

REPUBLIC OF GUATEMALA  
MUNICIPALITY OF GUATEMALA  
THE STUDY ON SOLID WASTE MANAGEMENT  
IN METROPOLITAN AREA OF GUATEMALA CITY

FINAL REPORT  
VOLUME I SUMMARY

SEPTEMBER 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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## PREFACE

In response to a request from the Government of the Republic of Guatemala, the Government of Japan decided to conduct a study on Solid Waste Management in Metropolitan Area of Guatemala City and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Guatemala a study team headed by Mr. Michio Sakamoto, CRC Research Institute, Inc. and composed of members from CRC Research Institute, Inc. and Environmental Technologic Consultant Co., Ltd., three times between June, 1990 and July 1991.

The team held discussions with the officials concerned of the Government of Guatemala, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

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 Republic of Guatemala for their close cooperation extended to the team.

September, 1991



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Kensuke Yanagiya

President

Japan International Cooperation Agency

Mr. Kensuke Yanagiya  
President,  
Japan International Cooperation Agency  
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir:

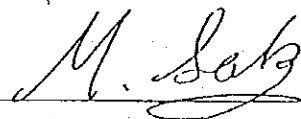
We have the pleasure of submitting to you the final report on the solid waste Management in Metropolitan Area of Guatemala City. This report has been prepared with a view to contributing toward the solid waste management to solve the growing problem of waste in the Metropolitan Area.

The purpose of the survey was to improve public health and preserve the local environment through establishing the Solid Waste Management in the Metropolitan Area of Guatemala City, (which covers the entire city of Guatemala and portions of five adjacent cities). Toward this objective, the Study Team conducted various surveys between June 1990 and September 1991, and gathered the results together in a four-volume report.

Through the surveys, it was concluded that organizational improvement of Guatemala City's public cleansing department, substitution of equipment, and training and guidance for private collectors would be indispensable to the solution of the Solid Waste problem in the Metropolitan Area of Guatemala City. Through these steps, Solid Waste collecting service would be improved as would the state of environmental sanitation in the landfill site. In this connection it is recommended that cooperation and assistance should be extended to the Solid Waste Management from the high ranking officers of the Municipality and related organizations, and a cooperative system should be established among the residents.

In submitting this report, all members of the Study Team would like to thank the personnel at your Agency, the Advisory Committee, Ministry of Foreign Affairs, and the Japanese Embassy in Guatemala as well as officials and individuals of the Municipality of Guatemala for their assistance and cooperation.

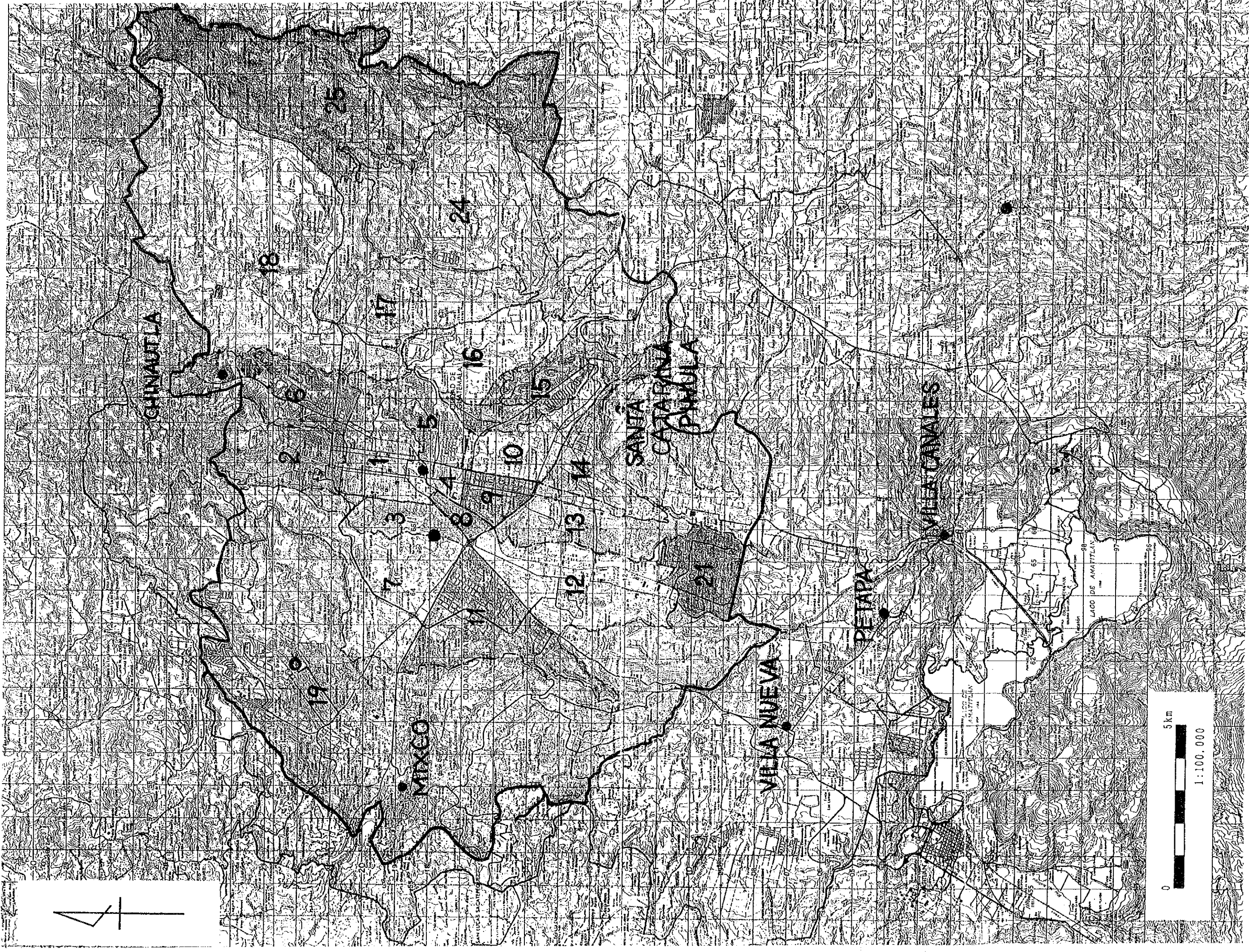
September 1991



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NORIO SAKAMOTO

Team Leader



Study area



## **PRINCIPAL FEATURES OF THE PLAN**





1. Master Plan

1.1 Planning Conditions

(1) Planning period

Until the year 2000

(2) Population

In 1990, 1,532,000, and 2,047,000 in the year 2000

(3) Types of solid waste

Solid waste not including hazardous materials

(4) Annual increase of real GDP

From 1990 to 1995 4%, and 3% from 1996 to 2000

(5) Dual collection system

Maintain and promote the dual collection system of municipal and private collectors during the period until the year 2000.

(6) Recycling and resource recovery

Continue and promote the sanitary recovery of certain parts of the collected solid waste during the period until the year 2000.

(7) Community participation

It is indispensable to count on the support of the community.

## 1.2 Target

The targets of the Master Plan are set as follows:

- (1) Increase the actual service coverage rate for collection of domestic solid waste from the actual 53% to 86% by the year 2000.
- (2) Immediately improve the sanitary and environmental conditions of the "El Trebol" disposal site, converting it into a controlled landfill.
- (3) Augment the existing landfilling capacity by initiating the construction of a new sanitary landfill.
- (4) Carry out the concession program for private collectors in 100% of easy collection area, and complete this process by the year 2000.
- (5) Establish a preventive maintenance and repair program for collection vehicles and other equipments, and maintain their constant operation rate of 90% to improve the collection productivity, sweeping efficiency and final disposal operation.
- (6) Reduce the number of clandestine open dumping sites through the above-mentioned 5 measures.

### 1.3 Recommended Implementation Schedule

<u>Program number</u>	<u>Program (What)</u>	<u>Responsibility (Who)</u>	<u>Schedule When)</u>
1.	Expansion of collection service	DLP/Private collectors/ MAM	1992-2000
2.	Improvement of the "El Trebol" disposal site	DLP	1991-1992
3.	Construction of a new sanitary landfill	DLP	1994-2000
4.	Concession of collection service to private collectors	DLP	1992-2000
5.	Preventive Maintenance Program	DLP	1991-1992
6.	Educational and community participation program	DLP	1991-2000
7.	Personnel training program	Municipality	1991-2000
8.	Recycling and resource recovery programs	DLP	1992-2000
9.	DLP Institutional development	Municipality	1992-1993
10.	Initiation of CMDS Activities	Municipality/ MAM	1992

DLP = Public Cleansing Bureau;  
MAM = Municipalities of the metropolitan area;  
CMDS = Metropolitan committee in charge of solid waste

### 1.4 Benefits

As a result of the implementation of the proposed Program, the following benefits will be secured, i.e.,

- (1) Institutional and organizational support-systems necessary for the promotion of SWM (Solid Waste Management) will be properly established.

- (2) Collection services will be extended to currently non-served areas, including marginal areas, through zone concessions to private collectors and exchanges between ECA (Easy Collection Area) and PCA (Possible Collection Area), and through the increase of operational efficiency.
- (3) The existing final disposal site, "El Trebol", will be transformed into a controlled landfill within a short time. Through the observation of the improvement process of "El Trebol", consensus among residents to open a new additional sanitary landfill will mature.
- (4) Environmental and sanitary conditions in the metropolitan area will be preserved at a satisfactory level by the desirable promotion of public health and environmental protection.
- (5) Participation of residents in the Solid Waste Management (SWM) program will be implemented through community education and campaign about SWM.

## 2. Priority Projects

### 2.1 Identification of Priority Projects

Among the proposed programs in the Master Plan, the following 3 projects are recommended as the projects with high priority in view of possibility to generate great benefit.

- (1) Expansion of collection services particularly in marginal areas
- (2) Sanitary final disposal of solid waste through the immediate improvement of the "El Trebol" landfill, and the initiation, as soon as possible, of a new sanitary landfill.
- (3) Institutional development of municipal public cleaning services through reorganization and systematization of the dual collection services to effectively plan the management, operation, organization and financial aspects.

### 2.2 Proposed Programs

The programs proposed in the Master Plan are detailed as follows.

#### (1) Collection service

##### 1) Program number 1: Expansion of collection services

Increase the coverage of collection services in the marginal areas by generally increasing collection efficiency throughout the entire city.

Gradually extend private collection services to all ECA and PCA and begin to withdraw municipal



collection services, in a coordinated manner, from currently covered areas in order to extend services to marginal areas.

Under municipal guidance and supervision, implement appropriate systems to manage solid waste in isolated areas.

(2) Improvement of final disposal

1) Program number 2: Improvement of the "El Trebol" disposal site

Immediate improvement of the El Trebol disposal site to convert it into a controlled landfill. Within a period of four months after obtaining of the bulldozers, it would be possible to construct a slope that would allow access to the bottom of the gullies to be reached, and to initiate the technical construction of the landfill. Only in this way could the Municipality demonstrate to the residents, over the short term, the advantages of a sanitary landfill, and bring real awareness to the community. Furthermore, through this work the Municipality could ensure the confidence and trust of the residents, which is so important in works of this kind.

2) Program number 3: Construction of a new sanitary landfill

Given the above-mentioned facts, construction of the indispensable and absolutely necessary second Sanitary Landfill could begin in 1994. The best site for new sanitary landfill would be "Las Guacamayas".

(3) Institutional development

- 1) Program number 4: Concessions of collection service to private collectors

Beginning in 1992, gradually initiate the granting of concession zones to private collectors, and attempt to complete this concession process of 26 zones by the year 2000. The fundamental criteria for this process are: that the private collectors shall collect all the solid waste, which is generated within their area; that only currently existing private collectors shall be eligible to receive concessions; that municipal services shall be halted to avoid competing with private collectors in the areas granted by concession; and that the DLP shall supervise and control the process.

- 2) Program number 5: Preventive maintenance and repair program

Operate maintenance services under the direct administration of the DLP with all its equipment and begin a preventive maintenance program for the equipment.

- 3) Program number 6: Education and community participation programs

The strategy behind this fundamental program includes:

Dialogue with the public; community motivation via the proper means of communication, such as the video prepared through the Study and the effective presentation of the DLP's programs to the public. Initiate programs in schools and in marginal areas, such as those that have already been started

successfully by the DLPM.

4) Program number 7: Personnel training program

It will be necessary to implement a permanent training program on three levels for DLPM personnel and some other personnel transferred from other municipal departments.

The training for managerial levels requiring participation in service entities outside the country and the middle level requiring training through short local courses and the operative level requiring training through actual work sessions.

5) Program number 8: Recycling and resource recovery program

Promote recycling and resource recovery of the various material sanitarily in the solid waste, passing from the present recovery rate 5% to 8% by the year 2000, with the following measures: increase the recovery before collection by the private collectors and the recovery which the private collectors execute; and discourage the recovery in "El Trebol", orientating so that the actual scavengers may formalize their work through the previously mentioned methods.

6) Program number 9: Institutional organization of the DLP

The executing agency proposed to administer and execute all the programs previously indicated shall be the Public Cleansing Bureau (DLP), a municipal department into which the current DLPM shall be transformed. The operational efficiency is improved without increase of personnel; and it is

recommended to establish a Working Group to facilitate this process of transition.

7) Program number 10: Initiate CMDS Activities

Regulate, supervise and coordinate the planning and finance of metropolitan sanitary landfills, and other matters related to municipal services via the CMDS.

CMDS = Metropolitan Committee in charge of solid waste

(4) Strengthening of finance

Capital costs, which will be required for the purchase of equipments and machines, and civil construction at the landfill sites, will depend on foreign assistance, such as donations and soft loans. Additional operating costs, which will be required for the maintenance of equipments and machines and the procurement of covering soil will be provided by an increase of the SWM budget. The municipality will be able to increase the SWM budget through new revenues to be obtained by charging some fees on the cleansing services implemented by the DLP.

2.3 Feasibility

(1) Socio-economic aspects

- 1) The proposed programs will be financially feasible as a result of the increase of municipal revenues and the SWM budget, and acquisition of international donations.

- 2) The concession process can stabilize the business of private collectors by eliminating excessive competition among them resulting in the increase of their collection amounts.

(2) Institutional aspects

- 1) The institutional organization will be realized without increase of bureaucracy.
- 2) The proposed organizational restructuring is realistic and will be possible to be implemented immediately since the change is required only within the same municipality.
- 3) It will ensure the continuity, improvement and extension of the coverage of collection services, especially in marginal areas after relations with private collectors have been formalized.
- 4) It will improve the efficiency of services once an evaluation and planning system has been established.
- 5) The long-term strategy established by the Master Plan will facilitate a study of possible sites for future sanitary landfills.
- 6) The implementation of education and community participation program with high priority will lead to permanent benefits, including the reduction in the cost of services.
- 7) Economies of scale at the metropolitan level will be achieved in final disposal and private collection services.

- 8) The proposed institutional re-organization can be carried out without causing social problems.

(3) Technical aspects

- 1) Solid waste management plan up until the year 2000 is established based on the use of two landfills including the opening of a new landfill.
- 2) The plan will increase the efficiency of waste collection and transport by use of the two landfill sites decreasing of clandestine open dumping.
- 3) "El Trebol" disposal site will be improved by converting it to a controlled landfill.
- 4) Las Guacamayas new landfill will be opened using sanitary landfill system.
- 5) Promotion of community participation will facilitate the improvement of collection process.

(4) Environmental aspects

- 1) Urban environment will be improved by the decrease of clandestine open dumping and the community participation.
- 2) The opening of "Las Guacamayas" new landfill will improve traffic conditions around "El Trebol" area.
- 3) Environmental improvement will be achieved by converting "El Trebol" disposal site to a controlled landfill.
- 4) Erosion problem and present clandestine open dumping at "Las Guacamayas" gully will be prevented by opening a new sanitary landfill site at "Las

Guacamayas".

(5) Overall evaluation

Improvement of collection service coverage in marginal areas is feasible if private collectors are granted concessions in areas where collection is comparatively easy, and if the city organization and equipment in areas where collection is possible are improved. A new sanitary landfill site can be acquired if residents notice a quick improvement of the "El Trebol" disposal site, and if the government can obtain their understanding necessary for the opening of a new sanitary landfill site.

Moreover, a systematic improvement of the city's cleansing services can also be realized with the cooperation of residents, private collectors and the central government as long as the highest authorities of the city make necessary decisions on the organizational and financial strengthening of solid waste management system.

Through these measures, the sanitary conditions of Guatemala City will certainly be improved and a healthy living environment will be assured.





## **CONTENT**





## CONTENT

PREFACE

STUDY AREA

PRINCIPAL FEATURES OF THE PLAN

### I. INTRODUCTION

1.	Background .....	1
2.	Objective .....	2
3.	Study Area .....	2
4.	The Organizational of Structure for the Study ....	2
5.	Report .....	3

### II. MASTER PLAN

1.	Basic Information .....	4
1.1	Characteristics of the Solid Waste .....	4
1.2	Population .....	4
1.3	Economics .....	4
2.	Present Situation of the SWM .....	6
2.1	Generation of Solid Waste .....	6
2.2	Service Coverage .....	9
2.3	Collection and Transport .....	11
2.4	Sweeping Service .....	13
2.5	Recovery of varuable resources .....	13
2.6	Final Disposal .....	15
2.7	Institutional Organization .....	16
2.8	Private Collection .....	17
2.9	Finance .....	19
2.10	Environmental Condition .....	20

3.	Actual Problems .....	22
4.	Goals and Targets .....	23
4.1	Goals .....	23
4.2	Targets .....	23
5.	Planning Condition .....	24
5.1	Population .....	24
5.2	Economic Growth .....	25
5.3	Land Use .....	25
5.4	Amount of Solid Waste Generation .....	25
6.	Selection of a New Sanitary Landfill Site .....	27
6.1	The Necessity of the Opening of a New Landfill .....	27
6.2	The Procedures for Site Selection .....	27
6.3	Evaluation .....	27
6.4	Environmental Conservation .....	28
6.5	Public Opinion .....	29
6.6	Strategy for Opening a New Landfill .....	30
7.	Institutional Development .....	31
7.1	Institutional Development .....	31
7.2	Concessions to Private Collectors .....	32
7.3	Personnel Training .....	33
7.4	Community Education and Participation .....	34
7.5	Equipment Maintenance .....	35
8.	Operational Planning .....	37
8.1	Collection and Transport .....	37
8.2	Planning of Final Disposal .....	39

9.	Financial Planning .....	43
9.1	Cost Estimation .....	43
9.2	Case Study .....	43
9.3	Necessary Budget .....	44
10.	Program for the Implementation of the Master Plan .....	45
10.1	The Main Constituent of the Project .....	45
10.2	Implementation Plan .....	45
10.3	Financial Plan .....	46

### III. FEASIBILITY STUDY

1.	Identification of Priority Projects .....	48
2.	Pilot Test .....	49
2.1	Container experiment .....	49
2.2	Video Program .....	50
2.3	Preventive Maintenance Experiment .....	51
3.	Collection in Marginal Areas .....	53
4.	Final Disposal Site .....	57
4.1	Improvement of the "El Trebol" Disposal Site .	57
4.2	Plan for the Construction of a New Disposal Site at "Las Guacamayas" .....	59
5.	Institutional Development .....	61
5.1	Proposed Organizational Structure .....	61
5.2	Concessions to Private Collectors .....	64

6.	Finance .....	66
6.1	Cost Estimation .....	66
6.2	Necessary Budget .....	66
6.3	New Revenue Sources .....	66
7.	Assessment of the Proposed Project .....	68
7.1	Socio-Economic Aspects .....	68
7.2	Institutional Aspects .....	68
7.3	Technical Aspects .....	69
7.4	Environmental Aspects .....	71
7.5	Overall Evaluation .....	72
8.	Implementation Program .....	74
8.1	Solid Waste Collection in Marginal Areas .....	74
8.2	Improvements in Final Disposal .....	74
8.3	Improvement of the Organizational System and Financing .....	75

### Appendix

#### The Organizational Structure and Members for the Study

## LIST OF TABLES AND FIGURES

### LIST OF TABLES

Table 1	Classified Solid Waste Generation (1990) .....	7
Table 2	Solid Waste Composition (1990, 1991) .....	8
Table 3	Solid Waste Chemical Content (1990, 1991) ...	8
Table 4	Solid Waste Amount Collected in 1990 .....	12
Table 5	The Number of Scavengers .....	14
Table 6	Future Population Projection by Municipalities in the Study Area .....	24
Table 7	Results and Forecast of Population by Areas and Solid Waste Quantity .....	26
Table 8	Classification of Collection Area .....	38
Table 9	Costs for Final Disposal .....	42
Table 10	Implementation Schedule (1990 - 2000) .....	47
Table 11	The Plan for Vehicle Replacement .....	56
Table 12	Implementation Schedule (1991 - 1996) .....	76

### LIST OF FIGURES

Fig. 1	Division of Collection Zones in 1990 .....	10
Fig. 2	Chart for the Public Cleansing Bureau, DLP ..	62
Fig. 2A	Chart for the Public Cleansing Division, DLP .....	63
Fig. 3	The Organization Structure for the Study .....	78



## ABBREVIATION

APT	Food for Work
BANVI	The National Housing Bank
BOD	Biochemical Oxygen Demand
CACM	Central American Common Market
CMDS	Metropolitan Solid Waste Committee
COITRAMBA	Integral Cooperative for Special Services of Motorized Transportation of Solid Wastes
CPI	Consumer Price Index
DLP	Public Cleansing Bureau
DLPM	Municipal Public Cleansing Department
ECA	Easy Collection Area
EDOM	Study on Metropolitan Regulations
EMPAGUA	Municipal Water Supply Corporation of Guatemala City
GDP	Gross Domestic Product
GNP	Gross National Product
GT	Working Group
IA	Isolated Area
INE	Institution of National Statistics
JICA	Japan International Cooperation Agency
JST	JICA Study Team
MP	Master Plan
PCA	Possible Collection Area
PLAMABAG	Master Plan on Water Supply of Guatemala City
Q	Quetzal (Guatemala's Monetary Unit)
SEGEPLAN	National Economic Planning Agency
SW	Solid Waste
SWM	Solid Waste Management
F/S	Feasibility Study



# **I. INTRODUCTION**





This study was conducted during the period from June 1990 to September 1991, and the Master Plan was prepared for the Solid Waste Management in Metropolitan area of Guatemala City. At the same time, the feasibility of priority projects was confirmed.

The background and objective of the study are explained below.

## 1. Background

The Constitution of Guatemala stipulates that the national and municipal governments establish policies to improve public health and to preserve the environment, and that municipalities must be responsible for cleansing services.

Thus, there exist the regulations on cleansing service including penal provisions for clandestine open dumping. However, they are not enforced because the actual management cleansing service is carried out based on custom.

The cleansing service by the Municipality of Guatemala does not catch up with drastic increase of population in recent years. As a result, unhealthy conditions such as disappearance of the natural beauty in the City, and environmental problems both inside and outside the final disposal site have arisen. Therefore, urgent countermeasures are necessary for the improvement of present conditions. Sufficient results have not been obtained, however, due to technical and financial limitations.

Under these conditions, the preparation of a Master Plan for Solid Waste Management in the Metropolitan Area of Guatemala City and the implementation of priority projects are of the utmost importance.

## 2. Objective

To contribute to the development of the Systematic Management of the Solid Waste in the Metropolitan Area of Guatemala City with a view to improve and safeguard the public health and to protect the quality of environment by the year 2000. At the same time, to effect the technical transfer to the counterpart of the Municipality of Guatemala through the studies.

## 3. Study Area

The Metropolitan Area of Guatemala City, the subject of the present study, extends over 350 km<sup>2</sup> and includes Guatemala City and partially the areas which are considered geographically as an integral area together with Guatemala City, the urban areas of the five neighboring municipalities: Mixco, Villanueva, Chinautla, Villa Canales and Sta. Catarina Pinula.

## 4. The Organizational Structure for the Study

On Guatemalan side, the Municipality of Guatemala is the responsible agency of this study, and the Steering Committee consisting of the authorities concerned was formed.

JICA established the Advisory Committee for the technical assistance to JST. The members of JST, the Counterpart, the Steering Committee of the Republic of Guatemala and the JICA Advisory Committee are shown in the appendix.

## 5. Report

The reports of this study consist of the four parts.

- Part 1     Summary Report
- Part 2     Main Report
- Part 3     Supporting Report
- Part 4     Data File



## II. MASTER PLAN





## 1. Basic Information

### 1.1 Characteristics of the Solid Waste

This Master Plan considers the solid waste generated within the area of the study. Specifically, this includes domestic waste, solid waste from the various markets, waste collected by cleansing of streets and public areas, as well as waste from gardens. Obviously, the management of hazardous waste is not the subject of this study.

### 1.2 Population

According to estimates realized by the INE (Institution of National Statistics), the Metropolitan Area of Guatemala City had a population of 1,711,000 inhabitants in 1990, and the annual rate of population increase for the period from 1981 - 1991 was estimated to be 4.8%. The population falling within the area of Master Plan in 1990 was calculated to be 1,532,000 inhabitants.

### 1.3 Economics

- (1) Guatemala's GDP has been growing at 4% per annum since 1988.
- (2) Although the Consumer Price Index (CPI) has been increasing at an average of 18% per annum since 1983.
- (3) The unemployment rate has remained steady at 36% since 1985. It is necessary to raise the level of education and promote industrialization in order to create more jobs and reduce unemployment rate.
- (4) Guatemala's national revenues are small, because of its relatively light tax burden. However, in 1987, the Central Government adopted a tax reform package that included income tax rates, property taxes, a 4%

surcharge on imports and other tax charges.

- (5) Agriculture and commerce have traditionally been the main industries and have accounted for 51% of the GDP. Manufacturing accounts for 15% of the GDP.
- (6) Guatemala's exports are coffee, sugar and bananas, while its imports are consumer and capital goods, and raw industrial materials. The trade balance has shown a deficit in recent years. Guatemala's currency has been depreciated against the U.S. dollar since 1985 and was Q5/\$ as of February 1991.

## 2. Present Situation of the SWM

### 2.1 Generation of Solid Waste

According to two waste sampling and analysis tests, carried out between July and October 1990 (the rainy season) and between January and March 1991 (the dry season), and based upon 892 samples classified by social classes, i.e., upper, middle, lower and slum classes, the weighted mean of generation and the arithmetic mean of bulk density were 0.5423 kg per capita a day and 0.248 ton/m<sup>3</sup>, respectively.

The total generation amount 830 ton/calendar day of domestic waste has been calculated by multiplying the generation unit by the total population 1,532,000 in the study area in 1990. The following Table 1 shows the generation amount of the domestic solid wastes according to zones and social classes in the study area, and Table 2 & Table 3 show the characteristics of the domestic solid wastes.

Table 1 Classified Solid Waste Generation (1990)

Unit: Ton/Day

Zone	High x 0.767kg/C.D.	Middle x 0.564kg/C.D.	Low x 0.549kg/C.D.	Slum x 0.296kg/C.D.	Total
1	1.95	15.74	5.57	3.00	26.26
2	0.00	9.69	4.04	0.00	13.73
3	0.00	16.50	5.35	2.89	24.74
4	0.00	2.16	0.23	0.00	2.39
5	0.00	21.25	20.68	2.48	44.40
6	0.00	25.61	14.96	5.38	45.95
7	0.00	71.26	19.82	5.34	96.41
8	0.00	5.83	5.68	0.00	11.51
9	1.99	0.79	0.00	0.00	2.78
10	9.87	1.28	0.00	0.00	11.17
11	5.09	33.66	0.00	0.00	38.75
12	9.63	17.00	4.14	0.00	30.77
13	8.25	10.11	3.94	0.00	22.30
14	16.19	1.40	0.68	0.00	18.27
15	14.04	1.29	1.26	0.00	16.59
16	0.00	3.65	3.55	0.00	7.21
17	0.00	5.84	3.79	0.00	9.64
18	0.00	63.67	33.81	9.11	106.59
19	0.00	10.44	10.16	0.00	20.61
21	0.00	25.47	10.62	0.00	36.09
24	0.00	3.50	1.46	0.00	4.96
25	0.00	2.13	2.08	0.00	4.21
Mixco	12.61	64.92	63.19	24.34	165.05
Villa Nueva	0.00	13.15	12.80	0.00	25.96
Villa Canales	0.00	6.97	6.79	0.00	13.76
S.C. Pinula	0.00	7.87	2.55	0.00	10.42
Chinautla	0.00	8.18	11.94	0.00	20.11
Total	79.64	449.37	249.10	52.54	830.64

(Note) C.D: Capita per day

Table 2 Solid Waste Composition (1990,1991)

Unit: %

Item	Class	High	Middle	Low	Slum	Commercial	Market	Building	Super Market
Apparent Specific Weight(kg/l)		0.212	0.252	0.254	0.248	0.132	0.255	0.066	0.063
Garbage		59.7	62.4	63.8	67.4	32.7	82.9	8.3	1.7
Paper		15.4	14.6	14.2	11.7	38.7	10.3	74.1	73.9
Textile		4.9	1.8	2.4	5.4	5.8	0.5	0.4	1.3
Plastic		7.6	9.0	8.4	7.5	9.1	4.2	9.8	20.7
Glass		4.4	4.3	2.8	1.3	4.1	0.3	3.3	1.1
Wood, Coco, Leaves		0.1	0.9	2.1	0.5	1.7	0.3	2.2	0.3
Leather, Rubber		0.3	0.5	1.1	1.4	1.2	0.5	0.0	0.0
Metal		2.1	1.4	2.4	1.5	3.0	0.7	1.6	1.0
Stone, Ceramic		3.1	1.0	1.0	0.5	1.9	0.2	0.0	0.0
Others (Ash, Soil)		2.7	4.3	2.0	3.0	2.1	0.3	0.5	0.0

Table 3 Solid Waste Chemical Content\* (1990, 1991)

(Wet Base %)

Item	Class	High	Middle	Low	Slum	Commercial	Market
Water content %		66.5	69.1	59.4	52.5	47.5	65.3
Combustible matter %		27.3	25.9	34.8	33.9	46.0	27.3
Ash %		6.2	5.1	5.9	13.4	6.6	7.5
T-N as N %		1.32	1.46	1.40	1.32	1.59	1.28
T-C as C %		10.84	10.67	13.44	10.97	19.29	11.51
C/N ratio		8.62	7.46	10.18	8.25	12.58	9.06
Lower heating value (kcal/kg)		830	753	1,209	1,364	1,933	835

H = 45V-6w

H: Lower heating value (wet base)

V: Combustible content (%)

W: Water content (%)

\* Above samples do not contain noncombustible matter (glass, metal, stone, ceramic, etc.).



## 2.2 Service Coverage

Service coverage in 1990 was incomplete. The situation on the collection service coverage is as follows:

- (1) The percentage of the total population covered by the service is only 53%.
- (2) Collection percentages for the Easy Collection Area (ECA), the Possible Collection Area (PCA) and the Isolated Area (IA) are 76.4%, 17.8% and 0%, respectively. (rf. Fig. 1)



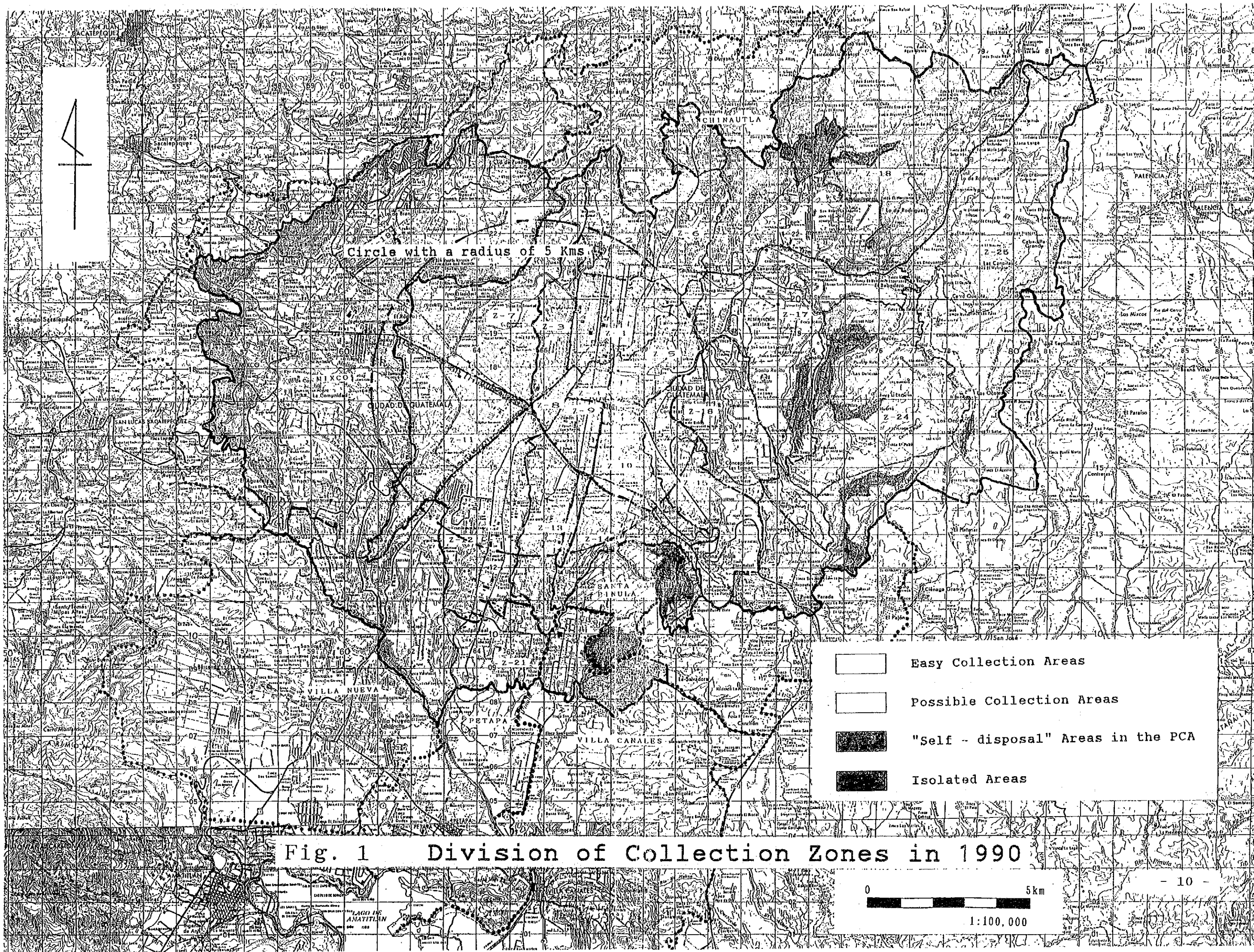


Fig. 1 Division of Collection Zones in 1990



- (3) Population still not covered in the ECA and the PCA is 223,000 and 311,000, respectively.
- (4) Collection services do not extend to low-income colonies and slums in marginal areas within the ECA.
- (5) 12% of the total population practices self-disposal.
- (6) In the PCA, 17.8% of the population's solid waste is actually collected, while 61.0% is not. The balance is self-disposed.
- (7) Solid waste collection and disposal systems are not planned at all in the IA.

### 2.3 Collection and Transport

- (1) Share of the work

The DLPM takes charge of collecting and transporting solid waste from markets, public facilities, including schools, hospitals and road sweeping, in addition to the Bell Service. Private collectors collect and transport domestic and commercial solid waste.

- (2) Solid waste amount collected and hauled in 1990

The amount of solid waste collected and transported by DLPM and private collectors is shown in the following Table 4.

Table 4 Solid Waste Amount Collected in 1990

(Unit: ton/workday)

Domestic waste	(513)	(41.4%)
Private	468	37.7%
(Recovered amount included)		
Municipal (Bell Collection)	45	3.7%
Non-domestic waste subtotal	(301)	(24.3%)
Markets and sweeping solid waste (municipal)	195	15.7%
Commercial waste (directly hauled)	106	8.6%
Construction and demolition waste (directly hauled)	426	34.3%
<b>Total</b>	<b>1,240</b>	<b>100.0%</b>

(3) Collection service of DLPM

With 35 collection vehicles and 177 workers, DLPM collected an averaged amount of 240 ton/working day of refuse daily (19% of the total amount). The average tonnage and number of trips were 3.76 ton/truck and 1.21 trips/day, respectively; compared with the convoy service which was 2.1 ton/truck and 5 - 7 trips/day. Municipal Bell Collection service is estimated to be less effective due to its unreliability as well as to unexpected interruptions, while the efficiency of the convoy service is high.

(4) Collection service of the private sector

In 1990, the private sector collected an average amount of 468 ton/working day (37.7% of the total amount), but their working productivity of 0.6 ton/person was extremely low. The loading rate of 2.21 ton/truck and the number of trips, being less than 1.0 trip/day, were quite unsatisfactory in spite of their high collection frequency (2 to 3 times/week) higher than the collection service of DLPM. The total number of collection vehicles is approximately 300, of which 17%

are however, hand carts and horse-drawn wagons. Unloading operation is very inefficient because of the lack of dumping devices. Collection service of private collectors does not have systematic planning.

## 2.4 Sweeping Service

### (1) Road sweeping

Mechanical road sweeping services are carried out with three sweepers, but their operation efficiency is low. As for manual road sweeping, which has been planned for more than 20 routes based on the use of 377 workers, the service level seems to be considerably high with a sweeping frequency of 1 to 5 days/week.

### (2) Pica pollo service

There are 12 routes with frequency 5 times/week service frequency and 4 routes with 2 times/week frequency. Collected solid waste is 19.5 kg/per worker a day and the number of workers is 51.

### (3) Refuse baskets

Refuse baskets installed in the city are 91 in all, the number is considered to be very low for a capital city with a population of 1.5 million. DLPM justified the reduced number of refuse baskets saying because public use them as dumping boxes of domestic waste.

## 2.5 Recovery of valuable resources

- (1) The "Scavengers" are people dedicated to recovery of various resources by selecting and separating the solid waste. The number of scavengers is estimated in the following Table 5.

Table 5 The number of Scavengers

Type of scavengers	Number of Scavengers
1. Scavengers at "El Trebol" dumping site	500
2. Private Collectors	700
3. Scavengers at sources	100
4. Commercial scavengers	20
5. Others	100
<b>TOTAL</b>	<b>1,420</b>

(2) Recovered material

It is estimated that 83.2 tons of material and 12,000 bottles are recovered by scavengers daily, which accounts for approximately 5% of all solid waste collected.

1) Economic aspects

This recovery of 5% of the solid waste does not indicate a substantial alleviation of the cost of collection and final disposal operations.

Nevertheless, scavengers make about 10 million Quatzales every year on this recycled material.

2) Health aspects

The reuse of material without any sanitary control is potentially dangerous, both for the scavengers who collect it and for the public that acquires and uses it.

3) Social aspects

a. Serious social problems exist for the group of "scavengers" working primarily at "El Trebol".



- b. The scavenging practice at "El Trebol" disposal site is causing not only the health problems for scavengers but also the operational hazards for landfilling.
- c. The resource recovery at sources, however, should be promoted further.

#### 4) Technical aspects

Resource recovery at "El Trebol" disposal site is inefficient and ineffective as stated above. The recovery of various solid waste at the place of origin is much more efficient and cleaner by formal scavengers.

### 2.6 Final Disposal

At present, "El Trebol" disposal site is the only final disposal site in the Metropolitan Area of Guatemala City. In 1990, the domestic waste of 780 tons/workday is openly being dumped there. This is causing air pollution in the surrounding area by the creation of smoke and bad odors due to the natural combustion of the waste in addition to the congestion problems of the collection vehicles.

At the "El Trebol" disposal site, there is almost no control of scavenger operations and collection vehicles; therefore a dangerous health and environmental hazard exists. The leachate from waste is discharged downstream without treatment.

The total amount of waste generation in the Metropolitan Area of Guatemala City is about 970 ton/working day at present, and is expected to be about 1,590 ton/working day in the year 2000. About 190 ton/working day are dumped illegally at present. Accordingly, it is desirable

to immediately improve the "El Trebol" disposal site and open a new sanitary landfill site.

## 2.7 Institutional Organization

### (1) Public Cleansing Department (DLPM)

DLPM is the administrative unit of the Municipality of Guatemala City, which is in charge of and responsible for operating, supervising, controlling and managing solid waste in the city.

Street, park and green area cleaning along with cleaning of markets and final disposal services are directly handled by the DLPM. Collection services are jointly operated by the municipal and private sectors.

The "composting" plant at the Alameda Norte is managed by the DLPM and local residents of the colony. Recovery of various materials from the garbage as well as the commercialization of this activity is performed by the private sector without any municipal participation.

In five cities of the metropolitan area Public cleansing departments are responsible for public sanitation within their own jurisdiction although they offer only limited services as a result of the shortage of physical, financial and human resources.

### (2) Organizational Structure

The DLPM is subject to the Public Services Bureau, and is an organization with 10 sections, which are controlled by a single head or chief.

Limiting factors for further effective operations are, among others, as follows: limited control and

supervision of Private Collection; the lack of a planned system for educational and community participation program and personnel training; insufficient enforcement of legal dispositions; and excessive bureaucratization, which hinders the proper administration of assigned resources.

(3) Details of DLPM

The details of DLPM are summarized as follows.

1) Staff

689 employees and workers make up the DLPM including only one professional staff. In the Metropolitan Area of Guatemala City, 2.9 municipal workers are needed to collect one ton of waste. This can be compared to the 1.5 workers needed in Rio de Janeiro (Brazil) or the 1.2 needed in Tokyo.

2) Facilities

35 collection vehicles, 3 mechanical sweepers, 4 bulldozers, and 2 front-loaders are in working order. Furthermore, the DLPM has a recently constructed office; a deteriorated workshop for repair work; a limited quantity of tools, and storage areas for tools and equipment.

2.8 Private Collection

(1) Private collectors

These are incorporated into the Association of Private Collectors, which include 307 associated members; the Integral Cooperative for Special Services of Motorized Transportation of Solid Wastes with 35 associated members; and 12 independent private collectors.

(2) Staff and facilities

These private collectors have personnel and equipment amounting to 924 workers, 250 collection vehicles, 36 horse-drawn carts, and 15 hand carts

(3) Coverage

They collect 48% of domestic waste, namely 468 ton/working day, and deliver service to a total of 147,000 households.

(4) Service characteristics

The services offered are from house to house collection. These services have continued without interruption over the last 20 years. And 85% of the citizens who use these services are satisfied. The frequency of collection is 2-3 times per week and the average number of trips per vehicle to El Trebol disposal site is 1.1 per day.

(5) Income of Private collectors

The private collectors form a part of the informal sector in the economic activity in Guatemala City and they play an important role in that sector. These service charges are more than Q8 million per year, and are directly covered by collection fees paid by users. Monthly collection fees vary from Q3 to Q15 per household, and from Q10 to Q150 per user for industrial and commercial services. These private collectors gain additional income through the sale of materials recovered during collection services (approximately 40% of the total amount recovered in the city). Total income is estimated to be about Q13 million per year.

(6) Problems with private collection

- 1) The solid waste of families that cannot afford the fee is not collected.
- 2) Collection services are disorganized and inefficient due to lack of consensus and rules among private collectors.
- 3) Lack of coordination between private collectors and the DLPM.

2.9 Finance

- (1) The sweeping and collection cost account for about 85% of the total budget for the DLPM, while the final disposal and the maintenance costs account for a smaller share, 6.5% and 3.4%, respectively. Personnel costs account for 75% of the total budget for DLPM while materials, and machine and equipment account for 23% and 2%, respectively.
- (2) The growth rate of DLPM's budget was about 15% per annum from 1988 to 1991 and this rate was higher than the growth rate of municipal budget which was 13%. However, the growth rate of municipal budget was greater than that of DLPM in 1990 and 1991.
- (3) Budget

The DLPM budget has changed in the following way over the last four years:

YEAR	DLPM Budget (Q1,000,000)	Share of the Total Municipal Budget
1988	4.00	9.3%
1989	4.97	11.0%
1990	5.72	10.4%
1991	6.67	9.7%

## 2.10 Environmental Condition

The population of the Metropolitan Area of Guatemala City is growing, and people are being exposed to a wide variety of environmental hazards.

Water pollution is a major issue related to environmental improvement in Guatemala. At present, the river water (e.g., Rio Zalia) is literally sewage, with a BOD measured at approximately 500 mg/l. The sewage and leachate released from improper waste management are the reasons for this contamination. Sewage is believed to be the major reason.

Existing conditions make it necessary to consider sewage treatment measures for the future, as well as waste management, to prevent further river water pollution.

The two major environmental problems caused by solid waste are the prevalence of clandestine open-dumping sites and an uncontrolled landfilling practice.

### (1) Illegal dumping:

It is estimated that there are over 500 clandestine open dumping sites throughout the Metropolitan Area of Guatemala City. These have become the sources of offensive odors, flies, harmful insects deteriorating sanitary and aesthetic conditions.

(2) "El Trebol" final disposal site

This site is not under a management program which properly considers the environment. And, it adversely affects nearby areas.

1) Water quality

Leachate is not properly controlled with high value of BOD (about 12,000 mg/l) and there have been no studies on its environmental impact.

2) Air

Adequate measures have not been taken against smoke generated by natural combustion at the dumping sites. These have occasionally triggered traffic congestion in neighboring areas. Nor have any measures been taken against offensive odors.

3) Noise

The noise caused by collection vehicles that number 71 per hour during peak hours stands at about noise level of 70dB ("A" characters).

### 3. Actual Problems

- (1) 47% of the total population who principally live in marginal or isolated areas do not benefit from collection services.
- (2) There are more than 500 clandestine open-dumping sites.
- (3) The "El Trebol" final disposal site is unsanitary.
- (4) The present dual collection system, by municipal and private collectors, suffers from imbalances and restrictions.
- (5) Institutional and organizational problems in the DLPM.
- (6) Insufficient budget for the DLPM.
- (7) Deficiencies in the maintenance of DLPM equipment.



#### 4. Goals and Targets

##### 4.1 Goals

The objective of the Master Plan is to contribute to the development of the systematic management of solid waste within the Metropolitan Area of Guatemala City, with the purpose of improving and maintaining public health while protecting the quality of the natural environment until the year 2000.

##### 4.2 Targets

- (1) Increase the coverage of actual existing collection services for domestic waste from the present 53% to 86% by the year 2000.
- (2) Convert the "El Trebol" disposal site to controlled landfill and immediately improve sanitary and environmental conditions.
- (3) Expand, as soon as possible, the final disposal capacity by implementing the construction of a new sanitary landfill.
- (4) Grant concessions to private collectors in 100% of ECA by the year 2000.
- (5) Establish a preventive maintenance and repair program for collection vehicles, and all other equipment, to achieve a 90% rate of operation. Thereby improving the productivity of collection, sweeping and final disposal services.
- (6) Implement (1) to (5) above to substantially reduce the number of clandestine open dumping sites estimated to number more than 500.

## 5. Planning Conditions

The planning conditions for the preparation of the Master Plan, which takes into account population, economic growth, land use and solid waste amount and composition, are as follows:

### 5.1 Population

The population in the year 2000 based on INE's estimation is shown in the following table.

Table 6 Future Population Projection  
by Municipalities in the Study Area

	1990			2000		
	Urban	Rural	Total	Urban	Rural	Total
All Guatemala	3,500,910	5,697,538	9,197,345	4,740,867	7,480,839	12,221,706
Guatemala Department	1,675,589	287,364	1,962,953	2,268,596	350,139	2,618,735
Guatemala City	1,076,725	0	1,076,725	1,340,639	0	1,340,639
Mixco	328,854	17,591	346,445	519,490	12,846	532,336
Villa Nueva	116,606	24,282	140,888	196,019	33,347	229,336
Villa Canales	4,544	49,461	54,005	5,482	63,925	69,407
Santa Catarina Pinula	7,052	19,243	26,295	10,343	25,955	36,298
Chinautla	51,770	7,360	59,130	71,997	6,602	78,599
Sub total	1,585,551	117,937	1,703,483	2,143,970	142,675	2,286,645
Metropolitan Area	1,592,000	119,000	1,711,000	2,154,000	154,000	2,308,000
Study Area	1,496,000	36,000	1,532,000	1,999,000	48,000	2,047,000

## 5.2 Economic Growth

It is assumed that Guatemalan real GDP will grow at 4% per year until 1995, and at 3% from 1996 to 2000, given the continuity of the present industrial structure and considering the good economic conditions at present.

However, the GDP per capita will not be largely improved, since the population will continue to expand at 3% per annum until the year 2000.

## 5.3 Land Use

New residential construction will advance mainly towards Mixco City to the west, the Cities of Villa Nueva, Santa Catarina Pinula, and Villa Canales in the south, and to the northeast portions of Guatemala City (Zones 17 and 18).

## 5.4 Amount of Solid Waste Generation

The following Table 7 shows the "Results and Forecast of Population by Area and Solid Waste Quantity".

Table 7 Results and Forecast of Population by Areas and Solid Waste Quantity (collected, to be collected, to be recovered and to be disposed of)

(1)	YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000		
(2)	TOTAL POPULATION	1,531,790	1,583,292	1,634,795	1,686,296	1,737,796	1,789,306	1,840,806	1,892,308	1,943,807	1,995,312	2,046,814		
(3)	POPULATION IN E	944,330	999,705	1,055,080	1,110,456	1,165,831	1,221,206	1,276,581	1,331,956	1,387,331	1,442,706	1,498,081		
(4)	POPULATION IN PCA	508,235	501,469	493,703	485,937	478,171	470,407	462,638	454,869	447,101	439,332	431,563		
(5)	POPULATION IN IA	78,225	82,119	86,012	89,906	93,799	97,693	101,587	105,480	109,374	113,267	117,161		
(6)	ECONOMIC GROWTH RATE	1.04	1.03	1.0000	1.0400	1.0816	1.1249	1.1694	1.2167	1.2532	1.2907	1.3295	1.3694	1.4100
(7)	WASTE GROWTH RATE (S)**	0.65	1.0000	1.0240	1.0478	1.0710	1.0940	1.1223	1.1448	1.1667	1.1883	1.2095	1.2303	
SOLID WASTE GENERATION (FIELD DATA)														
(8)	GENERATION PER CAPITAL PER DAY	0.5434	0.5553	0.5582	0.5808	0.5933	0.6086	0.6208	0.6327	0.6444	0.6559	0.6672		
(9)	TOTAL GENERATION AMOUNT (DOMESTIC)	830.69	879.20	928.89	979.40	1,031.03	1,088.97	1,142.77	1,197.26	1,252.59	1,308.73	1,365.63		
(10)	TOTAL GENERATION AMOUNT (DOMESTIC)	969.14	1,025.74	1,083.71	1,142.63	1,202.87	1,270.47	1,333.23	1,396.81	1,461.35	1,526.85	1,593.24		
HAULD AMOUNT TO TREBOL (FIELD DATA)														
(11)	DOMESTIC WASTE	483.33	575.09	666.84	758.60	850.35	942.11	1,007.13	1,072.15	1,137.18	1,202.20	1,267.22		
A)	BY PRIVATE SECTORS	438.21												
B)	BY MUNICIPALITY	45.12												
(12)	NON DOMESTIC WASTE	301.05	308.28	315.44	322.42	329.35	337.87	344.64	351.24	357.74	364.12	370.38		
A)	SWEEPING/MARKET	195.19	199.88	204.52	209.05	213.54	219.06	223.45	227.73	231.95	236.08	240.14		
B)	BUSINESS	105.86	108.40	110.92	113.37	115.81	118.81	121.19	123.51	125.79	128.04	130.24		
(13)	CONSTRUCTION WASTE	426.20	436.43	446.57	456.46	466.26	478.32	487.91	497.25	506.45	515.49	524.35		
(14)	TOTAL AMOUNT HAULED	1,210.58	1,319.80	1,428.85	1,537.48	1,645.96	1,758.30	1,839.88	1,920.64	2,001.37	2,081.81	2,161.95		
(15)	RECOVERY FACTOR	0.0500	0.0540	0.0580	0.0620	0.0660	0.0700	0.0720	0.0740	0.0760	0.0780	0.0800		
(16)	RECOVERED AMOUNT	29.46	36.91	45.11	54.04	63.70	74.26	81.24	88.48	94.72	103.76	111.80		
WASTE AMOUNT CALCULATION BY LANDFILLS														
(17)	TREBOL	1,210.58	1,319.80	1,428.85	1,537.48	1,645.96	1,758.30	1,839.88	1,920.64	2,001.37	2,081.81	2,161.95		
(18)	GUACAMAYA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
(19)	ANNUAL WASTE AMOUNT FOR TREBOL	378,912	413,097	447,230	330,325	349,762	370,063	384,577	398,897	413,083	427,070	440,907		
(20)	ACCUMULATED WASTE AMOUNT FOR TREBOL	378,912	792,009	1,239,239	1,569,564	1,919,326	2,289,389	2,673,966	3,072,863	3,485,926	3,912,996	4,353,903		
(21)	AMOUNT FOR GUACAMAYA	0	0	0	0	0	0	0	0	0	0	0		
(22)	ACCUMULATED WASTE AMOUNT FOR GUACAMAYA	0	0	0	135,257	165,424	180,285	191,243	202,267	213,366	224,537	235,783		
		0	0	0	135,257	300,681	480,966	674,476	874,476	1,087,842	1,312,379	1,548,162		

## 6. Selection of a New Sanitary Landfill Site

### 6.1 The Necessity of the Opening of a New Landfill

Regarding the solid waste management in the Metropolitan Area of Guatemala City up to the target year 2000, the biggest limitation arises from the fact that "El Trebol" is the only one official dump site available in the entire area.

It is obvious that there have been traffic jams in the surrounding areas of the "El Trebol" disposal site, and collection services are insufficient due to the long distance between the generating points and the "El Trebol" disposal site, particularly in the Mixco city area, which have led to the increase of illegal dumping sites.

### 6.2 The Procedures for Site Selection

On June 9, 1990 a Selection Committee was established to select a new site. The Committee consisted of 9 persons from the Steering Committee and municipal staff, and 5 persons from JST. As the basis for the new site selection, guidelines prepared by JST were studied together in the Committee and approved by both parties. Through the map survey, the field survey and the aerial survey, the Counterpart proposed three gullies: "Las Guacamayas", "Las-Vacas" and "El Campanero" were raised as candidate sites for the new landfill site by the municipal staff, which were studied and selected by the Committee. "Las Guacamayas" was selected finally as the most suitable site by referring to the selection guidelines and field surveys.

### 6.3 Evaluation

"Las Guacamayas" has been chosen as the new site, especially since favorable evaluations regarding the following matters were obtained for "Las Guacamayas."

Considering the amount of solid waste generation, for its effective collection and disposal, from the viewpoint of urban formation in the metropolitan area of Guatemala City until the year 2000, it is ideal to have at least two disposal sites: "El Trebol" and "Las Guacamayas". Landfilling will prevent any possible danger to the surrounding residential areas of "Las Guacamayas" caused by the erosion of the gully. The capacity of "Las Guacamayas" is big enough to accommodate wastes even after the year 2000, and access to the gully is already available.

Now, the point to which the municipality's attention should be paid is to recognize correctly the current on-going erosion by spring water in the gully and conduct immediately its investigation. Furthermore, before opening a new landfill site, it is necessary to clarify the relevant aspects such as land ownership and the future use of landfilled area.

#### 6.4 Environmental Conservation

Considering the present environmental conditions of "Las Guacamayas", for example, geology, topography, the surrounding residential areas, the pressing situation by erosions etc., the following countermeasures deemed necessary for the environmental conservation.

The basic policy is to use the sanitary landfill method from the beginning.

The objectives are:

- (1) Control of spontaneous combustion, smoke, and bad odor
- (2) Prevention of ground water contamination by leachate
- (3) Elimination of scavengers
- (4) Prevention of erosion

The countermeasures are:

- (1) Daily soil covering
- (2) Construction of leachate collection ditch at the gully bottom
- (3) Recirculation of leachate
- (4) Control of scavengers by fences and doors.
- (5) Construction of parks and sport facilities on filled area to improve the social environment of the community.

#### 6.5 Public Opinion

The opinion survey effected in February 1991 of the residents in the adjacent areas at the site of "Las Guacamayas" indicates that most of the residents wish the solid waste to be transported to sites far from residential areas, but at the same time, to have an adequate final disposal in a sanitary way and in a determinated place.

This means that citizens will approve a site for sanitary landfill in some place in the city. In other hand, the citizens may not wish the landfill near their own houses taking into account the actual conditions in "El Trebol" disposal site.

There is the possibility of opposition to the new landfill construction near "Las Guacamayas" although the people living in the surroundings of "Las Guacamayas" acknowledged the need of construction of a landfill in some place of the city.

Therefore, the improvement of the actual situation of "El Trebol" disposal site, is to be undertaken first so that people can realize the benefits of a sanitary landfill project in "Las Guacamayas".

## 6.6 Strategy for Opening a New Landfill

- 1) Immediate improvement of the "El Trebol" disposal site to convert it into a controlled landfill. Within a period of four months, it would be possible to construct a slope that would allow the bottom of the gullies to be reached, and to initiate the technical construction of the landfill. Only in this way could the Municipality demonstrate to the public, over the short term, the advantages of a sanitary landfill, and bring real awareness to the community. Furthermore, through this work the Municipality could ensure the confidence and trust of the public, which is so important in works of this kind.
  
- 2) Given the above-mentioned facts, construction of the indispensable and absolutely necessary second Sanitary Landfill could begin in 1994. The study has shown that the best alternative continues to be the site at "Las Guacamayas".



## 7. Institutional Development

### 7.1 Institutional Development

- (1) Among the various alternatives studied, it was concluded that the improvement of the present dual collection system is the most effective means to sustain the goal of solid waste management with the socio-economic situation of the present and the next 10 years taken into account.
- (2) Thereafter, the existing institutional organization for public cleansing service within the administration of Guatemala city (DLPM) was evaluated. From among all the alternatives that were studied, the one requiring the creation of "DLP" was selected as the most recommendable.
- (3) The organizational structure proposed for the DLP demonstrated the best prospects for an improvement in the administration of solid waste, given the following criteria:
  - 1) It includes the formal participation and coordination of Private Collectors in solid waste management.
  - 2) It incorporates a system of planning and evaluation.
  - 3) It promotes, in a permanent way, community education and participation.
  - 4) It improves the operational efficiency of municipal cleansing services without increasing personnel, while at the same time establishing as a priority the training of current DLPM personnel as well as transferred personnel from other municipal offices.

- 5) It facilitates inter-municipal coordination in the handling of solid waste through the Metropolitan Committee on Solid Waste (CMDS).
- 6) The restructuring of DLPM to a new entity, "DLP", is a realistic and viable proposition, which can be implemented immediately.

## 7.2 Concessions to Private Collectors

- (1) By selecting a dual system of collection services with the basic purpose of providing adequate services within this decade, the formalization of private collectors will be carried out by adopting a plan calling for the granting of concession zones, in a gradual manner. As a result, this, for the time being, will call for continued operation of private collectors within present zones even if they may not yet be formally granted as concessionaires. The fundamental criteria for this process are: that the private collectors shall collect all the solid waste, which is generated within their area; that only currently existing private collectors shall be eligible to receive concessions; that municipal services shall be halted to avoid competing with private collectors in the areas granted by concession; and that the DLP shall supervise and control the process.

### (2) Criteria for the granting of concession zones

- 1) The zones should be included in easy collection area.
- 2) The number of clandestine open dumps within the zone should be large.

- 3) Potential profitability of the zone should be high.
- 4) Possibility of conflicts among private collectors should be minimal.

(3) Process of granting concessions

The procedures shall be elaborated by the Municipal Department of Justice.

(4) The DLPM should supervise and control the concessionaires on the following points:

- 1) Total collection of solid waste within the zone granted as a concession.
- 2) Transportation of collected solid waste to the final disposal sites designated by the "DLP".
- 3) Prohibition of hazardous waste collection.
- 4) Control on the exclusive use of vehicles authorized by the "DLP", and other controls such as control of fees levied on users.

### 7.3 Personnel Training

Since the "DLP" will use personnel from the present DLPM as well as personnel transferred from other municipal offices, it will be absolutely necessary to implement educational and training programs for this personnel. These programs which should be permanent, realistic, and practical, will be realized on three levels:

- (1) The managerial level via allocation in service entitles outside the country;

- (2) The middle level, requiring short courses within the country and accounting for the training of 15 people per year;
- (3) The operational level, basically through actual work sessions within the area or within workshops concentrating on two activities per year, and handling 80 people.

#### 7.4 Community Education and Participation

- (1) Community participation is one of the most important preconditions for implementing and promoting the Solid Waste Management, and for reaching an acceptable state of cleanliness at a relatively low cost.
- (2) The proposed strategy includes:
  - 1) Dialogue with the general public, based on the dissemination of necessary information and on the guarantee of proper public cleansing services. Otherwise, it would neither be possible nor beneficial to carry out a dialogue with the community.
  - 2) Community motivation on the basis of the following elements: message or information on the handling of solid waste; the video program produced through the pilot study should have a great impact as the instrument to convey messages; and the direction of the message should preferably focus on the residents of marginal areas, teachers, students, market workers and roving vendors, as well as public and private collection workers.
  - 3) Effective presentation of the "DLP" to the public; by working day and night along public ways and roads, "DLP" personnel and equipment will

constantly be visible promotional elements (positive or negative).

#### 7.5 Equipment Maintenance

- (1) In the organizational structure proposed for the "DLP", the maintenance section has been viewed as an important section within the Department of Operations. The specific characteristics of the public cleansing equipment (compacting collection vehicles, mechanical sweepers, bulldozers, loaders, etc.) and the nature of the work, including the need to work on Saturdays and Sundays, as well as at night, requires that this section be directly administrated by the "DLP". Also it should be separated from the Central Maintenance Workshop that was established in the Municipality in the second semester of 1990.
- (2) To implement the above-mentioned proposal, it will be necessary to provide an infrastructure of workshops, garages, and open areas, as well as all necessary material and human resources. The infrastructure itself requires only low investment costs, which would be recovered very quickly by increasing the life of vehicles. The appointment of a section chief, preferably one with a mechanical engineering background, who would have authority to manage and control all maintenance work, will be a very important decision.
- (3) Preventive maintenance program in the "DLP". To that effect the preventive maintenance program developed during the pilot project stage may be used as a base to which the necessary adjustments would be made to facilitate its development. Most major repairs could be handled in the workshops of private sector, whether they be for the Municipality or for private collectors.

- (4) It will be convenient to carry out training courses for mechanics or assistants, either at the period of scheduled maintenance or when new vehicles are delivered.
- (5) For logistical reasons, heavy equipment that operates on site at the "El Trebol" disposal site shall be maintained on the site at the workshop that is being constructed for that very purpose; however, its administration shall be the responsibility of the maintenance section of the "DLP".

## 8. Operational Planning

### 8.1 Collection and Transport

#### (1) Basic concepts

The following are the basic concepts for planning a collection and transport operation;

- 1) One prerequisite is a systematic and gradual interchange of operation areas between ECA (easy collection area) and PCA (possible collection area); PCA should diminish gradually as ECA extends its operations.
- 2) Gradual and intentional concessions of collection zones to the private sector are to be carried out as scheduled. This means continuance of the dual collection system.
- 3) The above plans in question will be formulated in accordance with the actually available resources, including manpower and the equipment necessary to carry out the operations.
- 4) Appropriate institutional development must be achieved as an essential basis and financial basis must also be secured.

#### (2) Collection and transport systems

To facilitate the explanations below, the following table shows area divisions, their subdivisions, etc.

Table 8 Classification of Collection Area

Area Division	Sub division	Collectors	Systems
ECA	1) Regular Service areas (Service covered)	Private	Door to Door
	2) Marginal areas in a broad sense - Topographically accessible - Mainly low-income class - Fees collectable	Private	Door to Door Station
	3) Marginal areas in a narrow sense - Topographically not accessible - Slum colonies predominantly - Fees non-collectable	Private	Station (Container)
	2) + 3) marginal areas For a transitorial period only	Municipal	Block (Bell)
PCA	1) Regular Service areas (Mixed collection areas)	Private Municipal	Door to Door Station
	2) Marginal areas	Municipal	Station Block (Bell) (Container)
	3) Self-disposal areas (Rural & fringe areas) - Farms and scattered hamlets		

1) Collection and transport systems in the ECA

By 1996, collection services in the ECA will be exclusively entrusted to private collectors.

- a. Door to door curbside or backyard systems in regular service areas
- b. Combination system of "Door to door" and "Station" for low-income neighborhoods in marginal areas (in a broad sense)
- c. A station collection system for marginal areas (in a narrow sense)