社会開発調査部報告書

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MUNICIPALITY OF MANAGUA
THE REPUBLIC OF NICARAGUA

THE STUDY
ON
THE IMPROVEMENT OF
THE SOLID WASTE MANAGEMENT SYSTEM
FOR
THE CITY OF MANAGUA

FINAL REPORT
VOLUME II
MAIN REPORT

MAY 1995

KOKUSAI KOGYO Co., Ltd.

In this report, project cost is estimated at January 1995 prices and at an exchange rate of US$ 1 = Yen 102.20 = C$ 7.1183

PREFACE

In response to a request from the Government of the Republic of Nicaragua, The Government of Japan decided to conduct a master plan and feasibility study on the Solid Waste Management for the City of Nicaragua in the Republic of Managua and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Nicaragua a study team headed by Mr. Takeshi Tomiyasu, Kokusai Kogyo Co., Ltd. four times between April 1994 and March 1995.

The team held discussion with the officialsn concerned of the Government of Japan, 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 teo countries.

I wish to my sincire appreciation on the officials concerned of the Republic of Nicaragua for their close cooperation extended to the team.

May 1995

Kimio Fujita
President
Japan International Cooperation Agency

May 1995

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit to you the study report on the Solid Waste Management for the City of Managua, Nicaragua. This study contains the master plans until 2010 and the feasibulity studies on the priority projects.

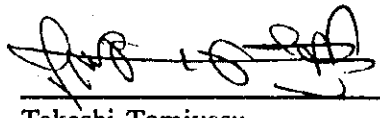
The MSWM master plans were formulated the City of Managua based on the phased targets and the optimum technical systems which mainly comprise of a new sanitary landfill site.

The feasibility studies were executed for the priority projects which consisted of improvement of collection and public area cleansing system, construction of the new landfill site, improvement of the existing workshop and promotion of public awareness, cooperation and participation. The study concluded that implementation of the priority projects by the Municipality of Managua supported by grant aid was appropriate.

We wish to take this opportunity to express our sincire gratitude to your Agency, the Ministry of Foreign Affairs, and the Ministry of Health and Welfare. And from the Nicaraguan side we also wish to express our deep gratitude the Ministry of Health and the Municipality of Managua, the Agency of potable Water and sewerage, Ministry of External Cooperation, the Embassy of Japan in the Republic of Nicaragua, and the JICA office in the Republic of Nicaragua.

Finally, we hope that this report will be effectively used for the omplementation of the project.

Respectfully,



Takeshi Tomiyasu
Team Leader
The Study on the Improvement of
the Solid Waste Management System
for the City of Managua

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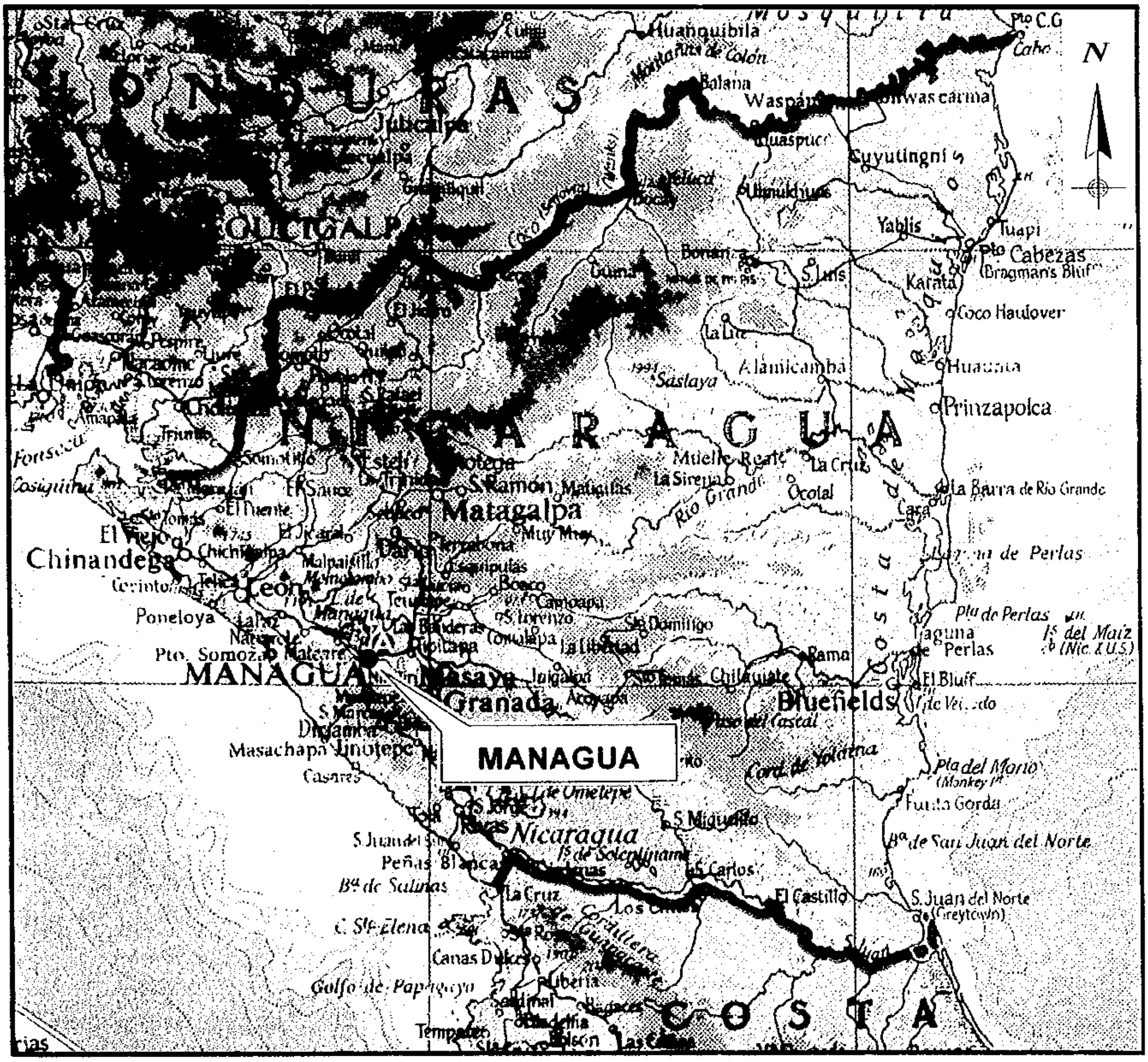
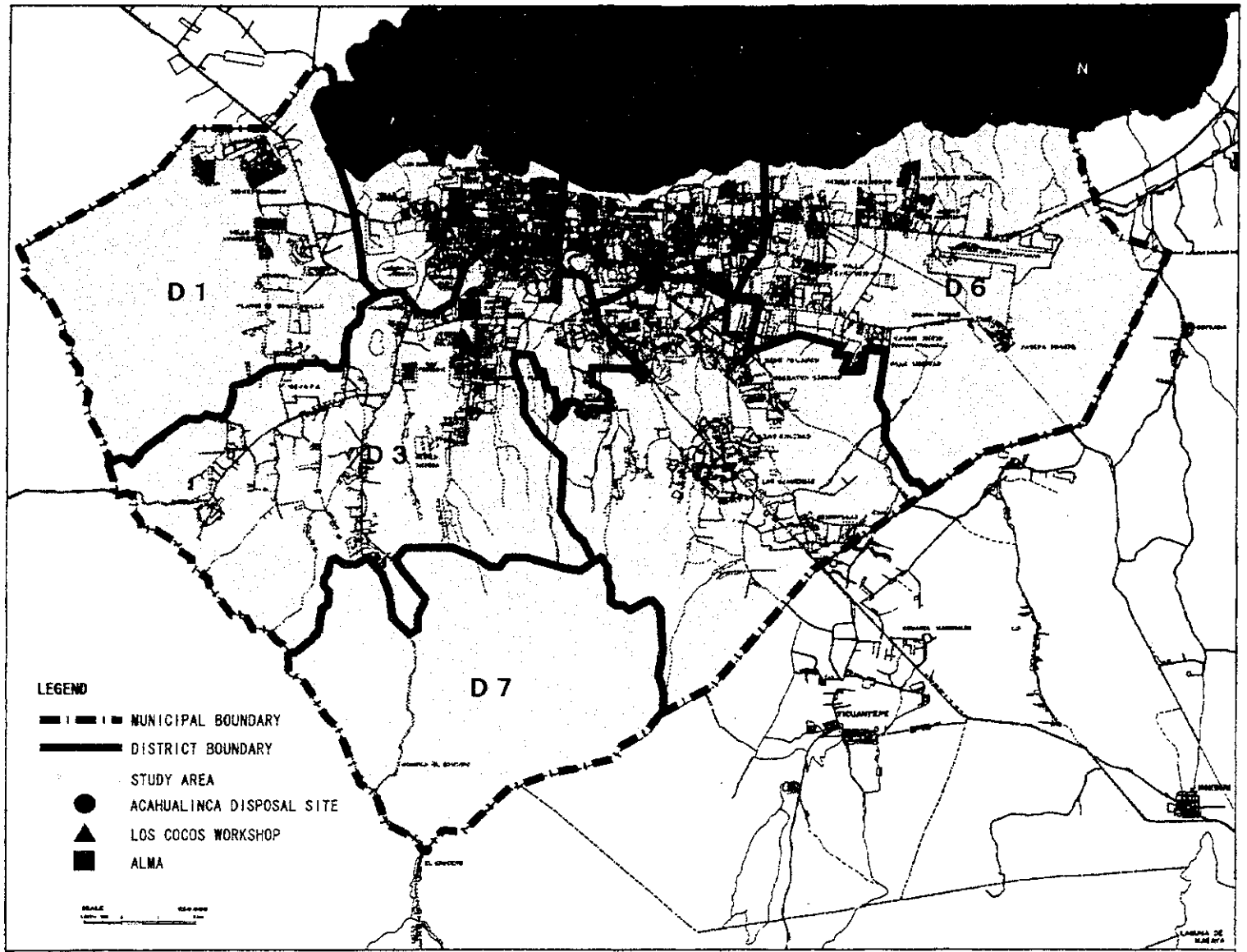
This is the MAIN REPORT.

Location Map of

The Study Area (1)





THE STUDY ON THE IMPROVEMENT OF THE SOLID WASTE MANAGEMENT SYSTEM FOR THE CITY OF MANAGUA

JAPAN INTERNATIONAL COOPERATION AGENCY

Location Map of The Study Area (2)

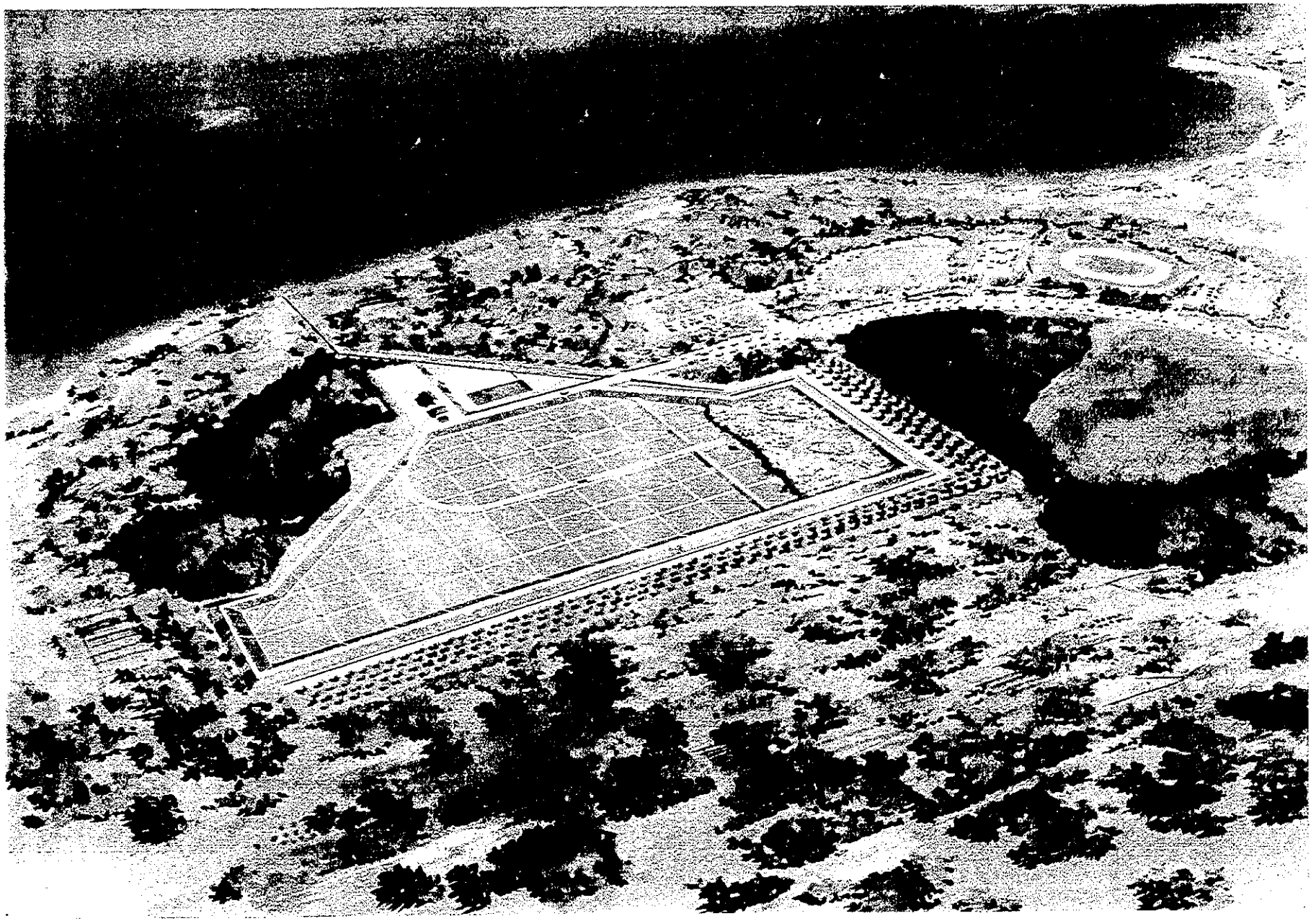


Plate 1: Image of Proposed New Final Disposal Site

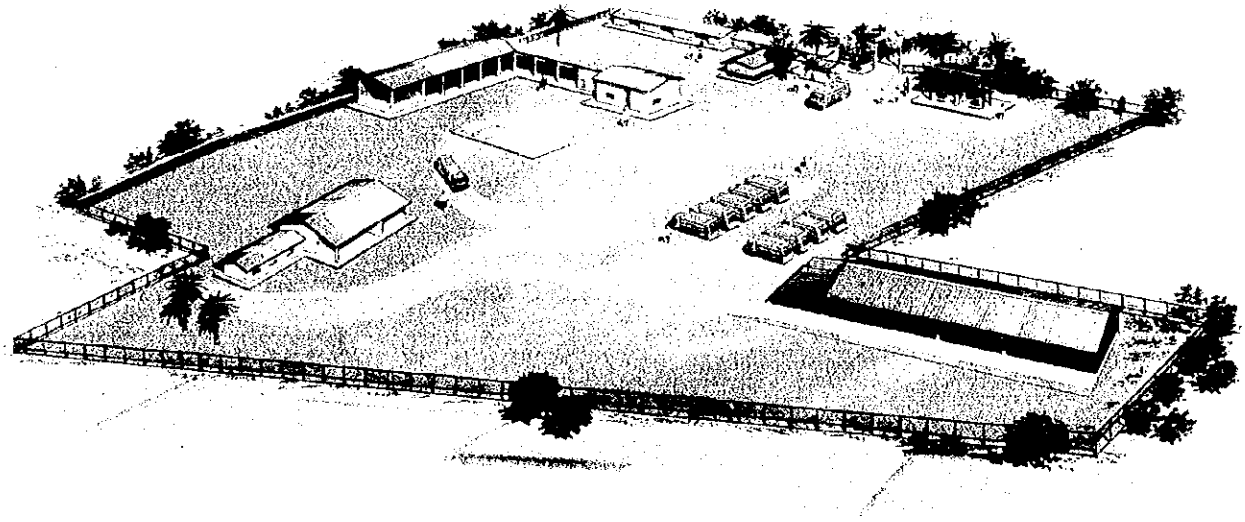


Plate 2: Image of Improved Los Cocos Workshop

Acahualinca Final Disposal Site

Los Cocos Workshop

Collection Work by Compactor Truck

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Weighing waste amount discharged by houses

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Measuring ammonia and methene at Acahualinca disposal Site

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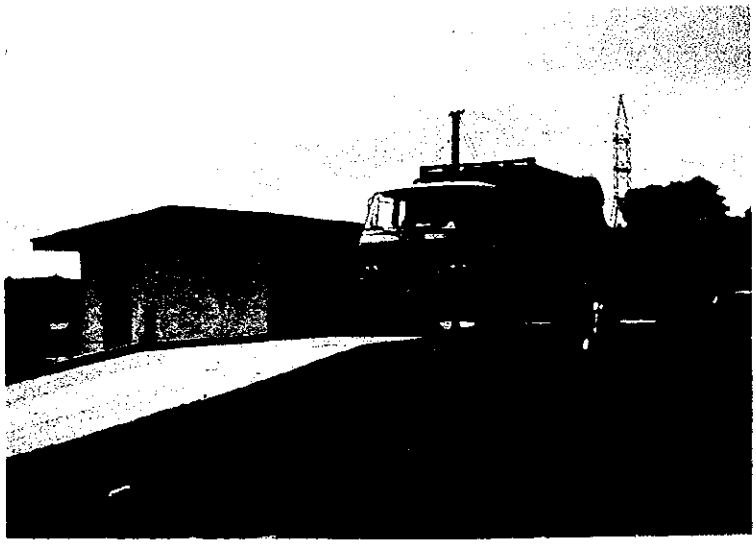
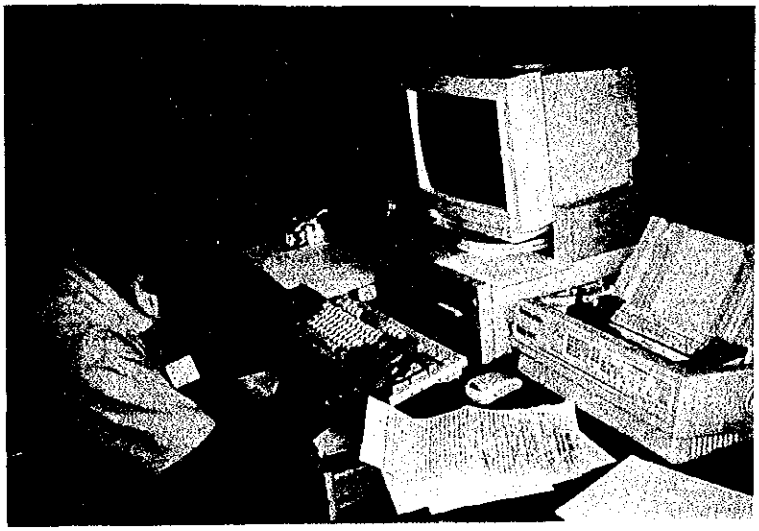


Truck Scale Inspection Building constructed by Managua Municipality and JICA in Acahualinca disposal Site

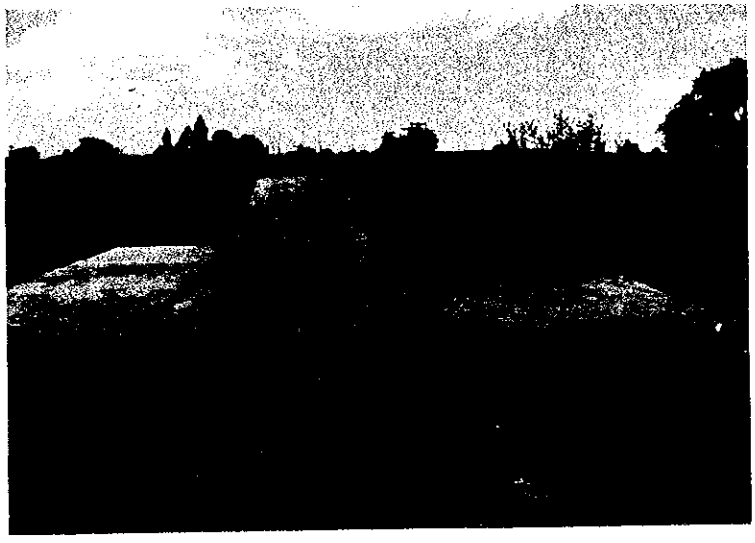


Inside View of the Inspection Building of Truck Scale
One set of Computer is installed

Geological Survey carried out in the Present Acahualinca Disposal Site

Plate 5: Field Survey(2)

Area Improvement Activities carried by residents



Container bed constructed by JICA

Bell collection system with cooperation of residents

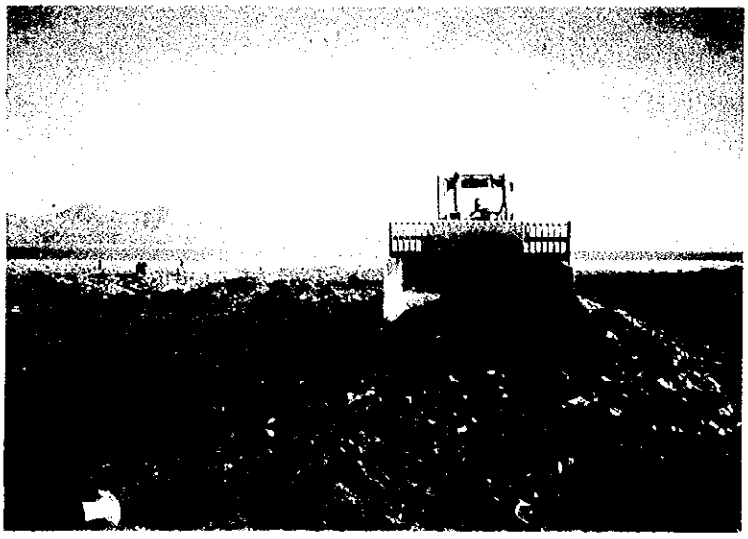
Plate 6: Pilot Project(1),Collection Experiment

Lecture on sanitary education given to the residents in the collection experiment area by the Study Team

Lecture on sanitary education given to the residents in collection experiment area by the Municipal staffs

Children are watching solid waste educa- tional video made by the Study Team

Plate 7: Pilot Project(2),Public Education Campaign



Construction of dike by using the waste

Gas removal facilitated installed on the waste compacted and covered by soil

Completion of final covering the waste and Gas removal facilities installed

Plate 8: Pilot Project(3),Sanitary landfill Experiment

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ABBREVIATIONS

ORGANIZATIONS AND INSTITUTIONS

ALMA	Municipality of Managua
BAVINIC	Housing Bank of Nicaragua
BCN	Central Bank of Nicaragua
CSE	Electoral Supreme Council
DCO	District Coordination Office
DEE	Department of Environmental Education
FIDEG	International Foundation for Global Economic Challenge
IDB	International Development Bank
INAA	Nicaraguan Institute of Aqueducts and Sewering
INE	Nicaraguan Institute of Energy
INEC	National Institute of Statistics and Census
INETER	Nicaraguan Institute of Territorial Studies
IRENA	Nicaraguan Institute of Natural Resources and the Environment
JICA	Japan International Cooperation Agency
JICE	Japan International Cooperation Center
MAN	Nicaraguan Environmental Movement
MARENA	Ministry of Environmental and Natural Resources
MCT	Ministry of Construction and Transport
MEDE	Ministry of Economy and Development
MINSA	Ministry of Health
MIPRES	Ministry to the Presidency
MWSHO	Municipal Works and Services Head Office
PCO	Public Cleansing Office
PHO	Panamerican Health Organization
PIDMA	Program for Environmental Investigation and Study
UNDP	United Nations Development Program
UNI	National Engineering University
WHO	World Health Organization

REPORT AND STUDY

ANLPS	Acahualinca Newly Proposed Landfill Site
ASG	Apparent Specific Gravity
DF/R	Draft Final Report
DWAS	Disposal Waste Amount Survey
F/R	Final Report
F/S	Feasibility Study
HCV	Higher Calorific Value
IC/R	Inception Report
IEE	Initial Environmental Evaluation
ISW	Industrial Solid Waste
ISWM	Industrial Solid Waste Management
IT/R	Intermediate Report
LCV	Lower Calorific Value
M/M	Minutes of Meeting
MSW	Municipal Solid Waste

MSWM	Municipal Solid Waste Management
N.A.	Not Available
O&M	Operation and Maintenance
POS	Public Opinion Survey
P/R	Progress Report
RIDS	Registered Illegal Dump Site
S/W	Scope of Works
SWM	Solid Waste Management
T/R	Terms of Reference
WACS	Waste Amount and Composition Survey

SOCIO-ECONOMY

EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GNP	Gross National Product
GRDP	Gross Regional Domestic Product
US$	U.S.dollar
C$	Cordoba
p.a.	per annum
mill.	million
bill.	1,000 million

UNIT

mm	millimeter
cm	centimeter
m	meter
km	kilometer
m^2	square meter
km^2	square kilometer
ha	hectare
m^3	cubic meter
mg	milligram
lit.	litre
kg	kilogram
ton	ton
sec.	second
min.	minute
hr	hour
d	day
%	percentage
no.	number
nos.	numbers
kw	kilowatt
kj	kilojoule
kcal	kilocalorie

CHAPTER 1
INTRODUCTION

CHAPTER 1 INTRODUCTION

This chapter describes the outline of the Study, i.e. background, scope, policy, key assumptions, work process and organization of the study. The readers may understand the general features of the study from the chapter.

1.1 Background

A civil war which lasted for 8 years has destroyed the social infrastructure and consequently worsened the economy of the Municipality of Managua (area : 330km^2, population : 1.1 million), in the Republic of Nicaragua. Furthermore, the rapid increase in population has brought about an increasing complexity in the generation of solid waste and the actualization of environmental problems. The management of solid waste in the Municipality of Managua has become a critical problem due to the following:

- a portion of the waste is not routinely collected
- enforcement of regulations on solid waste is inadequate
- collection routine is inefficient
- environmental conditions of present disposal sites contribute to health problems
- the institutional and administrative structures are not well established and not suited to the required cleansing services
- finance and auditing procedures are in need of revision
- Public education system and participation programs are not developed.

To overcome the above problems and to systematically improve the situation, the preparation of a Solid Waste Management (SWM) Master Plan for the Municipality of Managua is a very effective approach, technically as well as financially. However, this approach has not been practiced in the Municipality of Managua and further no SWM Plans have been prepared in the country.

In response to the request of the Government of Nicaragua, the Government of Japan decided to conduct the Study on the SWM for the Municipality of Managua in accordance with the relevant laws and regulations in force in Japan. Accordingly, the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, undertook the Study, in close cooperation with the authorities concerned of the Government of Nicaragua. Kokusai Kogyo Co., Ltd. was selected

by JICA as the consultant to carry out the study.

1.2 Scope of the Study

a. Objectives of the Study

The objectives of the Study are:

- to formulate a master plan for the improvement of Solid Waste Management in the Municipality of Managua up to the target year 2010
- to conduct a feasibility study on the priority projects based on the master plan, up to the target year 2000.

b. Study Area

The study covered the whole area under the administration of the Municipality of Managua, but the implementation of collection services was limited to the urbanized areas. The Study area is shown in the location map in the first section of this report.

c. Wastes

The wastes studied were household waste, market waste, commercial waste, street sweeping waste, and institutional waste. As for medical and industrial solid wastes, a quick study was carried out based on existing information, data, disposal waste amount at existing disposal sites, and interview survey results. The general recommendations proposed for the improvement of medical and industrial solid waste management in the Municipality were based on the results of the quick study.

1.3 Policy of the Study

a. Characteristics of an SWM Study

The eminent characteristics of an SWM study are:

- The study has to be carried out during the time when the existing SWM

system is operating.

- The essence of SWM is the prompt removal and appropriate processing/disposal of generated waste. An appropriate SWM system cannot be established without the mutual cooperation of the public and administration. In this context, a proper understanding of the social and cultural background of the study area is essential in the preparation of an SWM plan.
- The SWM is directly related to the daily life of the people. The proposed plan would not be sufficient and workable without the careful consideration of the intentions of the administrators and officers concerned in SWM. It should also take the opinion of the citizens into consideration.
- In order to formulate an SWM master plan, it is necessary to understand educational backgrounds of people in the area, their ways of thinking, customs, and their daily life, in addition to the present SWM technical and institutional system and the natural and socio-economic conditions of the study area.

Due to rapid changes in the socio-economic and political scenes of Nicaragua, it was very important to determine fully the present SWM institutional system and to formulate an appropriate institutional development plan. This would have been difficult to accomplish without the support and cooperation of the Nicaraguan counterparts.

b. Joint Study

The political and socio-economic arena of Nicaragua is undergoing rapid changes. A joint study should be carried out with the Nicaraguan counterparts therefore as they are familiar with prevailing local conditions, in order to determine the present solid waste management situation and for the formulation of an SWM plan that is est suited to future conditions. Field surveys, e.g., waste amount and composition survey (WACS), public opinion survey (POS), were especially carried out in close cooperation with the counterparts, as a means of extending technology transfer.

The study was carried out smoothly as discussions were held until mutual agreement was attained concerning policies involved in the selection and conclusion of candidate disposal sites, selection of optimum alternatives for the master plan, and the selection of priority projects.

Pilot projects, e.g., collection experiment, sanitary landfill experiment, and sanitary education campaigns, were conducted in cooperation with the Nicaraguan counterparts to verify the appropriateness of the plans and for the immediate improvement of SWM. The results led to the proposal of the following systems and

technologies which are presently being carried out by the municipality:

- Introduction of container and bell collection system in the non-collection area and its O&M
- Improve sanitary conditions, carry out technological transfer, and implement O&M system through the conduct of daily waste covering activities, installation of gas removal facilities, dike construction, etc., in the present disposal site.
- Conduct public health and sanitation education campaigns in non-collection area and primary schools using videos and pamphlets.

c. Workable Plan and Appropriate Technology

Upon careful consideration of the characteristics of an SWM study, the Study Team formulated the most workable and implementable SWM plan for the Municipality in close cooperation with the Nicaraguan counterparts. The SWM plan, therefore, included immediate, short, middle and long term improvement plans. Furthermore, in the light of the financial limitation of the Municipality, the Study Team developed the most appropriate technology both for technical and institutional systems for SWM in the area. Especially, the study and the plan to be formulated presented and supported a self-sustainable SWM for the Municipality of Managua.

1.4 Key Assumptions

Key assumptions used in this study area are as follows:

a. Socio-economic Conditions

Items	Unit	Descriptions
1. Population		
- Projected Urban Population of the Whole Study Area	persons	1995: 877,817 2000: 1,131,052 2010: 1,610,943
- Annual Growth Rate	%	1995-2000: 5.2%/year 2001-2010: 3.6%/year
2. Economy		
- GDP	US$ bill.	2.25 in 2000 3.40 in 2010
- Annual Increase Rate of GDP in Real Terms	%	1995: 3.5% 1996: 4.0% 1997: 4.5% 1998-2000: 5.0% 2001-2005: 4.5% 2006-2010: 4.0%
- GRDP	US$ bill.	The share of Managua in Nicaragua will increase until 2000 because the centralization of population and administrative functions. 1995: 0.93 2000: 1.24 2010: 1.87
- Future Budget of the Municipality of Managua	US$ mill.	The budget in 1995 will increase in accordance with GRDP increase rate in real terms. 1995: 27.4 2000: 36.5 2010: 55.4
- Income Level of the Citizens	US$/M	The income will increase according to the GRDP increase rate in real terms/population growth rate. 1995: 368.6 2000: 381.6 2010: 406.2
- Currency Exchange Rate		1 US$ = C$ 7.1183 = 102.20 Yen
- Inflation Rate	%	0 % 1995 - 2010 for the economic and financial analysis of the Study

b. Waste Amount and Composition

Items	Unit	1995	2000	2010
1. Waste Amount				
1-1 Waste Generation Amount	ton/day	921.7	1,280.4	2,171.8
- MSW		712.2	1,013.0	1,766.6
Household (AreaA)		396.4	580.1	1041.2
Household (AreaB)		197.9	289.7	519.8
Commercial (Restaurant)		26.3	33.1	50.3
Commercial (Others)		0.4	0.4	0.4
Market		26.9	33.9	51.4
Institutional		2.4	2.9	4.0
Hospital		6.5	8.3	12.5
Street Sweeping:-		16.5	17.4	17.4
Parks & Green Areas		1.4	3.8	3.8
Direct by Hauled		37.5	43.4	65.8
		209.5	267.4	405.2
- ISW		9.2	11.6	17.5
Industrial		5.7	255.8	387.7
Direct Hauled		194.6	-	-
Illegally Dumped				
1-2 Collection Ratio of Household Waste	%	77.0	90.0	100.0
1-3 Annual Increase Rate in Household Waste Generation		0.55% of GDP growth rate for an increase in household waste generation per capita.		
2. Waste Composition				
2-1 Physical Composition		1995	2000	2010
Combustibles	%	**76.6**	**78**	**80**
Kitchen waste		34.8	35	35
Paper		7.4	9	11
Textile		2.0	2	2
Plastic		4.2	5	7
Grass and Wood		26.1	25	23
Leather and Rubber		2.1	2	2
Non-Combustibles		**23.4**	**22**	**20**
Metal		1.8	2	2
Glass		2.9	3	3
Ceramic and Stone		7.5	7	6
Others (soil, etc.)		11.2	10	9
Total		**100.0**	**100.0**	**100.0**
2-2 Lower Calorific Value		1995	2000	2010
- (MSW excluding street sweeping and bulky wastes)	kcal/kg	1,254	1,336	1,494

Note: Industrial waste amount is limited to waste collected by the Municipality.
Illegally dumped waste amount is limited to waste collected by the Municipality.
Illegally dumped waste was forecasted using directly hauled waste figures.

c. Life Span of Equipment and Facilities

	Life Span (years)	Salvage value (%)
Containers	5	0
Trucks and Heavy Equipment	7	10
Machineries	15	0
Buildings and Civil Works	30	0

Note: The life span of other facilities for the disposal site depends on the period of its operation.

d. Executing Bodies for Technical Systems of MSWM

ALMA is the executing body of the technical systems, i.e. fund raising, procurement, maintenance and operation of equipment except for operations in collection area A. In 2000, 50% of the households in collection are A will receive collection services from private concessionaires; this number will increase to 100 in 2010. Municipality will rent out equipment to the concessionaire for the collection and haulage waste. The concessionaire will pay the Municipality a license fee, rental fee, and tipping fee.

e. Revenue and Expenditure for Financial Analysis

Items	Sources	Execution Body	Revenue	Expenditure
Collection & Haulage	Collection Area A	ALMA	-Waste Fee	-Investment and O&M of Vehicles
		Private	-License Fee -Rental Fee -Tipping Fee (Partial)	-Investment and maintenance cost of Vehicles
	Collection Area B	ALMA	-Waste Fee (partial)	-Investment and O&M of Vehicles
	Large Generation Sources	ALMA	-Waste Fee	-Investment and O&M of Vehicles
	Street Sweeping	ALMA	-(Property Tax)	-Investment and O&M of Vehicles
Final Disposal		ALMA	-Tipping Fee*	-Investment and O&M of Facilities, Vehicles and Equipment

* Tipping fee consists part of the waste fee collected from residents in Area A and Large Generation Sources, and the tipping fee charged to companies directly hauling waste.

1.5 Work Process of the Study

The study commenced in April of 1994 based on the Scope of Work (Appendix 1) signed between the Nicaraguan Government and JICA in October 1993, and will end in May 1995.

The study consisted of the following two phases:

Phase 1 : Formulation of a Master Plan
Phase 2 : Feasibility Study of the Priority Project

The study was carried out in the manner described below.

a. Phase 1 : Formulation of a Master Plan

aa. 1st Study Work in Nicaragua

1) Submission and discussion of inception report
2) Data collection and analysis
3) Field survey of present status of SWM
4) Time and motion study
5) Operation of truck scale
6) Survey of waste amount and composition (dry season)
7) Survey of candidate final disposal sites
8) Topographic and soil investigation, land use and environmental survey of Acahualinca landfill site
9) Public opinion survey on MSWM
10) Study on improvement measures for existing landfill site
11) Survey of industrial and medical waste
12) Forecast of future waste amount and composition
13) Selection of candidate final disposal sites
14) Preliminary examination of the Master Plan
15) Preparation of pilot projects
16) Preparation and submission of progress report (1)

ab. 1st Study Work in Japan

1) Determination of basic conditions for Master Plan
2) Establishment of goals and targets for Master Plan
3) Examination of technical system alternatives and selection of an

optimum alternative

4) General recommendations for the improvement of industrial and medical SWM
5) Formulation of draft Master Plan
6) Examination of the results for the Initial Environmental Examination (IEE)
7) Selection of priority projects
8) Compilation of Interim Report

ac. 2nd Study Work in Nicaragua

1) Submission and discussion of Interim Report

b. Phase 2 Feasibility Study of the First Priority Project

ba. 3rd Study Work in Nicaragua

1) Determination of basic conditions for the priority projects
2) Establishment of a study policy for priority projects
3) Supplementary data collection and analysis
4) Survey of waste amount and composition (rainy season)
5) Detailed survey of proposed facility site(s)
6) Implementation of pilot projects
7) Investigation on priority projects
8) Planning of MSWM seminar
9) Submission and discussion of Progress Report (2)

bb. 2nd Study Work in Japan

1) Revision of the draft Master Plan
2) Determination of design conditions for F/S
3) Preliminary design of primary facilities
4) Equipment Plan
5) Organizational and institutional development plan
6) Operation and maintenance plan
7) Public sanitary education program
8) Estimation of project cost
9) Financial plan
10) Project evaluation
11) Execution of Environmental Impact Assessment (EIA)
12) Total evaluation

13) Implementation plan
14) Compilation of draft final report

bc. 4th Study Work in Nicaragua

1) Submission and discussion of draft final report
2) MSWM seminar

bd. 3rd Study Work in Japan

1) Compilation of final report

be. Submission of Final Report

1.6 Study Organization

The Study organization and list of members are attached as Appendix 2. The study was supervised by the Nicaraguan Coordinating Committee and the Japanese Advisory Committee.

CHAPTER 2

PROFILE OF THE STUDY AREA

CHAPTER 2 PROFILE OF THE STUDY AREA

This chapter describes the background conditions, such as natural conditions, urban structure, social conditions, population, and economic conditions related to the Study.

2.1 Definition of the Study Area

2.1.1 Definition and Present Population of the Study Area

The study covers the urban area under the administration of the Municipality of Managua (ALMA).

The present population of the study area is tabulated in Table 2.1.1a, and the study area is shown in the location map.

Table 2.1.1a Present Population (1994)

District	Area (km^2)	Population		
		Total	Urban	Rural
D1	60.41	92,890	63,556	29,334
D2	18.65	134,696	134,696	-
D3	71.45	195,410	134,833	60,577
D4	16.61	204,711	204,711	-
D5	72.12	209,045	144,241	64,804
D6	69.97	220,855	152,390	68,465
D7	231.44	14,261	-	14,261
Total	540.65	1,071,868	834,427	237,441

Source: Population estimated by the Study Team based on 1991 CSE electoral data

2.1.2 Collection Service Area

For SWM, the Study Area was divided into two areas: the urban and rural area. Waste collection service is principally provided only in the urban area which is further divided into collection and non-collection areas. The municipality provides collection services to the collection area which consists of collection area A and B. The collection methods used in these two areas are in harmony with the city layout. The location of the collection areas, i.e., A and B and the non-collection area is difficulty to point out collectively in the map, because the areas intermingle with each other. The area conditions and waste collection systems provided in area A and B are as follows:

Collection Area A: City layout is good. Waste is discharged in front of the premises by the citizens and is collected by municipal collection vehicles.

Collection Area B: The passage of collection trucks (compactor trucks) is hampered by poor road conditions and very low illegal overhead electric connections. Therefore, waste is discharged at areas designated by the municipality, and collected by municipal wheel loaders and dump trucks.

The study area is summarized in Figure 2.1.1a.

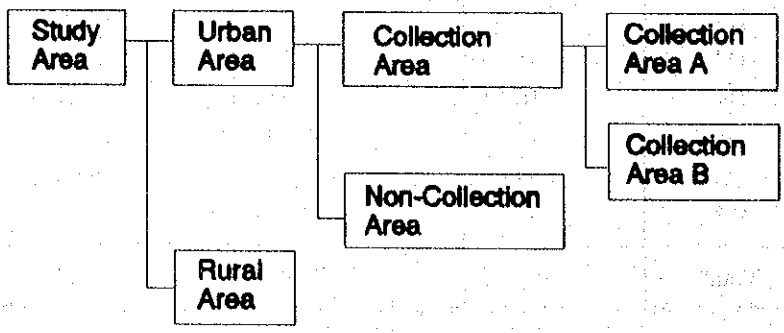

Figure 2.1.1a Classification of the Study Area

2.2 Natural Conditions

2.2.1 Topography and Geology

a. Topography

The western part of Nicaragua is geologically and geographically divided into 3 district regions, namely the Pacific coastal plain, Nicaraguan depression and interior highlands. The Study Area is located in the Nicaraguan depression.

The Nicaraguan depression is surrounded by the Pacific coastal plains and interior highlands, and is a belt-shaped lowland area extending from northeast to southwest. Approximately half of this area is occupied by two lakes: Lake Managua (38.2 m deep and measures approximately 1,040 km^2) and Lake Nicaragua (31.2m deep and measures approximately 8,200 km^2). Along the southwest margin of this depression is a volcanic chain extending from northwest to southeast.

The Study Area is located south of Lake Managua in the southwest margin of the Nicaraguan depression, and is surrounded by the mountain ranges of Managua bordering the municipalities. The whole study area extends from the southern to northern slope. The urban areas are established on the gently sloping terrain along Lake Managua.

Several crater lakes are scattered in the area, one of which is Lake Asososca, the water supply source of Managua. Lake Asososca is within an volcanic chain extending north-south.

b. Geology

Volcanic activities over a long period of time have significantly affected the geology of the study area.

2.2.2 Climate

The meteorological conditions of the study area were determined based on the 1991 meteorological survey carried out in Ingenio Julio Buitrago (IJB) along the Pacific coastal plains, the International Airport of Managua in the Nicaraguan depression, and Muy Muy in the interior highlands. The results are shown in Table O.4.2a.

a. Temperature

aa. Annual Average Temperature

IJB was observed to have the highest annual average temperature and Muy Muy the lowest.

In May, the temperature in all three areas was observed to be high. Temperature is low in November in IJB, and in December in Managua and Muy Muy.

Temperature in the study area is observed to decrease as you move further inland where the altitude is higher as seen from the annual average temperature of the three observation stations:

IJB: 4.3°C
Managua: 3.2°C
Muy Muy: 2.7°C

ab. Maximum Temperature

The hottest time of the year in IJB is in May where the temperature is recorded at 37°C. In Managua, it is in April and May at 36.4°C, and in Muy Muy, in June at 23.8°C.

ac. Minimum Temperature

The coolest time of the year is in December in IJB (18°C), and in January in Managua (17.8°C) and Muy Muy (16.2°C). As previously mentioned, temperature in the study area tends to decrease as you move further inland.

b. Annual Average Humidity

Annual average humidity, 69.3% in IJB, 74.2% in Managua, and 82% in Muy Muy, tends to increase further inland. The lowest value was observed in March in all three stations. The highest value was observed in October in IJB and Managua, and from August to September in Muy Muy.

c. Precipitation

Although there are no actual rainfall data in IJB for August 1990, precipitation in this area is still assumed to be the highest. Accordingly, IJB has the highest annual precipitation, followed by Muy Muy and then Managua.

The annual precipitation of Managua is the lowest at about half the value of the 2 other observation stations. The rainy and dry seasons in all three areas start from May to November and December to April, respectively. Eighty two (82%) to ninety eight (98%) percent of rain falls in the rainy season.

d. Evaporation

Regardless of the insufficient data on IJB for August, the area is considered to have the highest evaporation value, followed by Managua and then Muy Muy. Evaporation in all three observation stations peaks in April and is at its lowest in October and November in IJB, November in Managua, and December in Muy Muy, respectively. Evaporation tends to fluctuate in a manner similar to annual temperature.

e. Wind Velocity

Wind velocity tends to decrease further inland as seen from the data on average annual wind velocity: 2.0m/sec in IJB, 1.1m/sec in Managua, and 0.5m/sec in Muy Muy. It is further observed to be faster in the dry season than in the rainy season in IJB and Managua. Wind velocity is slow all year round in Muy Muy.

f. Wind Direction

Easterly winds prevail throughout the year at all observation points.

2.3 Social Conditions in the Study Area

2.3.1 Population

a. Present Population in Nicaragua

Managua is the political, economic and cultural center of Nicaragua and also a city historically plagued by earthquakes, wars, floods and landslides.

The earthquakes of 1931 and 1972, civil wars during the 1980's, frequent flooding and landslides have left the city without a core or a conventional city configuration.

The last Population and Housing Census was conducted in 1971. None has been carried out since then by INEC, although one who scheduled for 1982, due to the outbreak of civil war.

The 1993 population estimate of INEC placed the total population of the country at about 4.3 million which is 2.4 million more than its population twenty two years ago as shown in Table 2.3.1a.

Table 2.3.1a Population of Nicaragua

Year	Population	Growth Rate %
1971 (Census Year)	1,877,952	2.2
1975	2,162,272	3.6
1980	2,591,048	3.7
1985	3,272,064	4.8
1990	3,870,820	3.4
1993	4,264,845	3.3
1995	4,539,499	3.2
2000	5,261,315	3.0

Source: INEC (Nicaraguan Institute of Statistics and Census)

b. Population of the Study Area

The 1994 population of the municipal area is based on electoral registration data given by CSE and arranged by the Study Team considering also population data provided by the Planning Head Office of ALMA (see Table 2.3.1b).

Table 2.3.1b Present Population, Density, and Number of Households (1994)

District	Area (km^2)	Population			Density (pers/km^2)	House-holds	Person/ Household
		Total	Urban	Rural			
D1	60.41	92,890	63,556	29,334	1,538	10,192	9.1
D2	18.65	134,696	134,696	-	7,222	22,062	6.1
D3	71.45	195,410	134,833	60,577	2,735	29,423	6.6
D4	16.61	204,711	204,711	-	12,325	28,465	7.2
D5	72.12	209,045	144,241	64,804	2,899	33,052	6.3
D6	69.97	220,855	152,390	68,465	3,156	35,316	6.3
D7	231.44	14,261	-	14,261	62	1,186	12.0
Total	540.65	1,071,868	834,427	237,441	1,983	159,696	6.7

Source: Population estimated by the Study Team based on 1991 CSE electoral data
1) 31.6% of rural population was added to district 1
2) Part of district 7; population based on CSE data was divided into D3 & D5 rural population
3) Population provided by ALMA was used for district 7

c. Population Forecast of the Study Area

The population of the study area is estimated to have a growth of 5.2% from 1994 to 2000, and 3.6% from 2000 to 2010. Given these growth rates, the population of Managua is expected to increase 1.4 times over the present population by the year 2000, and 1.9 times by 2010, reaching a total population of around 2 million inhabitants.

The future population by district and urban area are projected as shown in Table 2.3.1c.

Table 2.3.1c Population Projection by District and Urban Area by District

(1) Population Projection by District

District	1995	2000	2005	2010
D1	97,720	125,911	150,267	179,333
D2	141,700	182,578	217,895	260,044
D3	205,571	264,875	316,111	377,258
D4	215,356	277,483	331,157	395,215
D5	219,915	283,357	338,168	403,582
D6	232,339	299,365	357,273	426,382
D7	15,003	19,331	23,070	27,532
Total	1,127,605	1,452,900	1,733,942	2,069,347

Source: Population projection estimated by the Study Team based on electoral data provided by CSE.
Population in 1994 was adjusted according to the data provided by ALMA

(2) Population Projection of the Urban Area by District

District	1995	2000	2005	2010
D1	66,861	86,149	102,813	122,701
D2	141,700	182,578	217,895	260,044
D3	241,844	182,764	218,117	260,308
D4	215,356	277,483	331,157	395,215
D5	151,742	195,516	233,336	278,471
D6	160,314	206,562	246,519	294,204
D7	0	0	0	0
Total	877,817	1,131,052	1,349,837	1,610,943

2.4 Infrastructure of the Study Area

2.4.1 Land Use

Thirty percent of the country's urban population reside in Managua, where job opportunities are relatively high.

The 1972 earthquake was a historical event, as it destroyed the central area of the city. Radical changes in the urban land use pattern resulted after the earthquake, as private companies grabbed control of the real estate market.

The growth and development of Managua city has been slow and government support is very weak.

2.4.2 Housing

a. General

Like most large cities in the developing world, Managua is characterized by high urban migration and natural growth. However due to the present economic conditions, the housing demands are difficult to meet.

Housing is a basic necessity which contributes to the populations productivity, welfare, social stability and economic development. Despite well meaning intentions and significant accomplishments in the past, there yet remain vast numbers of Nicaraguans living in unsuitable housing developments.

The Town Planning Head Office, through EDUM ("Urban Development Plan of Managua"), classifies housing units into 5 categories, by structure, location, land size, etc., as shown in Table 2.4.2a.

Table 2.4.2a Housing Categories in Managua

Housing Category	Description	%
Residential Housing	Housing designed and well constructed on area between 200 m^2 and 700 m^2. This housing category is inhabited by the medium and high income group (Las Colinas, Altos de Santo Domingo, El Carmen, Las Palmas, Altamira, Colonial Los Robles, etc)	9.55
Traditional Housing	This housing area was built before the 1972 earthquake in the old town of central Managua. Most of the buildings are made of sun-dried bricks, roofing tiles, on an area of about 300 m^2.	7.32
Popular Housing	Housing of simple design, constructed by individual or construction firm on an are of 80 m^2 to 250 m^2. Construction material consists of masonry, wood or prefabricated material on structural foundation.	49.74
Progressive Settlement (in poor condition)	Houses built in 1980 because of the acute housing shortage. Usually constructed with economic materials by the land owners or the community.	14.87
Spontaneous Settlement (in poor condition)	These are illegal settlements made of debris or waste materials (wood, plastic, zinc, block, etc.).	18.52
Total		100.00

Source: General Plan for Urban Development of Managua, Town Planning Head Office, ALMA

More than 33% of the total dwellings are in poor condition, badly in need of replacement or renovation. Most of these dwellings are located in progressive and spontaneous settlement areas where fundamental changes in government policies and urban planning strategies are necessary for a better and effective housing service. Collection service is hardly carried out in this area due to the absence of good access roads which will allow the passage of large collection vehicles ($15m^3$ compactor trucks); the absence of a waste collection service has rendered the area insanitary. To resolve this situation, a waste collection system that suits the infrastructure condition in this area should be selected.

a. Progressive and Spontaneous Settlements

aa. Progressive Settlements

The national government has be legalized the use of this settlement and rendered assistance to the urbanization layout. A progressive urban program was formulated by MINVAH in 1982 (former Ministry of Housing) and consisted of an alternative

program for the benefit of families of low income.

The program consisted of urban development activities such as provision of land, public water faucets installation and consolidated road infrastructure, etc.

As of April 1994, the number of progressive settlements in the urbanized area of Managua has reached 113 and occupies 750 hectares. The settlement has about 145,614 inhabitants, approximately 17.5% of the total urban population (Table 2.4.2b).

bb. Spontaneous Settlements

Special attention is to be given to spontaneous settlements which are increasing lately. Basic infrastructure and services are lacking, in this settlement, which is usually the cause of environmental problems that have pestered a large sector of the city's population since 1984.

As of 1994, ALMA estimated that the number of spontaneous settlements have reached 170 with 178,978 people, 21.4 % of the total urban area population (Table 2.4.1b).

Table 2.4.2b Summary of Progressive and Spontaneous Settlements

District	Nº of PS/SS		Area (ha)			Nº of Houses			Estimated Population			Urban Area Populat.	PS & SS /U-rb.A. Populat. (%)
	P.S	S.S	P.S	S.S	Total	P.S	S.S	Total	P.S	S.S	Total		
D1	7	3	85.7	11.5	97.2	2,400	161	2,561	15,015	963	15,978	63,556	1.9
D2	25	30	66.5	93.1	159.6	2,808	3,176	5,984	16,776	18,457	35,233	134,696	4.2
D3	24	46	157.1	217.3	374.4	4,662	8,119	12,781	29,634	50,503	80,137	134,833	9.6
D4	17	26	108.5	106.9	215.4	2,973	5,437	8,410	21,420	34,042	55,462	204,711	6.6
D5	16	27	106.9	131.3	238.2	3,954	5,564	9,518	23,958	34,266	58,224	144,241	7.0
D6	24	38	225.6	185.9	411.5	6,769	6,950	13,719	38,811	40,747	79,558	152,390	9.5
D7	0	0	0.0	0.0	0.0	0	0	0	0	0	0	0	0.0
Total	113	170	750.3	760.0	1,496.3	23,566	29,407	52,973	145,614	178,978	324,592	834,427	38.9

Note: PS: Progressive Settlement

SS: Spontaneous Settlement

2.4.3 Transportation

a. Roads in the City of Managua

The Municipal Works and Services Head Office of ALMA is responsible for the construction and maintenance of roads and bridges. As of May, 1994, the total road network in ALMA is 1,112.5 km. By surface type, asphalt and block accounted for 64 %; earth surface roads accounted for 35.54 % and are in poor condition. The road network by surface type and length according to the District Coordination Office of ALMA is shown in Table 2.4.3a.

Table 2.4.3a Road Surface Condition in Managua

District	Asphalt Surface (km)	Stone Paving Block (km)	Concrete Surface (km)	Unpaved (km)	Earth Surface (km)	Total (km)	%
D1	20.32	2.64	-	-	75.29	98.25	8.83
D2	110.46	26.43	0.79	5.11	36.10	178.89	16.08
D3	76.56	54.92	0.15	0.89	83.81	216.33	19.45
D4	134.07	65.24	-	1.27	63.72	264.30	23.76
D5	88.56	43.50	0.06	0.54	45.66	178.32	16.03
D6	61.54	15.75	-	-	81.72	159.01	14.29
D7	8.35	-	-	-	9.06	17.41	1.56
Total	499.86	208.48	1.00	7.81	395.36	1,112.51	100.00
%	44.93	18.74	0.09	0.70	35.54	100.00	

Source: District Coordination Office, Planning Head Office (ALMA)

Roads are normally wide enough for vehicles to pass, but the surface of each roads the surface is very rugged.

b. Railroad

The railroad system is inoperative because of low revenues and high operation and maintenance costs.

c. Air Traffic

The Augusto C. Sandino International Airport is the country's only airport for international air traffic. It can accommodate four planes simultaneously; the runway is 2,440 meters long.

2.4.4 Water Supply and Sewerage System

a. Water Supply

The water supply works in Managua City are undertaken by INAA. The most serious problem in Managua's water supply sector is the difficulty in meeting the demands of the very rapidly increasing population of the capital. The number of households receiving water service was about 100,000 as of December, 1991. In addition, the water supply sector is having difficulty providing for the additional number of households (30,000 – 35,000) requiring water supply services. The water charge collection rate is very low in progressive settlements, and the majority of the households in spontaneous settlements have illegal pipe connections.

b. Sewerage System

The sewerage system consists of 130 km collection pipes and 160 km conveyance pipes, and is based on the gravity system. Sewage is discharged, without any prior treatment into Lake Managua, at sixteen different places. Sewage discharge load is the largest pollutant of Managua Lake. The sewerage system covers about 86% of the urban area.

The service capacity may increase if pipe obstructions are eliminated or reduced. Rain water enters the system through illegal connections, leaving behind sediments and other solid materials.

c. Electricity

In the urban area, 95 % of the houses have electricity. In low income areas many of the houses with electricity get their power from illegal outlets which are hazardous and hamper the access of waste collection trucks.

2.4.5 Urban Development in the Study Area

ALMA is the central agency responsible for the preparation of city plans and for coordination with other governmental agencies.

The Town Planning Head Office of ALMA has prepared the "Urban Development Plan for Managua", and recently finished the Master Plan for the central area and

specific plans on urban development. However, at present, it is difficult for ALMA and the central government to realize the plans due to shortage of funds, etc. Delay in the implementation of the urban development plan is one of the reasons preventing the development of an efficient waste collection system.

2.5 Administration

2.5.1 National Government Administration

Politically, the country is divided into 9 Regions, 16 Departments and 142 Municipalities. Two of the 9 Regions are considered autonomous due to their peculiar ethnic and sociocultural characteristics. ALMA belongs to Region III and the Department of Managua.

2.5.2 Municipal Administration

Municipalities have full political autonomy, and are capable of providing their towns and cities maintenance services (waste collection, street cleansing, roads and streets maintenance and construction, storm drainage maintenance, park maintenance).

2.5.3 Public Health

The public health system in Nicaragua is directly under the jurisdiction of the Ministry of Health (MINSA).

In August 1979, the "Single National Health System" was established mainly to increase the coverage of the health care and enhance its efficiency through decentralization. This single national health system will be extended to all regions through the SILAIS (Sistemas Locales de Atencion Integral a la Salud – Integral Health Care System).

2.5.4 Sanitation and the Environment

Sanitation and Environmental issues are the primary concerns of INAA and MARENA. Municipalities also play a significant role in promoting public sanitation mainly in terms of Solid Waste Management, food control, storm water drainage installation, etc.

On the other hand, they have a very limited in environmental control. Although Environmental Head Offices are established in some municipalities, like Managua, the concerns of these offices are usually restricted to tree planting, environmental education and some specialized fields of study and the investigation of public complaints related to bad odors, water discharges and improper solid waste disposal.

2.6 Economic Conditions

2.6.1 National Economy

a. Economic Indicators

Table 2.6.1 shown how the economy of Nicaragua was valuated.

Table 2.6.1a Selected Economic Indicators

Indicator	Unit	1989	1990	1991	1992	1993
Population	millon	3.74	3.87	4.00	4.13	4.26
Economically active population	1,000	1,276.9	1,371.2	1,386.3	1,445.4	1,378.7
Gross Domestic Product Total	mill.US$ (1992)	1,696.1	1,691.1	1,687.7	1,686.0	1,674.2
Distribution						
Primary Sector	%	24.7	24.7	23.8	24.4	24.8
Secondary Sector	%	26.5	25.8	27.1	26.1	26.0
Tertiary Sector	%	48.8	49.5	49.2	49.5	49.1
GDP per capita	US$	453.5	437.0	421.9	408.2	393.0
Unemployment rate	%	8.4	10.8	14.0	16.2	20.0
Underemployment rate*	%	39.4	43.3	52.1	54.0	51.3
Export (FOB)	mill.US$	310.7	330.5	272.4	223.1	266.9
Import (CIF)	mill.US$	614.7	637.5	751.3	855.0	727.2
Total external Debt	mill.US$	9,743.0	10,615.6	10,304.1	10,808.2	10,987.4
Exchange rate (ave.)	C$/US$	3.12	140.90	4.27	5.00	5.70

Notes: (open unemployment + employment below 40 hours a week / economically active population x 100)
Sources: BCN Informe Anual 1992
Indicadores de Actividad Economica a Abril 1994
INEC Compendio Estadistico 1987/1991
FIDEG El Observador

b. Employment

Employment in Nicaragua reflects the economic crisis that has plagued, most Latin American countries for a decade.

Open unemployment is 20.0% and underemployment (open unemployment plus employment under 40 hours a week) is 51.3% as of 1993.

The sectoral distribution of employment in 1987 and 1991 are summarized in Table 2.6.1b.

Table 2.6.1b Sectoral Employment Distribution

unit: %

Sectoral Employment	1987	1991
Primary sector	34.6	34.8
Secondary Sector	19.5	19.1
Tertiary sector	45.9	46.1

c. International Trade and Foreign Debt

ca. International Trade

caa. Exports

Export volume was US$223 million in 1992; 60 % of exports were agricultural products, such as coffee, cotton, sugar, bananas, beef and tobacco.

cab. Imports

Import volume in 1992 amounted to US$ 855 million. Imports consisted of consumption goods, petroleum, intermediate goods and capital goods, which accounted for 33.5%, 14.6%, 30.7% and 21.2%, respectively, of total imports in 1993.

cb. Foreign Debt

The Nicaraguan foreign debt increased from US$ 9.7 billion in 1989 to US$ 10.8 billion in 1992, 5.8 times the GDP, which is 48 times the annual export amount, and became a serious obstacle to the development of the country.

d. Central Government Finances

da. General

Though the Nicaraguan economy has begun to show some improvement, the finances are still in the red as shown in Table 2.6.1c. The deficit in 1995 will be the same as in 1994.

Table 2.6.1c Central Government Finances

	Unit	1993	1994	1995
Revenue	mill.C$ mill.US$	2,223.3 390	2,538.5 407	2,677.8 387
Expenditure	mill.C$ mill.US$	2,939.9 516	2,790.4 448	2,940.8 424
Deficit	mill.C$ mill.US$	-716.6 -126	-252.3 -41	-263.0 -38

db. National Development Plan

The present Government, which was elected in February 1990 for a six-year term, has formulated a development plan for the 1992-1996 periods to build from the achievements of the first two years, which included pacification of the country, control of hyperinflation, stabilization of the exchange rate, delegation and liberalization of the private sector, and foreign debt rescheduling.

The 1992-1996 Development Plan also showed the GDP growth target by year (Table 2.6.1d) and the medium-term objectives for 1994-1996. The achievements of the first two years, however, indicate that the Development Plan could not produce positive economic growth.

Table 2.6.1d Targets of Economic Growth and Actual Growth

unit: %

Year	GDP Growth Target	Actual Growth
1992	4.0	- 0.1
1993	4.5	- 0.7
1994	5.0	+ 3.0*
1995	5.0	

Notes: * - Official figure; FIDEG estimated the economic growth of Nicaragua in 1994 as 1.4%

The medium-term objectives for 1994-1996 are summarized as follows:

1) Definition of the legal and institutional framework for the private sector
2) Export based growth
3) Improvement of human resources
4) Institutional reform
5) Promotion of domestic savings and investments
6) Consolidation of democracy

2.6.2 Regional Economy

a. Gross Regional Domestic Product

GRDP of Managua is estimated from the GDP and the data on social security system according to major economic activities as shown in Table 2.6.2a.

Table 2.6.2a Estimated GRDP of Managua

unit = C$ mill. 1980

	1990	1991	1992	Managua Share (%)
Total	10,709.6	10,158.9	9,856.2	54.5
Primary Sector	1,378.2	1,374.6	1,402.2	31.9
Secondary Sector	3,142.3	3,442.0	3,216.4	
Manufacturing	2,764.4	3,014.9	2,761.1	68.0
Construction	322.7	358.4	389.1	75.5
Mining	55.3	48.7	66.1	53.7
Tertiary Sector	6,189.2	5,362.3	5,237.7	
Commercial, restaurant & hotel	2,366.9	2,638.7	2,698.7	81.1
General Government	2,051.9	1,076.1	869.3	42.9
Transport & Communication	554.5	638.2	665.8	70.8
Bank & Security	443.3	454.6	480.4	81.6
Electricity,gas & water supply	0.9	1.0	1.0	0.2
Living Property	665.5	402.1	326.4	42.9
Other Services	106.1	151.6	196.1	24.3
Percentage (%)	59.1	56.2	54.1	

Source: Figures calculated by the Study Team based on BCN and INSSBI information

2.6.3 Income Levels

a. General

The GDP per capita and national income per capita according to " La Economia de Nicaragua " (Nestor Avendano) is shown in Table 2.6.3a.

Table 2.6.3a GDP and National Income Per Capita

unit: US$

Per Capita	1990	1991	1992	1993	1994
GDP	404	429	447	421	404
National Income	343	338	323	291	285

Source: Nestor Avendaño, La Economia de Nicaragua – El Ano 2000 y las Posibilidades de Crecimiento

b. Income Levels in Managua

The GRDP per capita of Managua was estimated to exceed US$ 800 in 1993, while GDP per capita is estimated at around US$ 400.

2.6.4 Industries

It is said that about 80% of the manufacturing industries is concentrated in Managua. According to the data from MEDE, a total of 2,097 manufacturing industries are in Managua, 60 of which employ more than 50 employees.

2.6.5 Municipal Finance

a. Budget

Financially, ALMA is still in the red. However, the 1995 budget is projected to be 25% more than the 1994 budget as shown in Table 2.6.5a.

Table 2.6.5a Budget of Managua Municipality

unit: C$ 1,000

	1990	1991	1992	1993	1994	1995
Revenue						
Municipal Sales Tax	20,915	64,805	102,805	110,549	95,607	124,538
Waste Fee		1,339	13,316	10,551	8,033	12,487
Others	2,503	51,100	51,410	41,301	40,571	68,127
Total	23,418	117,244	167,531	162,401	144,211	205,152
(1,000 US$)	23,418	23,449	33,506	27,067	21,817	27,390
Expenditure						
Current Expenditure	5,875	80,885	120,550	138,593	101,998	121,452
Capital Expenditure	11,405	37,416	43,635	31,192	44,954	71,293
Others					4,112	12,408
Total	17,280	118,300	164,185	169,785	151,064	205,152
(1,000 US$)	17,280	23,660	32,837	28,297	22,854	27,390
Balance	6,138	-1,056	3,345	-7,384	-6,853	0
(1,000 US$)	6,138	-211	669	-1,231	-1,037	0

Source: ALMA

b. Revenue

The operation, management and investment expenses of the city are financed using revenues from sales tax, vehicle license tax, cemetery services fees and general service fees. Taxes and fees are managed by the Tax Collection Head Office. ALMA revenue is shown in Table 2.6.5b.

Table 2.6.5b ALMA Revenue

unit: US$ 1,000

Item		1992	1993	1994	
				Initial	Projected
Municipal Sales Tax		20,561	18,425	19,118	14,464
Waste Fees		2,663	1,759	3,177	1,215
Other Income		10,282	6,883	10,801	6,138
	Rents and Leases	76	52	77	n.a.
	Miscellaneous Taxes*	519	242	412	n.a.
	Registration & Licenses	2,233	1,473	1,677	670
	Services Fees**	555	493	501	n.a.
	Fines	415	366	310	n.a.
	Cemetery Fees	137	108	130	n.a.
	Real Estate Tax	3,303	2,398	4,497	2,490
	Vehicle License Tax	2,568	1,684	2,508	1,215
	Others	476	67	689	1,763
Total		33,506	27,067	33,096	21,817

Notes: * – Slaughter house tax, beautification tax, pavement breaking tax, Advertisement tax, Parcel Division and Urbanization tax, rental tax,etc.
** – Birth certification, certificate of tax clearance, Parking in municipalities parking lots, pavements construction, tree planting, etc.

Source: ALMA

c. Expenditures

Municipal budget is divided roughly into current operational costs and investments cost. The salary of municipal employees is the highest item in the list of expenses. Investment costs occupy around 30–40% of the total expenditures; municipal debts were relatively small then.

Table 2.6.5c ALMA Expenditure

unit: US$ 1,000

TYPE OF EXPENDITURES	1992	1993		1994		
		Initial	Actual	Initial	Projected A*	Project-ed(Nov.)
Personal Services	12,140	11,175		9,758	10,580	
Salaries	11,434	10,577			10,131	
Others	706	598			449	
Non-Personal Services**	5,662	4,303		1,549	1,706	
Materials and Supplies	4,821	4,328		2,874	2,969	
Current Transfers***	1,356	1,500		2,410	1,824	
Public Debt	131	16		635	245	
CURRENT EXPENDITURES	**24,110**	**21,322**	**23,098**	**17,226**	17,323	15,431
Machines and Equipment	2,414	1,907			271	
Real Estate	0	226			196	
Municipal Investments****	5,123	2,566			6,809	
Debt Service	1,190	100			2,856	
CAPITAL EXPENDITURES	**8,727**	**4,799**		**13,8882**	10,132	6,801
Commercial Commitments	0	0		1,981	799	622
TOTAL	**32,837**	**26,121**		**33,109**	28,254	22,854

Notes * : Adjusted to values lower than the initial projections
** : Telephone, Water, Electricity, Advertisement, Per-diem, etc
*** : Social Benefits, Workers Insurance, etc.
**** : Construction Works including design

Around US$ 730,000, excluding wages, was estimated to have been appropriated for Solid Waste Management from the 1994 budget.

2.6.6 Municipal Tax System

The municipal taxation system is composed of three categories; indirect tax, fees, and other incomes, as stated in the Municipal Taxes Act for the Municipality of Managua. Main taxes or fees collected by the Municipality of Managua are as follows:

a. Indirect Tax

aa. Sales Tax (Income Tax):

Any permanent or non-permanent resident who habitually or irregularly sells goods or operates any industrial or professional activities or provides a specific service, shall pay a monthly tax of 2% of the net income obtained. (Municipal Tax Act for the Municipality of Managua, Art. 3)

ab. Registration and License:

Every person, permanent or non-permanent resident, who sells goods or operates on industry or services shall register yearly from December 1 to January 31. (Art. 9)

ac. Property Tax:

All owners of real estate, located within the city of Managua, either in urban or rural areas, shall pay an annual tax; 10% of the cadastral value of that real estate. This tax is only applicable to owners of real estates with a cadastral value higher than C$ 40,000. (Art.17)

ad. Vehicles License Tax:

Every owner of a motor vehicle or any other haulage vehicle shall pay a annual bearing tax. (Art. 19)

b. Fees

ba. Waste Fee:

The ALMA has the right to collect a municipal fee in order to cover the cleansing costs for the city.

bb. Service Fees:

Service fees are charged when someone requests permission to brand cattle or to transport cattle from one place to another, to issue certifications from the register office, to issue certificates of payments for taxes, registrations etc. These fees also include pavement and block paving services and parking vehicles in municipal areas.

bc. Miscellaneous Taxes:

Miscellaneous taxes are those collected by the declarations of slaughter, booth modification, breaking of pavement, lotteries, vacant lots looting and urbanization of areas, building and building improvement, real state renting and coin record player rental.

bd. Fines:

All permanent or non-permanent residents performing economic activities in the Municipality of Managua, and violates the provisions in the Municipal Tax System shall pay a fine.

be. Cemetery Fees:

The burial fees and maintenance fee of the cemeteries is estimated by the Municipality. (Art. 31)

c. Other Income

ca. Other revenues:

Other revenues are those taxes collected over the selling of plants, computer services and some other services.

2.6.7 Tax System and Utilities Charging System

Taxes in Nicaragua are established by the Central and Municipal Governments. Charges for utilities are imposed by companies which supply these services.

a. National Government Tax

The national taxation system in Nicaragua was based on three different groups of tax; the income tax, the consumption tax and property tax. However, in 1991 the responsibility for the property tax was transferred to the municipalities.

aa. Income Tax

Income tax is charged to all net incomes in Nicaragua borne from economic

activities by all permanent or non-permanent residents.

ab. Consumption Tax

Consumption tax includes many different types of taxes, most important of them being the IGV - the value added tax (Impuesto General al Valor); 15% is generally added to all goods and services according to their value.

Some imported products such as vehicles, perfumes, etc. are under the ISC - Selective Consumer Tax (Impuesto Selectivo de Consumo).

Other imported or consumed goods listed as a special products are under the IEC - the Special Consumer Tax (Impuesto Especifico al Consumo).

ac. Custom Tariffs

The custom tariffs, the DAI - the tariff of import (Derechos Arancelarios a la Importacion), and the ATP - the temporary tariff for protection (Arancel Temporal de Protection) are commonly adopted in Central America to motivate Nicaraguan industries. The ATP and DAI will be gradually abolished until 2000.

b. Municipal Government Tax

Municipalities have the right to impose taxes and fees in order to execute municipal activities.

c. Public Utilities Charges

The public utilities provided are electricity, telephone, water, sewage and drainage. They are charged where they are provided.

CHAPTER 3

FIELD SURVEYS

CHAPTER 3 FIELD SURVEYS

This chapter describes the results of the various field surveys executed in this Study. These results are used as the basic data for the formulation of the MSWM Master Plan.

3.1 Waste Amount and Composition Survey

3.1.1 Objectives and Definitions

a. Objectives of the Survey

Basic information such as the quantity of solid waste generated in the survey area, the population covered by the collection services, collection area map, etc., is the key to formulating a successful and feasible solid waste management plan.

A WACS (Waste Amount and Composition Survey) was carried out in order to obtain the basic information on waste generation ratio, discharge and recycling amount, self–disposal and collection amount, and ultimately to clarify the waste stream in the study area.

WACS was carried out twice, in April and November 1994, in order to obtain the waste data in summer and winter. The seasonal results were used to determine the average data.

b. Definitions of wastes

In order to clarify the contents of the WACS and the waste stream, the definitions of words used in the study are as follows:

ba. Household waste

Waste produced by households, including waste in shops but exclusive of those generated through commercial activities.

bb. Commercial waste

Only refers to wastes from commercial shops, i.e., restaurants, stationery shops, grocery shops, private offices.

bc. Market waste

Wastes from markets of wholesale and retail industries.

bd. Institutional waste

Government and municipal office wastes are examined as institutional waste in the Study.

be. Street sweeping waste

Wastes collected by the street sweeping cleansing service.

bf. Hospital waste

Non-infectious wastes generated in hospitals.

bg. Bulky waste

Bulky items (such as furniture and vehicles) abandoned and discharged by the above mentioned sources.

bh. Other waste

Wastes disposed of at the present disposal site which are not considered as MSW (items a to g).

3.1.2 Survey Method

a. Waste Amount Survey Method

Waste amount survey was carried in three different ways, as shown below:

- Generation ratio survey at generation sources;
- Final disposal amount survey at the present landfill;

- POS (Public Opinion Survey)

The WACS method is tabulated in Table 3.1.2a.

Table 3.1.2a Methodology of the Waste Amount Survey

Category	Generation Ratio Survey	Disposal Amount Survey	POS
MSW (Total)		X	
Household Waste	X		X
Commercial	X		X
Market Waste	X		
Institutional	X		
Street Sweeping	X	X	
Hospital Waste		X	X
Bulky Waste		X	
Others (Total)		X	
Industrial Waste		X	X
Others		X	

Note: The items marked "X" were surveyed in the Study.

b. Selection of Sampling Points for the Generation Ratio and Composition Survey

ba. Category of Waste, Generation Sources and Sampling Quantity

In order to obtain a representative generation ratio for each category of waste, the category of waste, generation sources and sampling quantity for the WACS is summarized in Table 3.1.2b. The observation work carried out at the present landfill site only took the amount of "bulky and other wastes" into consideration.

Table 3.1.2b Category of Wastes, Generation Sources and Sampling Quantity for WACS

CATEGORY OF WASTE	GENERATION SOURCES	(1) SAMPLING AREA (Nos.)	(2) NUMBER OF SAMPLES PER AREA (Nos.)	(1)x(2) NUMBER OF SAMPLES
Household Waste	Residential Area (High Income)	4	5	20
	Residential Area (Middle Income)	4	5	20
	Residential Area (Low Income)	4	5	20
Commercial Waste	Commercial Area (Restaurants)	1	5	5
	Commercial Area (Other Shops)	1	5	5
Market Waste	Markets	2	1	2
Institutional Waste	Institutions (Government Offices)	1	5	5
Street Sweeping Waste	Street Sweeping	2	1	2
TOTAL		19	-----	79

c. Method of the Generation Ratio and Composition Survey

The method of the Survey is tabulated in Table 3.1.2c. Considering the fluctuation in the daily amount of waste generated, the survey was conducted continuously for 8 days. Data amassed in the first day is used only as a reference.

Table 3.1.2c Survey Method

Generation Source	Collection of Samples	Waste Amount Survey	Waste Composition Survey
Residential Area (High Income)	by plastic bag	by spring balance	Analysis Items - ASG (Apparent Specific Gravity) - Physical composition in wet base (kitchen waste, paper, textile, plastic, glass, grass and wood, leather and rubber, metal, ceramic and stone, others) - Chemical Analysis + Three contents (moisture, combustibles, ash) + Lower calorific value + Ultimate analysis (carbon,hydrogen, nitrogen, sulphur,chlorine, oxygen)
Residential Area (Middle Income)	by plastic bag	by spring balance	
Residential Area (Low Income)	by plastic bag	by spring balance	
Commercial Area	by plastic bag	by spring balance	
Market	by collection truck	by weighbridge	
Institution	by plastic bag	by spring balance	
Street Sweeping	by plastic bag	by spring balance	

ca. Method of the Generation Ratio Survey

Before the execution of the WACS, the required number of plastic bags were distributed to residences, shops, and offices selected as sampling points. Samples discharged from markets were collected by collection truck.

The weight of the plastic bag from each sampling point was weighed with a spring balance. Then the plastic bags were bound with colored strings which classified the bags according to generation source. The samples were measured at the truck scale.

cb. Method of Waste Composition Survey

The composition of waste, in dry and wet base, from the following categories were measured:

- residential area (high income)
- residential area (middle income)
- residential area (low income)
- commercial area (restaurant)
- commercial area (others)
- markets
- institutions
- street sweeping

The following analyses were carried out on waste materials:

- Physical Composition
  The physical composition, in dry and wet base, was measured in summer and winter.
- Moisture Content
- Chemical Analysis:
  - Ash content
    Ash content in this Study refers to ash after the combustion of combustible and non-combustible items, i.e. metal, glass, ceramics and soil, others.
  - Combustible content
  - Lower calorific value
  - Ultimate analysis
    Ultimate analysis was done on the carbon, hydrogen, nitrogen, sulphur, chlorine and oxygen contents in wastes.

d. Period and Schedule of the Survey

The Survey was conducted in summer, from the 25th of April to the 3rd of May 1994, and in winter, from the 23rd of November to the 1st of December 1994.

3.1.3 Findings

a. Waste Amount

aa. Waste Generation Ratios

Based on the WACS conducted in April and November 1994, the generation ratios of each generation source are concluded as follows:

Table 3.1.3a Waste Generation Ratio

	Unit	1994
Household	g/person/day	664
Shop	g/shop/day	999
Restaurant	g/shop/day	13,828
Market	g/shop/day	3,875
Institutional	g/employee/day	61
Street Sweeping	g/km/day	49,850
Hospital	g/bed/day	2,897
Park and Green Area	g/ha/day	83,800

ab. Number of Generation Sources

Population, number of shops, number of hospital beds, number of public offices, length of streets and park and green area covered by cleansing services in the Study Area were obtained from counterparts as shown in Table 3.1.3b.

Table 3.1.3b Population, number of shops, number of hospital beds, number of public offices, length of streets and parks and green areas covered by the cleansing service

District	Urban Area Population (person)	Shops		Mar-ket (shop)	Hospital (beds)	No. of Public Officers			Length of Streets (Km)	Park and Green Area (ha)
		Restaurant	Others			Govern-ment	Municipal-ity	Total		
1	63,556	35	0	107	0	662	74	736	11.58	3.8
2	134,696	216	20	204	680	1,100	123	1,223	48.03	3.0
3	134,833	388	40	526	583	28,947	3,238	32,185	91.85	3.2
4	204,711	574	14	3,519	196	1,269	142	1,411	74.06	4.2
5	144,241	307	319	1,483	469	983	110	1,093	36.05	1.7
6	152,390	318	0	873	247	1,010	113	1,123	65.88	0.8
7	0	0	0	0	0	232	26	258	3.55	0.0
Total	834,427	1,838	393	6,712	2,175	34,203	3,826	38,029	331.00	16.7

Notes:

Population : Population estimated by the Study Team based on the 1991 CSE electoral data
Restaurant : Data supplied by the Ministry of Economy
Other shop : Number of shops in the commercial area was counted by the Study Team
Market : Fixed number of shops supplied by the administration of each market
Public Officer : Data supplied by ALMA
Number of government officers in each district was estimated according to the ratio of municipal officers in each district
Length of Streets : Data supplied by the Coordination Head Office
Public Cleansing Area : Data supplied by ALMA

ac. Generation Amount

The generation amount of municipal solid waste (MSW) calculated based on the generation ratios, unit number of generation sources and disposal amount of bulky and other waste were tabulated in Table 3.1.3c

ad. Waste Composition

The waste composition of the Study area is summarized in Table 3.1.3d

Table 3.1.3c Waste Generation Amount

unit: ton/day

Type of Waste	District 1	District 2	District 3	District 4	District 5	District 6	District 7	Total
Household Waste	42.2	89.4	89.5	136.0	95.8	101.2	0	554.1
Commercial Waste (Restaurant)	0.5	3.0	5.4	7.9	4.2	4.4	0	25.4
Commercial Waste (Others)	0	0.02	0.04	0.01	0.33	0	0	0.4
Market Waste	0.4	0.8	2.0	13.7	5.7	3.4	0	26.0
Institutional Waste	0.03	0.06	1.99	0.08	0.06	0.06	0.02	2.3
Street Sweeping Waste	0.6	2.4	4.5	3.7	1.8	3.3	0.2	16.5
Hospital Waste	0	1.9	1.7	0.6	1.4	0.7	0	6.3
Park and Green Area Waste	0.3	0.2	0.3	0.4	0.1	0.1	0	1.4
Bulky Waste								2.1
Other Waste								31.5
Total	44.03	97.78	105.43	162.39	109.39	113.16	0.22	666

Table 3.1.3d Results of the Waste Composition Survey

Classification				Household				Commercial		Market	Institution	Road
				High Income	Middle Income	Low Income	Weighed Average	Res-taurant	Others			
Physical Com-position (wet base)	Apparent Specific Gravity		(kg/l)	0.19	0.16	0.22	0.20	0.32	0.04	0.28	0.25	0.16
	Com-bustibles	Kitchen waste	(%)	54.35	43.66	29.02	34.86	62.63	4.60	38.77	9.98	13.14
		Paper	(%)	12.55	9.05	2.98	5.37	10.40	82.34	7.40	73.02	5.86
		Textile	(%)	2.59	1.65	1.95	1.87	0.25	0.15	1.20	2.99	4.23
		Plastic	(%)	6.15	4.74	3.29	3.88	3.80	8.51	5.81	4.90	4.59
		Grass and wood	(%)	11.44	23.61	29.93	27.11	10.39	0.00	28.60	3.90	42.33
		Leather and rubber	(%)	0.21	0.54	2.87	2.00	0.00	0.39	0.75	0.03	2.09
		Sub-total	(%)	87.29	83.26	70.04	75.09	87.47	95.99	82.53	94.82	72.24
	Incom-bustible	Metal	(%)	2.72	1.09	1.94	1.69	3.68	3.73	1.44	1.88	4.86
		Glass	(%)	4.69	3.27	2.61	2.91	5.81	0.00	2.07	0.00	0.27
		Ceramic and stone	(%)	2.05	4.16	10.50	8.07	1.60	0.00	4.16	0.00	8.02
		Others (soil, etc)	(%)	3.25	8.22	14.91	12.24	1.44	0.28	9.80	3.30	14.61
		Sub-total	(%)	12.71	16.74	29.96	24.91	12.53	4.01	17.47	5.18	27.76
	Total		(%)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Chemical Analysis	Three contents	Combustibles	(%)	28.13	29.47	27.97	28.47	24.77	81.68	26.29	67.45	32.30
		Moisture	(%)	58.30	43.82	37.27	40.27	60.06	6.93	49.68	22.63	28.07
		Ash	(%)	13.57	26.71	34.76	31.26	15.17	11.39	24.03	9.92	39.63
		Total	(%)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Ultimate Analysis of com-bustibles	Carbon	(%)	16.19	18.23	18.54	18.34	14.79	41.32	18.02	33.14	21.50
		Hydrogen	(%)	2.31	2.54	2.54	2.53	2.05	6.14	2.54	4.80	2.93
		Nitrogen	(%)	0.56	0.74	0.78	0.76	0.65	0.35	0.69	0.44	0.88
		Sulphur	(%)	0.04	0.05	0.05	0.05	0.04	0.04	0.05	0.04	0.06
		Chlorine	(%)	0.27	0.25	0.24	0.24	0.18	0.86	0.28	0.44	0.28
		Oxygen	(%)	8.76	7.66	5.82	6.55	7.06	32.97	4.45	28.59	6.65
		Total	(%)	28.13	29.47	27.97	28.47	24.77	81.68	26.03	67.45	32.30
	Lower Calorific Value		(kcal/kg)	1,022	929	1,045	1,006	909	3,900	914	2,810	1,246
	C/N Ratio		–	29.01	24.69	23.94	24.39	23.00	119.81	26.28	75.77	24.51

3.2 Public Opinion Survey

A public Opinion Survey (POS) was carried out in order to determine the reasoning of the public regarding MSWM, which will be taken into account in the formulation of the Master Plan.

The waste fee amount imposed on the residents is based on the length of the front grounds of eery household that comes in contact with the street. By using this as a basis, along with the type and structure of the houses, the residences were classified into high, middle and low income groups.

Table 3.2.1a Household Expenditure by Income Group

No.	Expenditure (C$/month)	Residence Classification (%)		
		low income group	middle income group	high income group
1	Less than 500	37.5	10.0	0.0
2	500 - 1,500	52.5	45.0	10.0
3	1,500 - 3,000	7.5	20.0	10.0
4	3,000 - 5,000	0.0	10.0	17.5
5	5,000 - 7,000	0.0	7.5	22.5
6	7,000 - 10,000	0.0	0.0	5.0
7	10,000 -	0.0	0.0	15.0
8	I don't know	2.5	7.5	20.0

3.2.1 Objectives of the Survey

Solid waste management affects the culture and lifestyle of the people and the public opinion survey was carried out in order to determine these effects and the people's view about MSWM, which will be taken into account in the formulation of the MSWM master plan. The main objectives are summarized below.

- To determine the people's lifestyle
- To determine the waste discharge method
- To determine the extent of the waste collection service

- To determine whether recycling is practiced or not
- To determine the collection fee system and financial state of municipality and residents
- To determine the extent of public cooperation

3.2.2 Selection of the Samples

Sampling was carried out to collect information and data required to understand present MSWM condition in the study area.

- A total of 180 subject for POS were selected in the Study Area: 120 were from the residential areas and 60 from commercial areas.
- Residential areas were classified into three income groups:

  . High income group
  . Middle income group
  . Low income group

- The commercial areas were classified into two categories, i.e., restaurants and other shops, and the number of participants or subjects from each category is shown below.

  . Restaurant : 20 participants
  . Other shops : 40 participants

Table 3.2.2a List of Public Opinion Survey Samples

Category	Income Level	Location	Number of Samples
Residential Area	High Income	Altos de Santo Domingo	10
		Las Colinas	10
		Villa Fontana	10
		Lomas de Monserrat	10
	Middle Income	Barrio Altagracia	10
		Colonia Francisco Morazán	10
		Colonia Bello Horizonte	10
		Jardínes de Veracruz	10
	Low Income	Barrio Acahualinca	10
		Ciudad Sandino	10
		Asentamiento Santos López	10
		Asentamiento A.C Sandino	10
Commercial Area	Restaurants	Rotonda Bello Horizonte	10
		Alrededores del super "Ciudad Jardín	10
	Shops	Centro Comercial Managua	20
		Alrededores del super "Ciudad Jardín	20
Total			180

3.2.3 Findings

a. Preliminary Questions

- 100 % of the interviewees live in detached houses (refer to Q1–4).

b. General Questions

- Maximum expenditure of families within the low and middle income group ranges from C$ 500–1,500, and C$ 5,000–7,000 for the high income group (refer to Q2–3).
- Houses are built in areas averaging approximately 300m² (refer to Q2–8).

c. Question on Waste Discharge from Your House/Shop.

- Approximately 80 % of the interviewees in the low income and 70% in the middle and high income group use reusable nylon sacks and disposable plastic bags, respectively, as waste containers due to their manageability and because many find them satisfactory as waste containers (refer to Q3–4, 3–5).
- Approximately 80 % of the interviewees intend to cooperate by carrying waste to the communal containers (refer to Q3–8).

- More than 60 % of the interviewees discharge garden wastes regularly for regular collection service (refer to Q3-15, 3-17).
- The majority of people sweep the road in front of their houses (refer to Q3-19).

d. Questions on Waste Collection Services in Your Area

- Approximately 90 % of people are satisfied with the present waste collection services (Q4-3).
- The method of waste collection is curb collection (Q4-5).
- Frequency of waste collection service is thrice a week (Q4-6).

e. Questions on Resource Recovery and Recycling

- More than 90 % of the interviewees feel the necessity for resource recovery and recycling (refer to Q5-3).
- Only a few of the people are aware of composting and heat recovery as methods of recycling and resource recovery. 50% of those interviewes were aware of the recycling of paper, while 15% were aware of composting (Q5-4).
- There are door-to-door collectors but collection frequency is very low (refer to Q5-5, 5-6).
- The system of shops buying reusable material from common residents has not been established yet (refer to Q5-7).

f. Collection Fee and Financial Matters

- More than 85 % of the interviewees state that the municipalities are responsible for municipal solid waste management (refer to Q6-1).
- Approximately 63 % of the interviewees are satisfied with the present municipal solid waste management (refer to Q6-2).
- The average waste fee amount presently collected and the amount residents are willing to pay are shown in Table 3.3a (refer to Q6-4, 6-8).