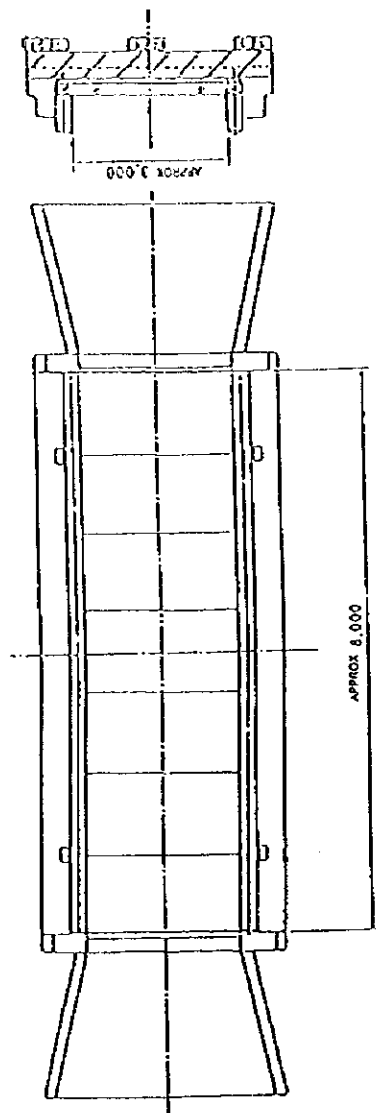
Drawings No.	Title
CSW-10	Wheel Loader ( 1m <sup>3</sup> Bucket )



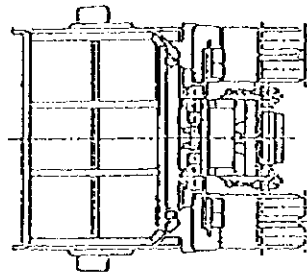
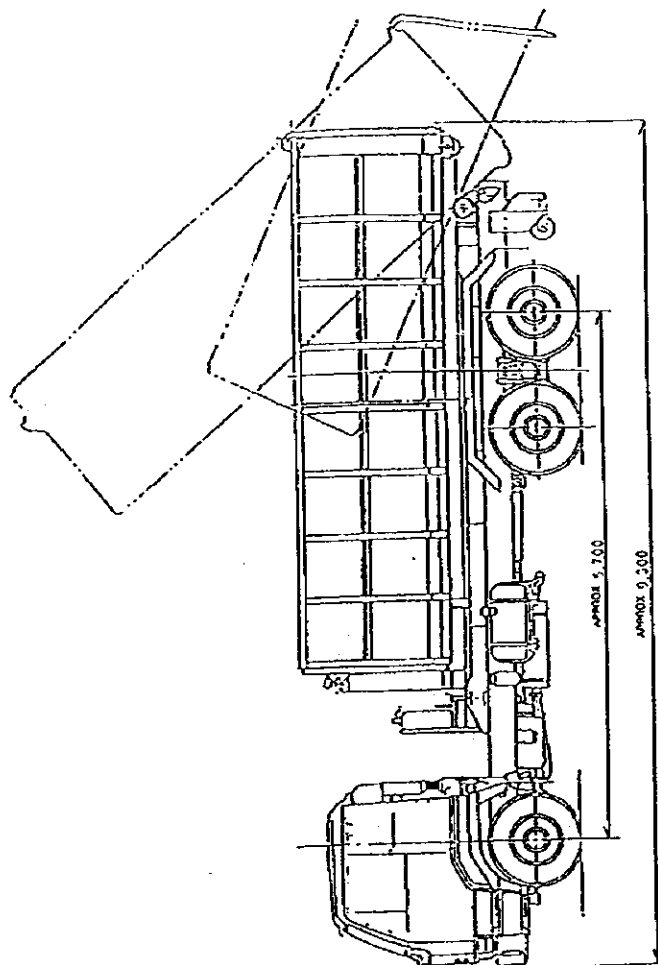
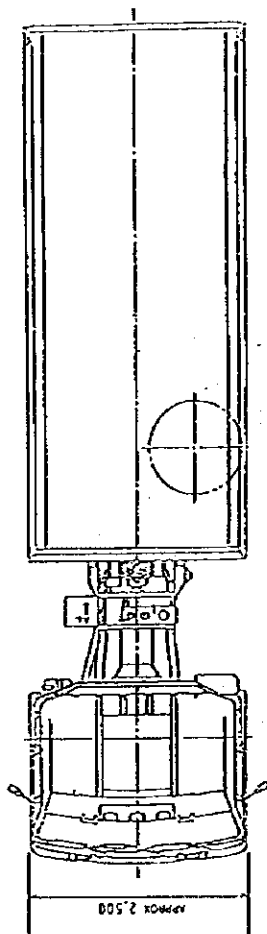
Drawings No.	Title
CSW-11	Wheel Loader ( 3m <sup>3</sup> Bucket )



Drawings No.	Title
CSW-12	Vacuum Tank Truck ( 3000lit )

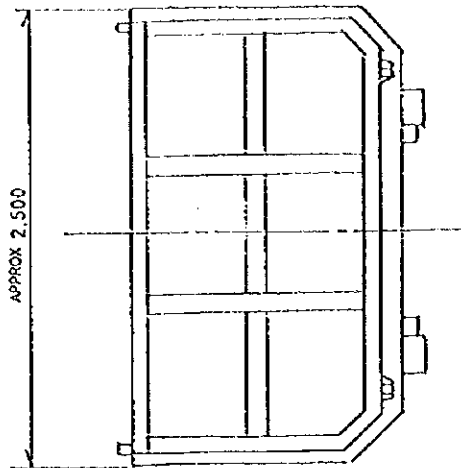
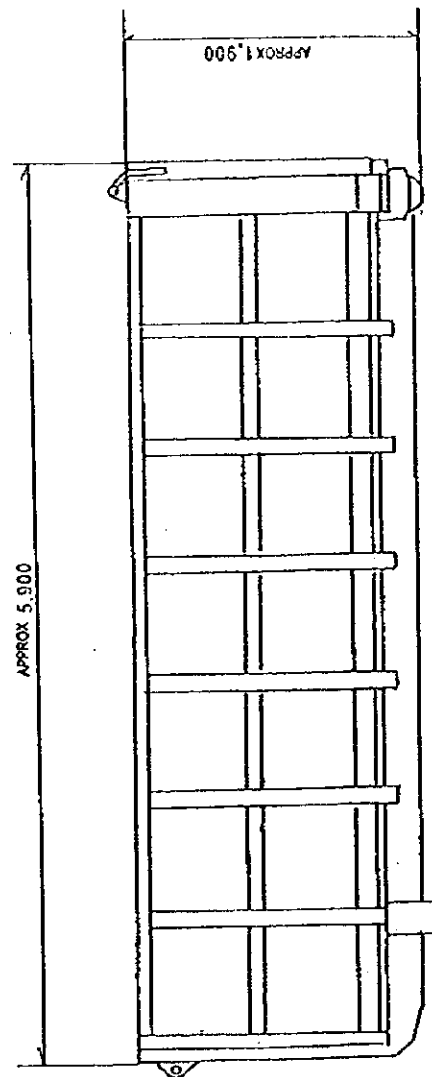


Drawings No.	Title
CSW-13	Weigh Bridge ( 40ton )



Drawings No.	Title
CSW-14	20m <sup>3</sup> Arm-Type Detachable Container Truck





Drawings No.	Title
CSW-15	20m <sup>3</sup> Container ( Arm-Type )

## **Chapter 3    Implementation Plan**



## **Chapter 3 Implementation Plan**

### **3.1 Implementation Plan**

#### **3.1-1 Implementation Concept**

The Project will be implemented within the framework of the Japan's Grant Aid System and will formally commence with the Exchange of the Notes (E/N) between both Japan and Sri Lanka governments upon approval of the Project by the Government of Japan. The Government of Sri Lanka will then select the Consultant (Japanese firm) to conduct the detailed design work for the vehicles and equipment. With the completion of the detailed design documents, the Contractor (a Japanese Firm) which is the successful bidder, will conduct the assigned work and supply the vehicles and equipment. The basic principles and points to note for the implementation of the Project are explained below.

##### **(1) Project Implementing Body**

The Responsible Agency of the Project on the Sri Lanka side will be Ministry of Provincial Council & Local Government and Western Provincial Council (WPC). Implementing Agency of the Project on the Sri Lanka side will be WPC and Dehiwala MC, Moratuwa MC, Kolonnawa UC, Kotte MC and Maharagama PS. It will be necessary for the Government of Sri Lanka to appoint a key person responsible for the implementation of the Project in order to maintain close communication and consultation of with the Japanese Consultant and the Contractor to ensure the Project's successful progress.

This key person must ensure that all the parties concerned of this Project by explaining and answering their questions, and provide all possible assistance for the smooth progress of the Project.

##### **(2) Consultant**

The Consultant (a Japanese firm) selected by the Government of Sri Lanka will enter into a design and work supervision agreement with the government of Sri Lanka to proceed to the equipment procurement stage of the Project. The consultant will prepare the detail design for the equipment to be procured under Japan's grand aid and will then supervise the procurement process. The Consultant will also prepare the tender document and will conduct the tender process on behalf of the Government of Sri Lanka.

### **(3) Contractor**

The Contractor, a Japanese firm, selected by open tender according to with the procedure of the Japan's grant aid system, will procure and supply the equipment. As the vehicles and heavy equipment will require the supply of spare parts and the provision of after-service in the case of breakdown following the completion of the Project, the Contractor should pay close attention to the need to establish communication links between the recipient side and the Contractor after the delivery of the equipment..

### **(4) Necessity of Dispatch Japanese Engineers**

This Project is a procurement of equipment consists of vehicles and heavy equipment for final disposal supplied to five local authorities in the CMA. Therefore, dispatch of engineer will not be necessary in principal.

As for Phase II, installation works for the weigh bridge including foundation and electrical wiring works will be required and it will be carried out by Sri Lanka side in accordance with detailed design drawing prepared by the manufacturer. It will be desirable to dispatch Japanese engineer of the Consultant to provide guidance and advice for the installation works. And it will be necessary to dispatch Japanese engineer of the Consultant to provide assistance and advice for improvement of existing disposal site and for proper operation of existing final disposal site. Also the Japanese engineer will monitor and follow-up the construction of Ratmalana transfer station and progress of Hanwella disposal site.

## **3.1-2 Implementation Conditions**

### **(1) Conditions of the Procurement in Sri Lanka**

Conditions of the procurement of vehicles and heavy equipment in Sri Lanka are as follows.

- ① There are no manufacturers of vehicles and heavy equipment in Sri Lanka.
- ② The market share of Japanese vehicle and construction machinery manufacturers is large and more than 70% of all registered automobiles in Sri Lanka in 1997.
- ③ There are several Agents of Japanese manufactures of vehicles and construction machinery. They have workshops for maintenance and repair of vehicles and equipment and can provide sufficient after-service.

## **(2) Point to Note**

- 1) The equipment to be procured in the Project is not manufactured in Sri Lanka. Therefore it shall be procured from Japan or third countries. It is desirable to choose vehicles and equipment commonly used in Sri Lanka and similar equipment used in Colombo MC considering proper maintenance and operation, and also training of staffs.
- 2) Transportation company in Sri Lanka have enough capability and experience to carry out the customs clearance and inland transportation of the vehicles and equipment within Sri Lanka.
- 3) Equipment shall be considered to use standardize vehicles as much as possible, in order to make easy operation and maintenance.

### **3.1-3 Scope of Works**

The division work between Japan side and Sri Lanka sides is as follows.

#### **(1) Works by the Japan Side**

- 1) Procurement of collection and haulage equipment
- 2) Procurement of equipment for removal of accumulated solid waste
- 3) Procurement of patrol equipment
- 4) Procurement of equipment for existing final disposal sites
- 5) Procurement of equipment for Ratmalana transfer station and transportation vehicle
- 6) Procurement of workshop equipment
- 7) Guidance on works done by the Sri Lanka side and weigh bridge installation works

#### **(2) Items to be Borne by the Sri Lanka Side**

- 1) Construction of workshop
- 2) Construction of garage
- 3) Improvement of existing final disposal sites
- 4) Construction of Ratmalana transfer station

### **3.1-4 Consultant Supervision**

According with the Japan's Grant Aid System, the consultant will organize a project team to conduct the detailed design and work supervision, taking all the basic design principals into consideration. At the work supervision, the consultant will also dispatch an engineer to advice for installation of weigh-bridge and for follow-up the works to be done by the recipient country.

### (1) Basic Principal of Consultant Supervision

The consultant will adopt the following principal to fulfill his responsibility to supervise and guide the Contractor in view of the punctual and safe completion of the Project related work within the planned period. The scope of work for the Consultant is shown in Table 3.1-1.

Table 3.1-1 Contents of Consultant Work in the Project  
(conducted in each phase)

1.	Pre-supply stage	Detailed design study Preparation of tender documents Acting execution of tender Evaluation of tender results Contract work assistance
2.	Supply stage	Consultant supervision Inspections Report preparation, etc.

#### 1) Schedule Control

- a) The Consultant shall ensure that the Contractor always checks the progress of manufacture and delivery of the equipment against the original plan to ascertain the state of work progress.
- b) The consultant shall control each work item on a monthly basis so that the Contractor adheres to the contracted work schedule.

#### 2) Quality Control

- a) The Consultant shall confirm that the specifications and quality of equipment and materials meet to requirement specified in the detailed design documents.
- b) The Consultant shall witness the quality inspections and various performance tests in connection with the equipment to be procured at the completion of manufacturing work.
- c) The Consultant shall provide advice and guidance in Sri Lanka for works to be done by the recipient country. The Consultant shall advice and guide for improvement of existing final disposal site, construction of Ratmalana transfer station and the proper installation of the weigh bridge.

### (2) Work Supervision System

The system to supervise the actual work of procurement process and the involvement of the related organization are shown in Figure 3.1-1.

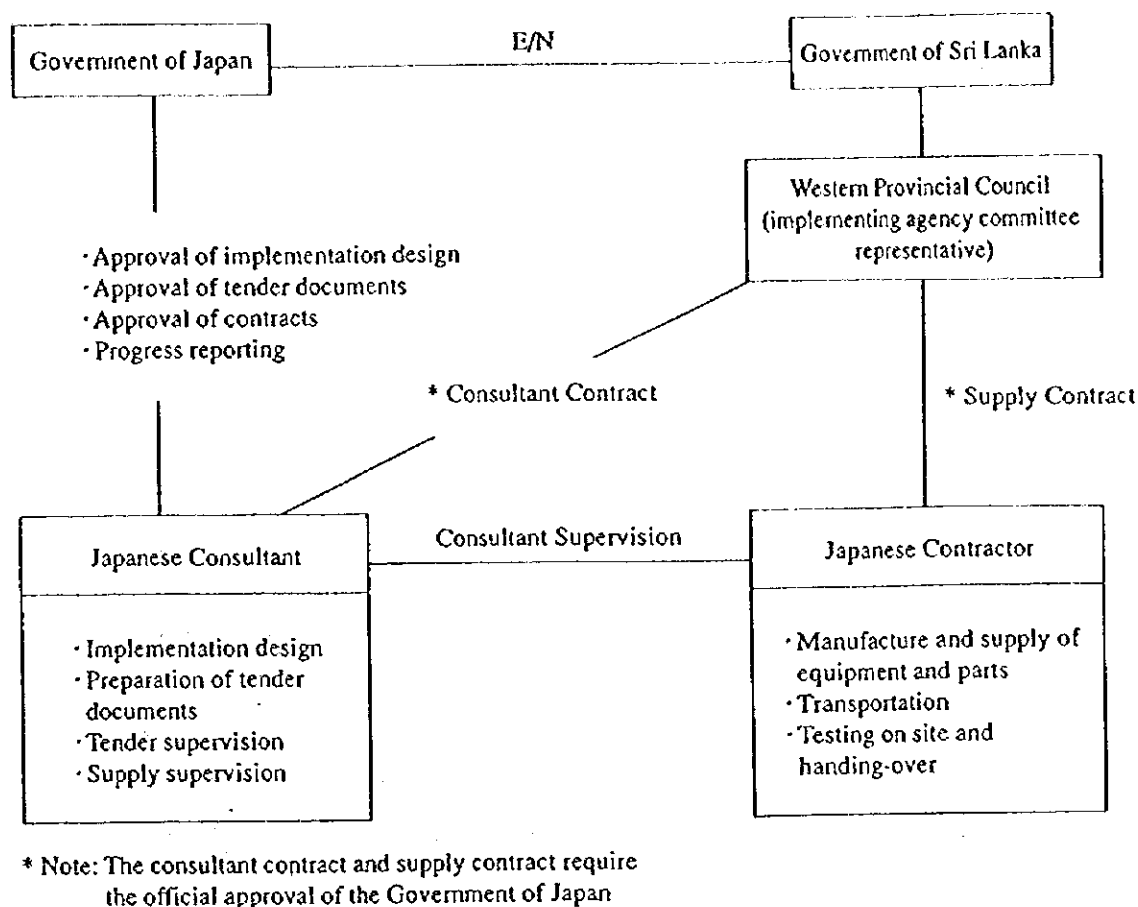


Fig.3.1-1 Project Implementation Relationship Chart

### 3.1-5 Procurement Plan

Since the vehicles and equipment to be procured under this Project are not manufactured in Sri Lanka, the equipment will be procured from Japan taking into consideration of all the required standards, specifications, quality, stable supply, production volume and supply stability, delivery time and ease operation and maintenance.

Concerning spare parts of equipment, these shall also be procured from Japan.



### **3.1-6 Implementation Schedule**

In the case that the Project is extended to the implemented stage with grant aid provided by the Government of Japan, the actual procurement of each phase will be conducted in three stages following the signing of E/N, i.e., (1) preparation of detail design documents; (2) tender process and signing of the contract, and (3) actual procurement.

#### **(1) Detailed design**

As soon as the E/N has been signed, the Japanese Consultant will conclude a consultant agreement with Sri Lanka side and will commence the detailed design work. Based on the Basic Design Study findings and the Detailed Design Study findings, the tender document (specifications and detail design drawings) will be prepare. At the beginning and end of the detailed design stage, the Consultant will have thorough discussions with Sri Lanka side and will then proceed to the tender process upon approval of the documents by both governments. Detailed design work is estimated to take two months in Phase I and one month in Phase II.

#### **(2) Tender and Contract**

The consultant will announce the tender, hold a tender explanation meeting and distribute the tender documents to the prospective bidders on behalf of the Government of Sri-Lanka. Upon receipt of bid prices and application documents, the Consultant will promptly examine them to facilitate the contract between the Government of Sri-Lanka and Japanese contractor. The tender will be witnessed by all applicants and representatives of related organizations. If the contents of the bid with the lowest price are assessed as being appropriate, the bid will be accepted and the bidder will conclude a contract with the Government of Sri-Lanka.

The time required from tender announcement to signing of the procurement contract is expected to be 1.0 months.

#### **(3) Procurement of Equipment**

Following signing of the procurement contract and its official approval by the Government of Japan, the contractor will commence the procurement work. It is predicted that, considering of the size of this Project, Phase I will take 8.5 month and Phase II will take 6.5 month, if procurement of equipment is smoothly carried out.

The consultant will conduct detailed arrangements prior to the commencement of the procurement work, and supervise the Contractor in regard to the manufacturing, transportation of equipment and work schedule, etc. The Consultant will also enforce schedule control, as well as quality control, in order to completes the entire work within the period stipulated in the E/N. The Project implementation schedule is shown in Table 3.1-2.

Table 3.1-2 Project Implementation Schedule

Phase I

	1	2	3	4	5	6	7	8	9	10	11
Implementation Design	(Field survey)	(Work in Japan)	(Field confirmation)								
									(Total 2.0 months)		
Supply Work	(Supple preparation)						(Equipment procurement)				
								(Transportation)			
								(Acceptance and inspection)			
		(Total 8.5 months)									

Phase II

	1	2	3	4	5	6	7	8	9	10	11
Implementation Design	(Field survey)	(Work in Japan)	(Field confirmation)								
									(Total 1.0 month)		
Supply Work	(Supple preparation)					(Equipment procurement)					
							(Transportation)				
							(Acceptance and inspection)				
		(Total 6.5 months)									

### **3.1-7 Work to be Undertaken by Recipient Country**

The items to be undertaken by the Sri Lanka side are as follows:

- 1) to provide necessary data and information for the Project;
- 2) to construct a garage and repair workshop to act as storage and maintenance sites for the equipment supplied under the Project;
- 3) to improve existing final disposal sites;
- 4) to construct Ratmalana transfer station and install the weigh bridge there;
- 5) to carry out proper earth covering (existing final disposal sites) using the supplied equipment;
- 6) to secure a budget for operation and maintenance following Project implementation;
- 7) to secure personnel to operate and maintain the equipment supplied under the Project;
- 8) to maintain properly and effectively the equipment supplied under the Project;
- 9) to take measures for the prompt unloading and customs clearance in Sri Lanka of the equipment supplied under the Project;
- 10) to ensure tax exemptions and provide necessary conveniences for the equipment supplied and Japanese nationals dispatched under the Project;
- 11) to ensure customs duty and business tax exemptions for the equipment supplied under the Project;
- 12) to bear payment commissions and expenses for opening an account with a Japanese foreign exchange bank; and
- 13) to bear all expenses other than those covered by the Grant, necessary for the execution of the Project.